WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Esquimalt Graving Dock – South Side Electrical Supply

Standby Power Generation System:

PWGSC No. R.057890.003

Contract No. EZ108-170397

ELECTRICAL OPERATING & MAINTENANCE MANUAL Volume 1 of 2

May, 2017

ELECTRICAL CONSULTANT:	**AES Engineering Ltd. - Victoria**
ELECTRICAL CONTRACTOR:	**WESTERN PACIFIC ENTERPRISES Ltd.** 1321 Ketch Court, Coquitlam BC, V3K 6X7 604-540-1321 Fax 604-540-1390

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Standby Power Generation System
PWGSC No. R.057890.003
Contract No. EZ108-170397
Electrical Operations & Maintenance Manual----- Volume 1 of 2

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

TABLE OF CONTENTS

2 – GENERAL INFORMATION

2.1 Consultant

2.2 Contractor

2.3 Third Party Commissioning Agent

2.4 Main Vendors

- Frontier Power Products
- Thomson Power Systems
- Schneider Electric Canada

2.1 Consultant

AES Engineering Ltd.
1815 Blanchard St, Victoria, BC, V8T 5A4
250-381-6121

2.2 Contractor

Western Pacific Enterprises Ltd.
1321 Ketch Court, Coquitlam BC, V3K 6X7
604-540-1321

2.3 Third Party Commissioning Agent

LD Cowley and Associates Ltd.
2968 Henderson Rd. Victoria, B.C. V8R 5M3
250-896-7042

2.4 Main Vendors

2.4.1 Frontier Power Products

7983 Progress Way, Delta, B.C. V4G 1A3
604-946-5531

2.4.2 Thomson Power Systems

9087 198 St, Langley, B.C. V1M 3B1
604-888-0110

2.4.3 Schneider Electric Canada, Inc.
2195 Keating Cross Rd, Victoria, B.C. V8M 2A5
250-652-7100 x7819

3 – SHOP DRAWINGS

3.1. Power Cable (1001Volt) - Record Drawing
3.2. Connectors and Terminations – Record Drawing
3.3. Resistive Load bank – Record Drawing
3.4. Medium Voltage Transformer – Record Drawing
3.5. Electrical Enclosure – Record Drawing
3.6. Power Panels and Breakers – Record Drawings
    - 6SES-SP-0
    - 6SES-SP-2
    - 2SES-SP-2
    - 6A & 6C
    - Main Breakers
3.7. Power System SCADA – Record Drawing
3.8. 750KW Standby Diesel Generator – Record Drawing
3.9. 750KW Standby Generator Tier 4 Emissions – Record Drawing
3.10. Towable Standby Power – Record Drawing
3.11. Spill Kit
3.12. Generator Switch Board (TCS) – Record Drawing
3.13. Manual Transfer Switch - Record Drawing
3.14. Temporary Power Connection Box – Record Drawing
3.15. Transformer CT’s

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
☒ SUBMITTAL

FOR:
☒ APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Aug 17, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 015

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – 25KV Cable**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**1c#4/0 28KV Power Cable (1pg)**	RAN

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:

Reference Specification Section 26 05 14 item 2.1

AES ENGINEERING LTD.
REVIEWED ONLY
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. APPROVAL OF DIMENSIONS AND OTHER GENERAL CONSTRUCTION FEATURES IS NOT IMPLIED.
☐ REVIEWED ☐ REVISE AND RESUBMIT
☒ REVIEWED AS MODIFIED ☐ NOT REVIEWED
Project Number: 1-16-008 Date: 2016/08/23
Reviewed By: Jacob Bieling

-Separator tape over neutral wires.
-Extruded PVC jacket rated minus 40 degrees C.

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

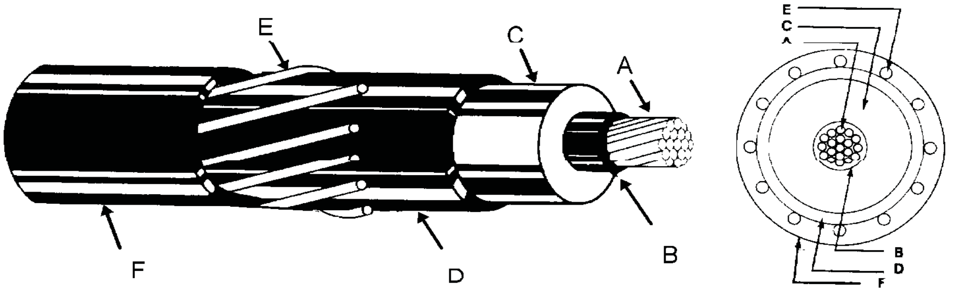
WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 17 Aug, 2016
W P
REVIEWED by _GW_

General Cable

BICC®
BRAND

Drawing / Data Sheet

Single Conductor EmPowr® Link STRANDFILL® Concentric Neutral (Round Wire) Power Cable 28kV



Representative drawing not to scale

Component Description	Thickness (inches)			Diameter (inches)		
	Min.	Nom.*	Max.	Min.	Nom.*	Max.
A: Conductor 4/0 AWG Class B Compact Stranded Bare Filled CU Conductor	--	--	--	0.466	0.475	0.480
B: Conductor Shield Semiconducting Thermoset Polymer	0.012	0.018	--	--	0.511	--
C: Insulation **Insulation Level** Tree Retardant Crosslinked Polyethylene 100%	0.265	0.280	0.310	1.030	1.071	1.120
D: Insulation Shield Semiconducting Thermoset Polymer	0.040	0.045	0.075	1.110	1.161	1.240
E: Concentric Neutral / Metallic Shield 20 x 10 AWG Bare Copper Round Wire	--	--	--	--	1.353	--
F: Jacket Extruded-To-Fill Linear Low Density Polyethylene	0.045	0.055	0.080	--	1.463	--
Single Conductor Finished Cable Nominal Weight: 1891 lb/kft *						

* - Nominal Values are Subject to Manufacturing Tolerances; Bold Font Indicates Minimum Average Values

Customer:	INDUSTRY STANDARD	**Customer P/N:**	**EA/PC Number:** UT.1579328.8
Specification / Standard:	CSA C68.5	**Prepared By:** HQQUJJB	**Date:** 10/25/2012

Dimensions and weights not designated minimum or maximum are nominal and subject to manufacturing tolerances.

The information contained in this document is the exclusive and proprietary intellectual property of General Cable Corporation, and any reproduction or disclosure, in whole or in part, is prohibited without the express written consent of an officer of General Cable Corporation.

©General Cable Corporation 2012, all rights reserved.

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Aug 17, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 016

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – 25KV Cable Termination**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**HVT-Z-SJ 25KV termination (1pg)**	RVW
1	PDF	**2hole Long Barrel Lug (1pg)**	RVW
1	PDF	**25KV 600A Deadbreak Elbow (2pg)**	RVW

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 05 22 item 2.1

AES ENGINEERING LTD.
AES
REVIEWED ONLY
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. APPROVAL OF DIMENSIONS AND OTHER GENERAL CONSTRUCTION FEATURES IS NOT IMPLIED.
☒ REVIEWED ☐ REVISE AND RESUBMIT
☐ REVIEWED AS MODIFIED ☐ NOT REVIEWED
Project Number: 1-16-008 Date: 2016/08/23
Reviewed By: Jacob Bieling

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

elastimold

Product Specifications

Issue Date: 10/25/2012
Page: 1 of 2
File: PSS-K656LR-W0X

15/25kV	600A Deadbreak Elbow	w/ Test Point	K656LR-W0X

Features:

- Fully rated 15/25kV, 600 Amp Deadbreak Elbow
- Fully shielded, fully submersible molded rubber housing
- 100% peroxide-cured construction includes insulation and conductive EPDM materials
- Can be easily connected or disconnected using standard hand tools and equipment in a de-energized state
- Optional accessories allow visible external separation, by-pass, isolation, dead-ending, grounding, and testing as well as adding taps, surge arrestors, and fault current indicators
- Non-corrosive, capacitive test point

K656LR
Elbow Connector
(with Test Point)

Applications:

The Elastimold® K656LR (with test point) is designed to provide fully shielded, dead-front submersible cable connections to high-voltage apparatus. The K656LR can be used through 28kV with conductor range from #2 AWG to 1250 kcmil for aluminum and copper conductors and insulation diameters from .640'' to 1.935''. When used on metallic tape shield or drain wire cable, an ECS cable seal grounding device is recommended.

Ratings:

Meets ANSI/IEEE Standard 386, Latest Revision

For 15kV Voltage Class:

8.3kV Max Phase-to-Ground – Operating Voltage
14.4kV Max Phase-to-Phase
95kV BIL – Impulse Withstand (1.2 x 50 microsecond wave)
34kV AC – One minute withstand
53kV DC – 15 minutes withstand
11kV AC – Corona Extinction @ 3pC sensitivity
600 Amp – Continuous
25kA Sym – 10 Cycles Momentary

For 28kV Voltage Class:

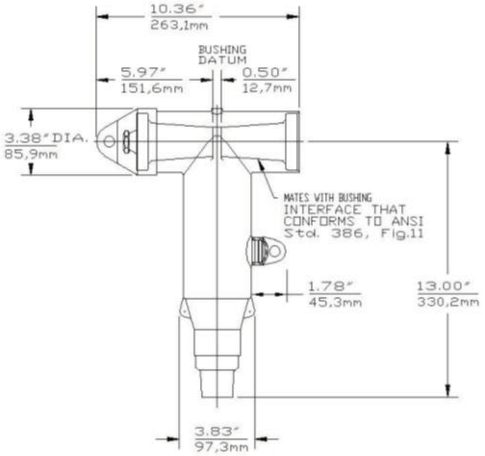
16.2kV Max Phase-to-Ground – Operating Voltage
28kV Max Phase-to-Phase
140kV BIL – Impulse Withstand (1.2 x 50 microsecond wave)
45kV AC – One minute withstand
84kV DC – 15 minutes withstand
21.5kV AC – Corona Extinction @ 3pC sensitivity
600 Amp – Continuous
25kA Sym – 10 Cycles Momentary

WESTERN PACIFIC ENTERPRISES GP-SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 17 Aug, 2016
W P
REVIEWED by _GW_

elastimold Product Specifications

Issue Date: 10/25/2012
Page: 2 of 2
File: PSS-K656LR-W0X

15/25kV	600A Deadbreak Elbow	w/ Test Point	K656LR-W0X



Step 1 (W)
Determine the insulation diameter of the cable.
Select the insulation letter code that best straddles the insulation diameter from W table below. Insert code into catalog number.

Step 2
Choose the proper connector material type and insert it into the catalog number.

Step 3 (X)
Choose the proper compression lug code according to the conductor size from the Conductor Code Table. Insert code into catalog number.

Universal Al	**0**
CU	**2**
Bi-metal	**5**

Example:
The ordering number for a 600 Amp Elbow Connector for a 4/0 compacted, 175 mil wall cable with an insulation diameter of .830'' to .910'' and test point is K656LR-G0270.

K656LR - W Code XXX Code

Cable Insulation Diameter in inches		Cable Insulation Diameter in millimeters		Symbol for W
MIN.	MAX.	MIN.	MAX.	
0.640	0.820	16.256	20.828	F
0.760	0.950	19.304	24.130	G
0.850	1.050	21.590	26.670	H
0.980	1.180	24.892	29.972	J
1.090	1.310	27.686	33.274	K
1.180	1.465	29.972	37.211	L
1.280	1.430	32.512	36.322	LM
1.370	1.630	34.798	41.402	M
1.515	1.780	38.481	45.212	N
1.725	1.935	43.815	49.149	P

X Code	AWG or kcmil		mm2	Connector Only		
	Strand./ Compr.	Solid/ Compact	Compact	Universal Aluminum	Copper	Bi-metal
210	-	2	-	03700210	03702210	03705210
220	2	1	35	03700220	03702220	03705220
230	1	1/0	50	03700230	03702230	03705230
240	1/0	2/0		03700240	03702240	03705240
250	2/0	3/0	70	03700250	03702250	03705250
260	3/0	4/0	95	03700260	03702260	03705260
270	4/0	250	125	03700270	03702270	03705270
280	250	300	-	03700280	03702280	03705280
290	300	350	150	03700290	03702290	03705290
300	350	400	185	03700300	03702300	03705300
310	400	450	240	03700310	03702310	03705310
320	450	500/550	-	03700320	03702320	03705320
330	500	600	250/300	03700330	03702330	03705330
350	600	700	-	03700350	03702350	03705350
360	650	750	400	03700360	03702360	03705360
380	700/750	900	-	03700380	03702380	03705380
390	800	-	-	03700390	03702390	03705390
400	900	1000	500	03700400	03702400	03705400
410	1000	-	-	03700410	03702410	03705410
420	-	1250	-	03700420	03702420	03705420
440	1250	-	-	03700440	03702440	03705440

Each kit contains the following:

1	Elbow connector housing	K656BLR
1	Copper compression lug	03700**XXX**
1	Stud	650SA
1	Insulated Plug w/ Cap	K650BIP
3	Tube, lubricant	82-08
1	Cable adapter	655CA-**W**
1	Installation Instruction	IS-0230
1	Installation Instruction	IS-0249
1	Crimp chart	CC-0050

ILSCO

SureCrimp® Copper Compression Lugs
Long Barrel - 2 Hole, w/o Sight Hole
Conductor Range: 600kcmil - 300kcmil

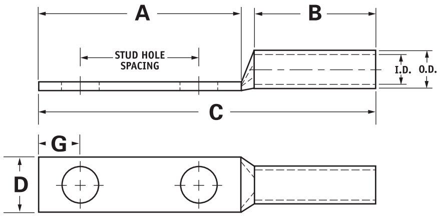
NEBS3 TESTED BY TELCORDIA
RoHS Compliant
UL LISTED 453G
LR-29601

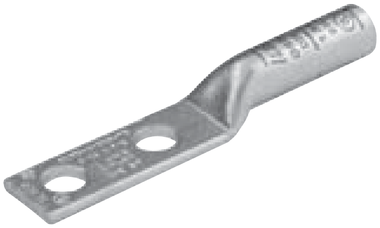
TYPE
CLND

Features
- Manufactured from high strength seamless copper tubing
- Electro-Tin plated
- Chamfered entry
- Color coded
- UL 486A/B 90° Listed and CSA Certified for 600 volts
- May be used for high voltage applications up to 35KV
- UL Listed and CSA Certified with ILSCO and major competitor's compression tools
- UL467 Listed 1/0 AWG - 8 AWG

Benefits
- Offers maximum conductivity and excellent crimping characteristics
- Provides low contact resistance
- For easy conductor insertion
- Identifies the proper compression die
- Ensures reliability
- Proper high voltage spacing and insulation techniques must be used
- Reduces inventory requirements

- For grounding and bonding applications





NOW MEETS NEBS3 REQUIREMENTS

Catalog Number	Wire Size	Alt Wire Size	Expanded* Wire Range	Bolt Size	Stud Hole Dia.	Stud Hole Spacing	Dimensions					Color Code	Die Die Index	O.D.	I.D.
							A	B	C	D	G				
CLND-300-38-1	300kcmil	250 G,H FLEX	300kcmil - 2/0 AWG	3/8	0.406	1.000	1.937	2.000	4.524	1.189	0.414	White	I-66	0.812	0.660
CLND-300-12-134	300kcmil	250 G,H FLEX	300kcmil - 2/0 AWG	1/2	0.562	1.750	3.000	2.000	5.587	1.189	0.546	White	I-66	0.812	0.660
CLND-350-14-34	350kcmil	250 I,K,M FLEX 262.2 DLO	350kcmil - 3/0 AWG	1/4	0.281	0.750	1.437	2.000	4.060	1.291	0.320	Red	I-71	0.890	0.703
CLND-350-516-134	350kcmil	250 I,K,M FLEX 262.2 DLO	350kcmil - 3/0 AWG	5/16	0.343	1.750	2.500	2.000	5.123	1.291	0.352	Red	I-71	0.890	0.703
CLND-350-38-1	350kcmil	250 I,K,M FLEX 262.2 DLO	350kcmil - 3/0 AWG	3/8	0.406	1.000	1.937	2.000	4.560	1.291	0.414	Red	I-71	0.890	0.703
CLND-350-12-114	350kcmil	250 I,K,M FLEX 262.2 DLO	350kcmil - 3/0 AWG	1/2	0.562	1.250	2.500	2.000	5.123	1.291	0.546	Red	I-71	0.890	0.703
CLND-350-12-134	350kcmil	250 I,K,M FLEX 262.2 DLO	350kcmil - 3/0 AWG	1/2	0.562	1.750	3.000	2.000	5.623	1.291	0.546	Red	I-71	0.890	0.703
CLND-400-38-1	400kcmil	300 G,H,I,K,M FLEX 313.1 DLO	400kcmil - 4/0 AWG	3/8	0.406	1.000	1.937	2.125	4.729	1.365	0.414	Blue	I-76	0.937	0.750
CLND-400-38-116	400kcmil	300 G,H,I,K,M FLEX 313.1 DLO	400kcmil - 4/0 AWG	3/8	0.406	1.062	1.937	2.125	4.729	1.365	0.414	Blue	I-76	0.937	0.750
CLND-400-12-134	400kcmil	300 G,H,I,K,M FLEX 313.1 DLO	400kcmil - 4/0 AWG	1/2	0.562	1.750	3.000	2.125	5.792	1.365	0.546	Blue	I-76	0.937	0.750
CLND-500-14-34	500kcmil	350 G,H,I,K,M FLEX 373.7 DLO	500kcmil - 250kcmil	1/4	0.281	0.750	1.437	2.250	4.419	1.535	0.320	Brown	I-87	1.062	0.828
CLND-500-38-1	500kcmil	350 G,H,I,K,M FLEX 373.7 DLO	500kcmil - 250kcmil	3/8	0.406	1.000	1.937	2.250	4.919	1.535	0.414	Brown	I-87	1.062	0.828
CLND-500-12-114	500kcmil	350 G,H,I,K,M FLEX 373.7 DLO	500kcmil - 250kcmil	1/2	0.562	1.250	2.500	2.250	5.482	1.535	0.546	Brown	I-87	1.062	0.828
CLND-500-12-134	500kcmil	350 G,H,I,K,M FLEX 373.7 DLO	500kcmil - 250kcmil	1/2	0.562	1.750	3.000	2.250	5.982	1.535	0.546	Brown	I-87	1.062	0.828
CLND-600-38-1	600kcmil	400 G,H,I,K,M FLEX 444.4 DLO	600kcmil - 250kcmil	3/8	0.406	1.000	1.937	2.687	5.433	1.712	0.414	Green	I-94	1.187	0.920
CLND-600-12-134	600kcmil	400 G,H,I,K,M FLEX 444.4 DLO	600kcmil - 250kcmil	1/2	0.562	1.750	3.000	2.687	6.496	1.712	0.546	Green	I-94	1.187	0.920

All wire sizes, unless noted otherwise, are American Wire Gauge (AWG)
* When installed with specified dieless tools
+ See pages 217 to 225 for complete tooling information.
For Bent Tangs change the 4th letter to a B and add "-4" for 45 deg. or "-9" for 90 deg.
UL File E6207

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 17 Aug, 2016
W P
REVIEWED by _GW_

C_HVT-Z-J-SJ

HVT-Z-J/SJ

Terminations with Built-in Stress Control for Jacketed Concentric Neutral Cables

The Raychem HVT-Z medium voltage termination system features a co-extruded one-piece termination. Unlike the HVT product line, which includes a non-tracking tube and a separate stress control tube, the HVT-Z termination consists of the same proven non-tracking tube together with a co-extruded, built-in stress control grading layer. This stress control layer is based on ceramic semi-conductor technology (ZnO) and provides superior discharge and impulse performance. When the tubing is shrunk down, the coating softens and sticks to irregular surfaces, providing moisture seals as well as electrical stress control. The termination design provides a superior product with a shorter overall length and fewer rain sheds than the HVT product line.

- Reliable, field proven performance
- Slim profile and lightweight, can be installed upright or inverted
- Non-tracking material is maintenance free even in highly polluted environments
- Fully qualified Class 1 termination per IEEE-48 for a long, trouble free service life
- Unlimited shelf life

Selection Information: dimensions in inches (millimeters)

Indoor Kit	Outdoor Kit	Conductor Size (Min.-Max.)		Insulation Diameter (Min.-Max.)	Jacket O.D. (Max.)
15 kV		**15 kV (100%)**	**15 kV (133%)**		
HVT-Z-151-J	HVT-Z-151-SJ	#2-#1 AWG		0.60-0.95	1.05
HVT-Z-152-J	HVT-Z-152-SJ	#2/0-250 kcmil	#2-4/0 AWG	0.80-1.05	1.45
HVT-Z-153-J	HVT-Z-153-SJ	350-500 kcmil	250-500 kcmil	1.05-1.40	1.90
HVT-Z-154-J	HVT-Z-154-SJ	750-1000 kcmil	750-1000 kcmil	1.25-2.00	2.50
Installed Length 11.5' (300)					
25 kV/35 kV		**25 kV**	**35 kV**		
HVT-Z-252/352-J	HVT-Z-252/352-SJ	#1-3.0 AWGI		0.80-1.05	1.45
HVT-Z-253/353-J	HVT-Z-253/353-SJ	#4/0-500 kcmil	#1/0-4/0 AWG	0.05-1.40	1.90
HVT-Z-254/354-J	HVT-Z-254/354-SJ	750-1000 kcmil	250-1000 kcmil	1.25-2.00	2.50
Installed Length 20' (500)					

Ordering Information

1. Select the appropriate catalog number. All selections are based on the typical dimensions of 100% and 133% insulated cables manufactured in accordance with the data contained in AEIC CS5 and AEIC CS6, as well as the dimensions of commonly used connectors. Nominal Insulation thickness (100%): 15 kV: 175 mils, 25 kV: 260 mils, 35 kV: 345 mils. Nominal thickness (133%): 15 kV: 220 mils.
2. For cables manufactured to other specifications, confirm selection with cable dimensions.
3. Kits do not contain connectors. Order compression or solder connectors separately.
4. Indoor (-J) kits are suitable for unjacketed and jacketed URD cable.
5. Outdoor (-SJ) kits include skirts for outdoor use and are suitable for unjacketed and jacketed URD cable. To order skirts refer to Accessory and Tool section.
6. Cable mounting brackets are available to accommodate cable diameters from 0.80-2.40 inches (20-46 mm) refer to Accessory and Tools section for ordering information.
7. Standard package: 1 kit/box.
8. Refer to the Application and Technical Specification section for testing information.
9. Related test reports:
   Outdoor: 15 kV: EDR-5323, 25-35 kV: EDR-5338.
   Indoor: 15 kV: EDR-5322, 25-35 kV: EDR5338.

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 17 Aug, 2016
REVIEWED by _GW_
W P

NOTE: If Legacy HVT Product is required please contact your local TE Connectivity sales representative.

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Sep 9, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 023

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – Load Bank rev1**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**Loadbank Appendix A (7pgs)**	RVW
1	PDF	**BOM (1pgs)**	RVW
1	PDF	**DWG_SSPL160706 rev 1 (9pgs)**	RVW

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:

Reference Specification Section 26 05 33 item 1.1
Spec review sheet attached

AES ENGINEERING LTD.
REVIEWED ONLY
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. APPROVAL OF DIMENSIONS AND OTHER GENERAL CONSTRUCTION FEATURES IS NOT IMPLIED.
☒ REVIEWED ☐ REVISE AND RESUBMIT
☐ REVIEWED AS MODIFIED ☐ NOT REVIEWED
Project Number: 1-16-008 Date: 2016-10-12
Reviewed By: Jacob Bieling

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

	Requirements	Compliant		Comme
Part 2	**Products**	**Yes**	**No**	
2.1	Ratings	Yes		
	duty cycle	Yes		
	Ambient operating temp -28c to 49c		No	-15°c to 50°c is standard ambient operating temp
2.2	**Construction**			
	aluminized steel	Yes		
	themostatically controlled heater	Yes		
	SS fasteners	Yes		
	forklift channels	Yes		
	horisontal airflow exhaust louver	Yes		
	2mils paint thickness	Yes		80 m
	removable Load elements trays	Yes		
2.3	**Resistive Load Elements**			
	Chromium Alloy		no	Kanthal alloy A1 provided
	50% derated operating max		no	dual pass "Cool Load" resistors provided
	Elements supported	Yes		
	resistance change due to temp		no	not confirmed
	20 load steps	Yes		
2.4	**Cooling**			
	TEFC Motors	Yes		Marath
	motor overload protection & 200Ka fuse	Yes		
2.5	**Protective Devices**			
	differential pressure Sw	Yes		
	over temp sw	Yes		digital
	Major fault protection	Yes		
	Warning Signage	Yes		
2.6	**Control Panel**			
	interior type, on/off sw, indication lights, step switches	Yes		
	Blower S/S Push Button		No	selector switch provided
	Load dump / load regulate	Yes		
	Ethernet/modbus communications	Yes		PM8240 power digital meter
2.7	**Quality control**			
	testing & compliance to dwgs & spec	Yes		
	CUL listed	Yes		CSA certified
Part 3	**Execution**			
	placement for concrete slab	Yes		
	Control panel for remote location	Yes		

Please comment on impact to operation would be at the specified temperatures.

Kanthal is a chromium alloy
Accepted

Not clear, Kanthal is rated to ~1400C but where is the over temp trip set?

Please confirm it will remain withing parameters

Acceptable

marathon™
Thomson Power Systems

Date: 2016-09-22
C- 054107
W-095113 Load bank
Ref: ESQUIMALT GRAVING DOCK

Clarifications to AES comments:

- **How the ambient temp affects the resistance rating?**
- **TPS: There's a 3% change in resistance between 25C and 870C, so less than 3% expected between -15C to 50C**

- **On the Cool Load resistors, how do they perform compared to the 50% de-rating asked for in the specifications?**
- **TPS: max continuous operating temperature of load bank elements is 1400C. As designed, expected temperature of load bank elements at full load is 420C, so it would be running at 30% of rated (420C / 1400C), well below the requested 50% de-rating**

- **Kanthal is rated to ~1400C, but where is the over temp. trip set?**
- **TPS: please see previous point, expected temperature of load bank elements at full load is 420C, for this heating alloy, the max continuous operating temperature is 1400C; melting point is approx., 1500C..**

Thanks

Samuel Rodero
Project Manager & Inside Sales Eng.
Thomson Power Systems

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 06 Sept, 2016
W P
REVIEWED by _GW_

APPENDIX "A"

LOADBANK MODEL LBO-1000H-600V-3-C DESCRIPTION

This unit is designed to operate at 600V, 3-phase 3-wire systems. Its construction will be our standard, aluminized steel enclosure with colors ASA # 61 grey for installation and operation outdoors on a roof, floor, or concrete pad. The weatherproof enclosure in a NEMA 3R type is mounted with free standing.

The load bank is offered in load step versions:

Model:	LBO-1000H-600V-3-C
Capacity	1000kW
Operating Voltage	600V
Amps/Phase	963A
Test Frequency	60Hz
Duty Cycle	Rated on continuous operation
Load Steps at Rated Voltage	20@ 50kW

Load Element:

Thomson dual pass "cool load ™" resistor is a coiled type heater consisting of coiled Alloy Aluchrom 0 (also known as KANTHAL Alloy A1, max continuous operating temperature: 1400℃(2250℉), 10 mm Diameter, 1672 mm Length), wires silver-soldered to stainless steel terminal studs (#10-24x45 mm L). Thomson **"cool load™"** resistor design guarantees lower operating temperatures and extended life in the most adverse environments. Five standard load resistor frame models (LB-18, LB-24, LB-24L, LB-29 and LB-29L) are used in a single or stacked configuration for load banks from 20kW to 1100kW.

Elements Frame

The load bank contains four elements frames (LB-29L), withstand voltage 3kV/20s isolation of the load circuits to the elements frames and insulating Class H, consisting of

180 resistance elements held in ceramic support insulators at 110 mm spacing. The load bank module consists of two air plenums containing one cooling fan at the intake end and two elements frames located at the discharge end. Removable racks and dual pass **"cool load™"** resistors provide superior serviceability and reliability.

At 600V, 3-phase 3-wire system, one load step consists of nine elements with star connection and will be 20 steps in total.

Construction:

The enclosure assembly consists mainly of 16 GA. aluminized steel with stainless steel exterior fasteners. Bottom is 13GA. aluminized steel, 14GA. aluminized steel is also utilized for components panel. The air intake and discharge are covered with 12x12 mm stainless screen and 16 GA. aluminized trim.

The air discharge contains a 355 mm long hood with 12x12 mm stainless steel screen, 16 GA. aluminized rain baffle and 50 mm mounting flanges, and the intake consists of a **Horizontal** hood with a 12x12 mm stainless steel screen and 16 GA. aluminized rain baffle.

On the right side of the enclosure is the power cable and wiring compartment accessible through removable cable access on the bottom and contains the following, there are two rooms for the low voltage and high voltage:

- 20-Load stepping contactors
- 3-Control fuses
- 3-Power bus bars with4C #2/0-500MCM screw lugs per phase
- 4-Ground lugs with #6-250MCM screw lugs
- 2-Air flow permissive switch
- 1-Plenum over temp digital temperature controller
- 1-Control transformers with primary fusing
- 1-Motor starter with over load protection.
- 3-CT:1200/5
- 3-Fuse of voltage measurement

- 60-Branch fuse
- 1- Anti-condensation heater 100W c/w thermo starter
- Provision for removable entrance to cable access.

The unit is constructed to permit access to the power connections, fuses, fan motor starter and control terminals through the side door.

Phase sequence of A-B-C is important for the load cable connections. Should the air charge at the air intake, phase sequence is wrong.

Stand:

The stand c/w forklifting channel is constructed of 10 gauge steel painted with ASA61 grey and 50 mm mounting flange suitable for installation on a concrete pad, proof, structure base or trailer mounting. Dimensions of each are approx. 1122mm Wide, 380 mm High, 2430 mm Depth with a 127x355 mm cable access for cable connection

Tolerance:

0-+3% Overall load tolerance at rated voltage.

Safety Features:

Branch fuse provides fault protection on all three phases of switch step. The fuse will be fast acting current limiting type with an interrupting rating of 200kA I.C.

A differential pressure sail switch and a motor overload relay provide cooling air loss protection (one provided for each air plenum). Each switch is electrically interlocked with the load application controls to prevent load from being applied if loss of cooling air detected in any exhaust stack. The fault condition will cause the air fail light to indicate.

A digital temperature controller is provided to sense load bank exhaust temperature (one provided for each exhaust stack) and over temperature protection. Each switch is electrically interlocked with the load application controls to prevent load from being applied if loss of cooling air detected in any exhaust stack. The fault condition will cause the air fail light to indicate.

Blower motor circuits are protected by current limiting fuses and thermal overload relays.

Operator warning and caution statements are located on appropriate access panel.

APPENDIX "A"

Control Power:

For 600V, 3-phase 3-wire system, the control power is provided by the test source through a transformer with 600/480/208V Primary and 120V Secondary. 120VAC, 1 Phase, 60 Hertz, required for control circuit operation. Transformer primary and secondary circuits are fuse protected.

Cooling System:

The cooling system has two element cooling fans. One element cooling fan delivers a net 20400 CMH of air against the back pressure created by the screen and element frames. The air flow required is about 40.800 CMH. **Cooling air flow is horizontal.** The cool air intakes from right side and discharges at the head on the enclosure and hot air outlet from left sides through exhaust hood.

The air exhaust hood contains an 1100 mm height hood with 12x12 mm stainless steel screen, 16 GA. stainless steel rain baffles and 50 mm mounting flange,

For 600V, 3-phase 3-wire system, the fan power is provided by the test source 600V, 60Hz, 3-phases, 3-wire, through the current limiting fuses and thermal overload relays. The fan motor rated 4kw @1750 RPM contains reconnect able windings

Operator Control:

The load bank remote control panel will be provided with a NEMA 1, wall mounted enclosure with a hinged and gasket cover, approx. 815 mm Hx650 mm Wx200 mm D, constructed of aluminized steel with colors ASA # 61 grey. The wires from the control panel to load bank body should be supplied and connected by customer on the site.

- 20-Load step switches
- 20-Load step lights
- 1-Master control on/off switch
- 1-Master control on light
- 1-Loss of air flow light
- 1-High temp. light
- 1-Load on/off switch

- 1-Load available light
- 1-Control Mode switch: AUTO/OFF/MANUAL
- 1-Digital power meter
- 1-Test block
- 1-Control relay (internally mounted)
- 1-Micro control relay #1 (internally mounted)
- 20- Load step control relay
- 1-OFF Time delay (0-5m) (internally mounted)
- 1-Interconnected terminal block (internally mounted)
- Component Identification plates
- Provision for terminal to load dump signal
- Provision for terminal to permission start (dry contact)
- Provision for terminal to load bank in auto
- Provision for terminal to summary alarm

There are three-way control mode switches on the control panel: AUTO/OFF/MANUAL

- AUTO –Under the "**Auto load step control by PLC**" mode, the load bank will start/stop via a dry contact for load bank external permission start signal and will auto start the motor and operate the fan; there are load step relay application circuit to automatically maintain by gen controller PLC on the generator.
- MANUAL –Under the "manual" mode, the fan and load step are manually operated.
- OFF- Under this mode, the load bank won't operate.

Load Connections:

On the outer side of the air plenum is the power cable accessible through a cable access on the bottom; the tin-plated copper bus bars with standard 4C #2/0-500MCM screw lugs are provided for customer load connections and Ground lugs with #6-250MCM screw lugs. Bolt-on access panels are provided to safely enclose all electrical connections and wirings.

APPENDIX "A"

Auto Load Dump:

The auto load dump circuit is activated by the external signal of disconnect via the terminal, open to load dump. Enable this to remove the jumper then connect the control wires for the signal of load on utility via automatic transfer switches.

In the event of a normal power failure occurred during a load test of emergency diesel generator, the control panel shall immediately disconnect the load bank and allow the emergency

Auto Load Step Control:

An automatic load step controller is provided for maintaining by the gen controller PLC via the load step relay. The controller monitors the connected downstream loads and will automatically add or subtract load steps in response to building load changes as to maintain a constant load level on the generator set. The controller includes a power transducer, initial time-delay circuit, and automatic time delay load step application circuit on the gen control panel.

Anti-condensation heater:

One heater (100W) on the outer side of the air plenum is provided in the compartment of the load bank along with control components to 5℃.The load bank module requires a 220V, 1 phase, 2A supply for the control and wiring compartment anti-condensation heater.

Lifting Eyes:

The four lifting eyes are provided on the top for hoisting load bank body. The two fork-lift channels on the base is provided for lifting the load bank.

Weight and Dimensions:

Dimensions of each are approx. 1122mm Wx2300mm Hx2430mm D; Weight is approx. 1200 Kg.

Certification and Warranty

For a period of one (1) year after installation or eighteen (18) months from date of shipment from our facility, whichever expires first. The load bank shall be tested. Tests shall include electrical functional testing and also verifying compliance to assembly drawings and specifications. Each load step shall be cold resistance checked to verify proper calibration of resistive load steps and proper ohm value. Tests using high potential equipment shall be performed to ensure isolation of the load circuits from the control circuits and to determine isolation of the load circuits to the load bank frame. Tests of all safety circuits shall be performed to verify compliance to the specification. All testing shall be done using a test specification written by our Traveler's Card. Thomson load banks utilize an ISO9001 Certified Quality System and are CSA Certified.

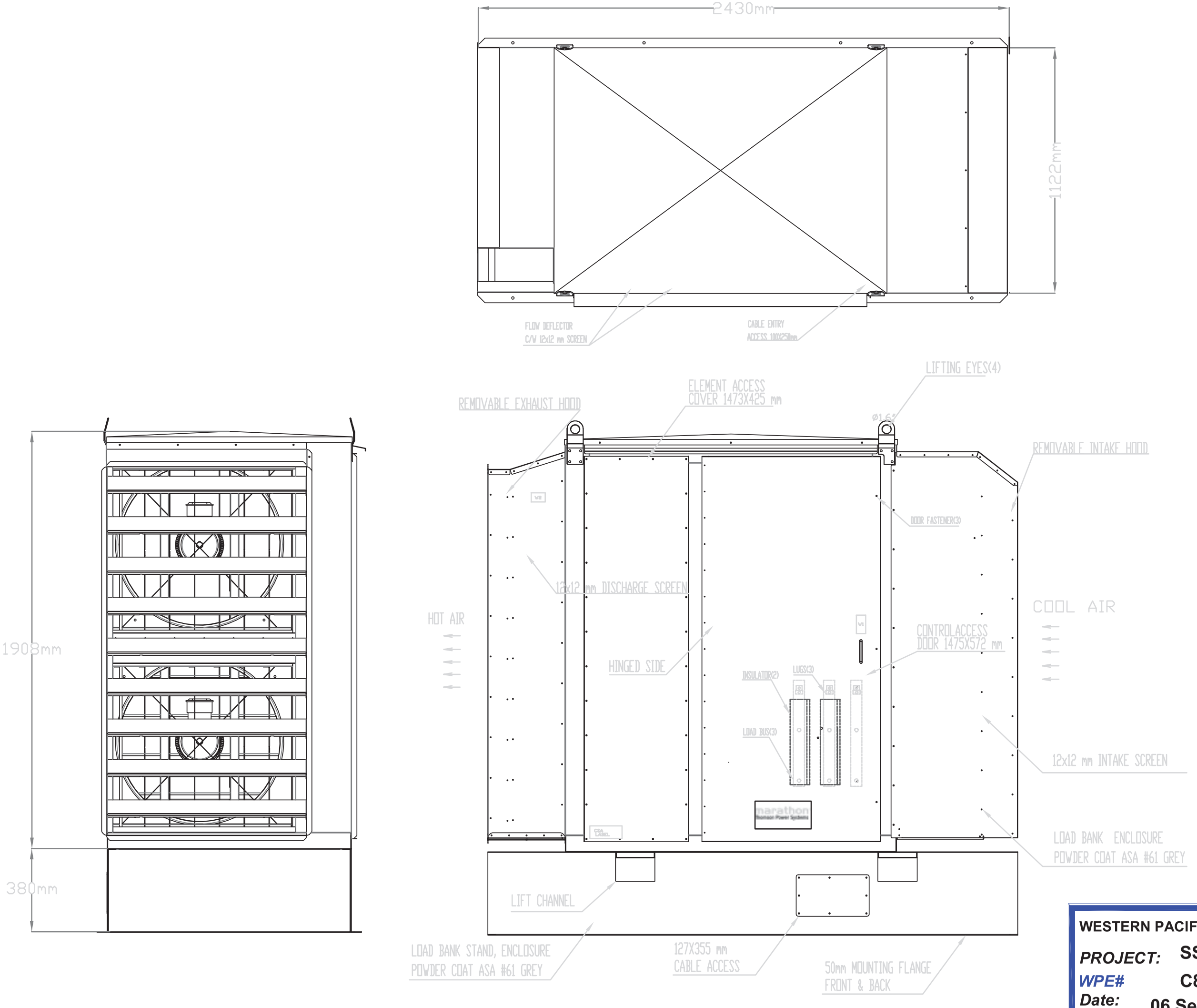
Instruction Manuals

Detailed Instruction Manuals shall be provided with the load bank. The Instruction Manuals shall include sections concerning Safety, Description of the load Bank Installation and Operation. The manuals shall also include complete electrical schematics and interconnections for the load bank and control unit. Schematics shall be drawn in order to facilitate understanding of load bank operation for maintenance purpose.

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 06 Sept, 2016
REVIEWED by _GW_

Bill of Materials for Work Order Number W-095113

PART#	DESCRIPTION	DEV#	QTY
010991	LOAD BANK, MODEL LBO, OUTDOOR SHANGHAI SIMPSON/010991		1.00
COMMENT	SQUARE D, DIGITAL METER, PM8240		1.00
009968	TEST BLOCK, FT-1, C-C-C-C-C-C P P P P GE/FT-207		1.00

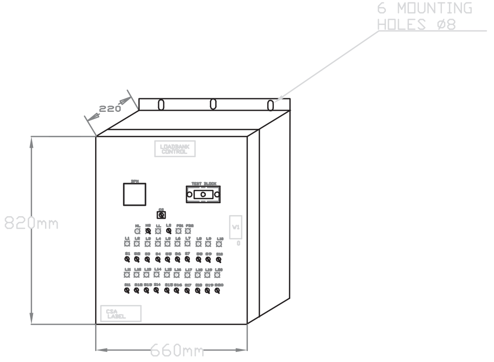


NOTES

1	LOAD BANK ENCLOSURE, 16GA AULMINIZED STEEL, BOTTOM, 13GA ALUMINIZED STEEL
2	ENCLOSURE TYPE NEMA 3R
3	AIR INTAKE/DISCHARGE VENTS ARE COVERED WITH 12x12 mm SCREEN
4	DIMENSIONS: MILLIMETER(mm)
5	APPROX WEIGHT: 950KG EXCLUSIVE OFTHE STAND & CONTROL PANEL
6	COAT PAINTING COLOR ASA #61 GREY 4C #2/0-500MCM LUGS PER PHASE 4@1C #6-250MCM LUGS GORUND CONNECTION

CAUTION

DISCHARGE AIR TEMPERATURE MAY RISE TO 200°C,
ENSURE THE DISCHARGE AIR PASSAGE IS UNOBSTRUCTED.
FOR PERSONNEL SAFETY REMAIN 16FT.(5m) MINIMUM
FROM DISCHARGE SIDE OF LOAD BANK.
TO PREVENT HOT AIR RECIRCULATION, OBSTRUCTIONS
AT THE DISCHARGE SIDE MUST BE KEPT TO A MINIMUM.
TO ALLOW GENERAL ACCESSIBILITY, ETC., IT IS
RECOMMENDED THAT A MINIMUM OF 3FT.(1m) CLEARANCE
BE MAINTAINED AROUND THE OTHER 3 SIDES.



WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS

PROJECT: **SSES Standby Power**
WPE# **C847**
Date: **06 Sept, 2016**

REVIEWED by _GW_

W P

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

REFER TO SHEET #

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

No.	REVISIONS	BY	AUTH	DATE
2	REVIEW	MS	XJ	2016/8/22
1	APPROVED	LU	XJ	2016/7/6

DRAWING No.
REFERENCE DRAWINGS

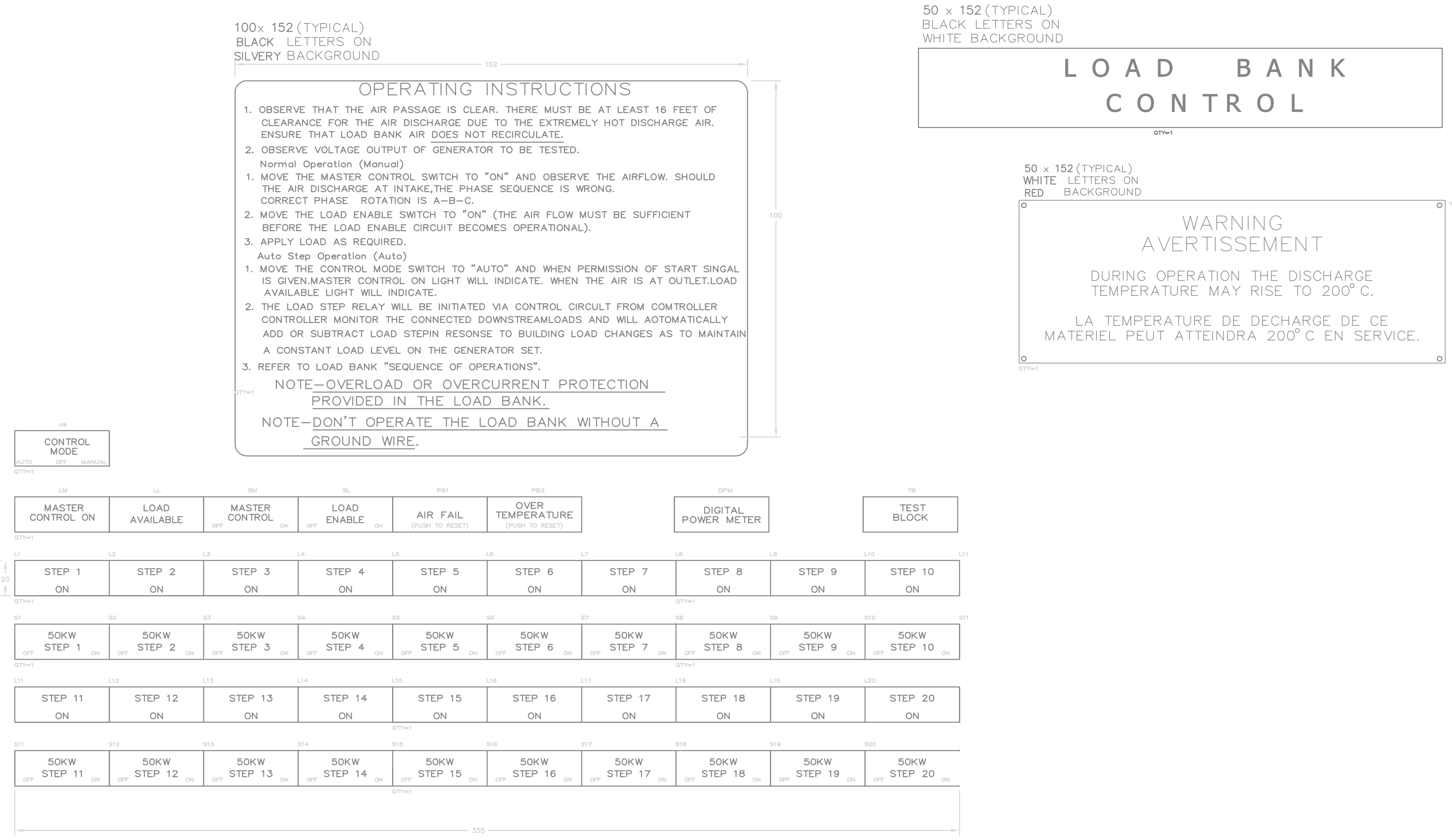
marathon™
Thomson Power Systems

1000KW 600V OUTDOOR LOAD BANK
MODEL LBO-1000H-600V-3-C
ENCLOSURE DETAILS
ESQUIMALT GRAVING DOCK

CUSTOMER

CUSTOMER ORDER No.	WORK ORDER No.		
C-054107	W-093113		
DRAWN BY	AUTH BY	DATE	REV
MS	XJ	2016/7/6	1
DRAWING/FILE No.		SHEET	
SSPL160706		1	

THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



OPERATING INSTRUCTIONS

1. OBSERVE THAT THE AIR PASSAGE IS CLEAR. THERE MUST BE AT LEAST 16 FEET OF CLEARANCE FOR THE AIR DISCHARGE DUE TO THE EXTREMELY HOT DISCHARGE AIR. ENSURE THAT LOAD BANK AIR DOES NOT RECIRCULATE.
2. OBSERVE VOLTAGE OUTPUT OF GENERATOR TO BE TESTED.

Normal Operation (Manual)

1. MOVE THE MASTER CONTROL SWITCH TO "ON" AND OBSERVE THE AIRFLOW. SHOULD THE AIR DISCHARGE AT INTAKE,THE PHASE SEQUENCE IS WRONG. CORRECT PHASE ROTATION IS A–B–C.
2. MOVE THE LOAD ENABLE SWITCH TO "ON" (THE AIR FLOW MUST BE SUFFICIENT BEFORE THE LOAD ENABLE CIRCUIT BECOMES OPERATIONAL).
3. APPLY LOAD AS REQUIRED.

Auto Step Operation (Auto)

1. MOVE THE CONTROL MODE SWITCH TO "AUTO" AND WHEN PERMISSION OF START SINGAL IS GIVEN.MASTER CONTROL ON LIGHT WILL INDICATE. WHEN THE AIR IS AT OUTLET.LOAD AVAILABLE LIGHT WILL INDICATE.
2. THE LOAD STEP RELAY WILL BE INITIATED VIA CONTROL CIRCUIT FROM COMTROLLER CONTROLLER MONITOR THE CONNECTED DOWNSTREAMLOADS AND WILL AOTOMATICALLY ADD OR SUBTRACT LOAD STEPIN RESONSE TO BUILDING LOAD CHANGES AS TO MAINTAIN A CONSTANT LOAD LEVEL ON THE GENERATOR SET.
3. REFER TO LOAD BANK "SEQUENCE OF OPERATIONS".

NOTE–OVERLOAD OR OVERCURRENT PROTECTION PROVIDED IN THE LOAD BANK.

NOTE–DON'T OPERATE THE LOAD BANK WITHOUT A GROUND WIRE.

LOAD BANK
CONTROL

WARNING
AVERTISSEMENT

DURING OPERATION THE DISCHARGE TEMPERATURE MAY RISE TO 200° C.

LA TEMPERATURE DE DECHARGE DE CE MATERIEL PEUT ATTEINDRA 200° C EN SERVICE.

REFER TO SHEET #

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	REVIEW	MS	XJ	2016/8/22
		1	APPROVED	MS	XJ	2016-07-28

marathon™
Thomson Power Systems

1000kW 600V 60Hz OUTDOOR LOAD BANK
MODEL LBO–1000H–600V–3–C
NAMEPLATE DETAILS
ESQUIMALT GRAVING DOCK

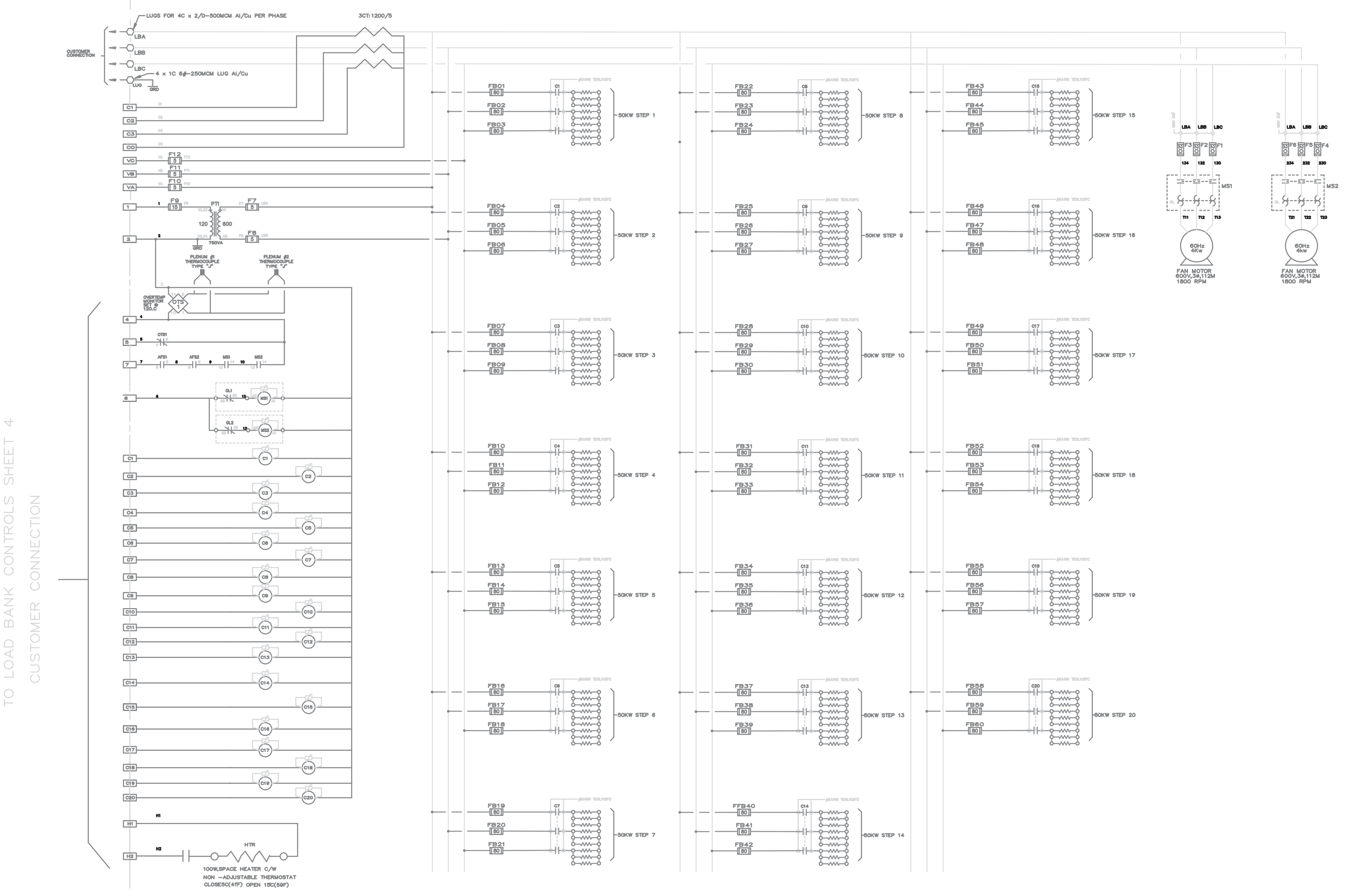
APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER

CUSTOMER ORDER No.			WORK ORDER No.	
C–054107			W–095113	
DRAWN BY	AUTH BY		DATE	REV
MS	XJ		16–07–28	1
DRAWING/FILE No.			SHEET	
SSPL160706			2	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS



REFER TO SHEET #

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	REVIEW	MS	XJ	2016/8/22
		1	APPROVED	MS	XJ	2016/7/28

marathon™
Thomson Power Systems

1000kW 600V 60Hz OUTDOOR LOAD BANK
MODEL LBO-1000H-600V-3-C
LOAD BANK SCHEMATIC DIAGRAM
ESQUIMALT GRAVING DOCK

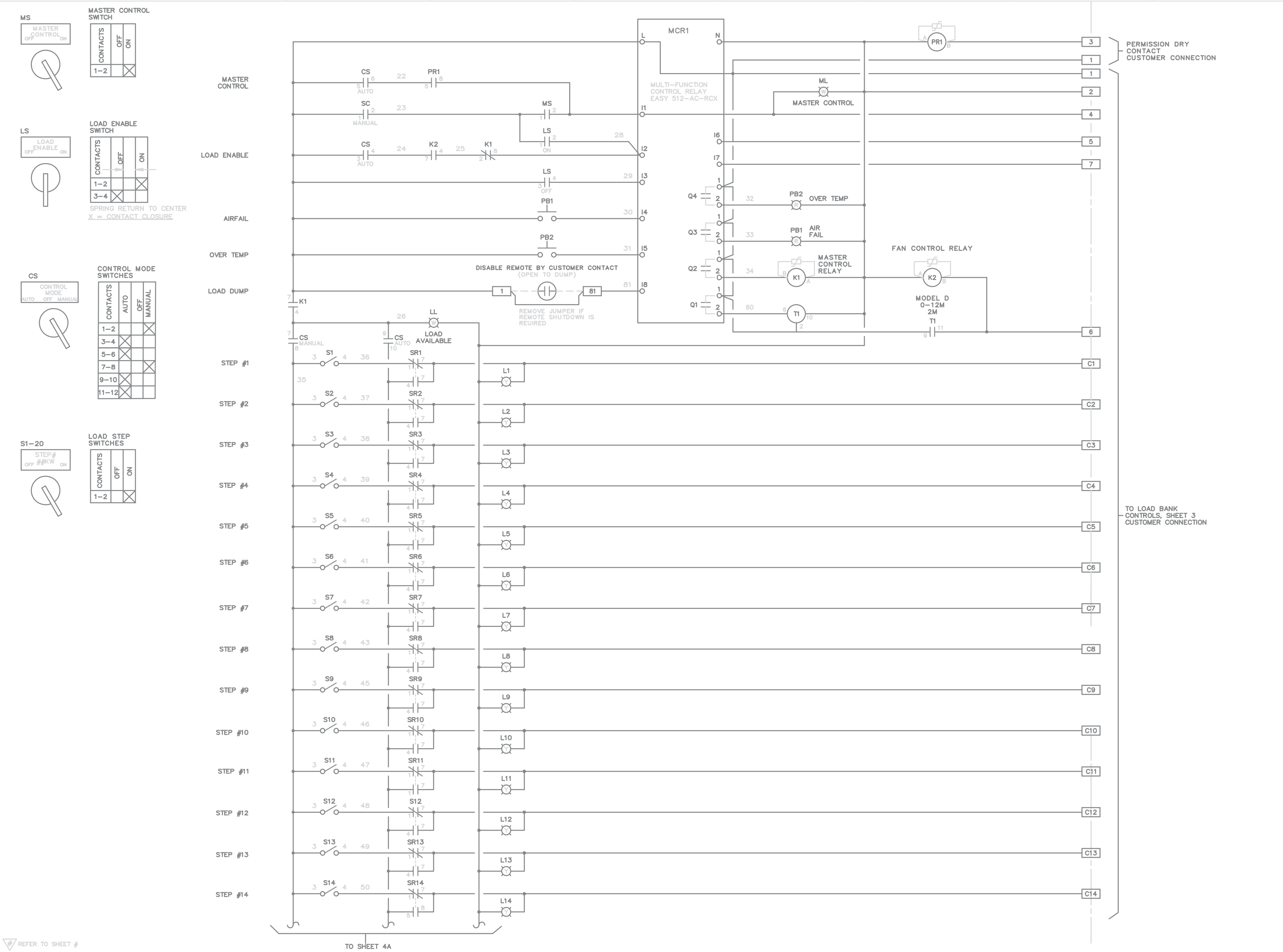
APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER

CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095113
DRAWN BY MS
AUTH BY XJ
DATE 16-07-28
REV 1
DRAWING/FILE No. SSPL160706
SHEET 3

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS



APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	REVIEW	MS	XJ	2016/8/22
		1	APPROVED	MS	XJ	16–07–28

marathon™
Thomson Power Systems

1000KW 600V OUTDOOR LOAD BANK
MODEL LBO–1000H–600V–3–C
LOAD BANK SCHEMATIC DIAGRAM

ESQUIMALT GRAVING DOCK

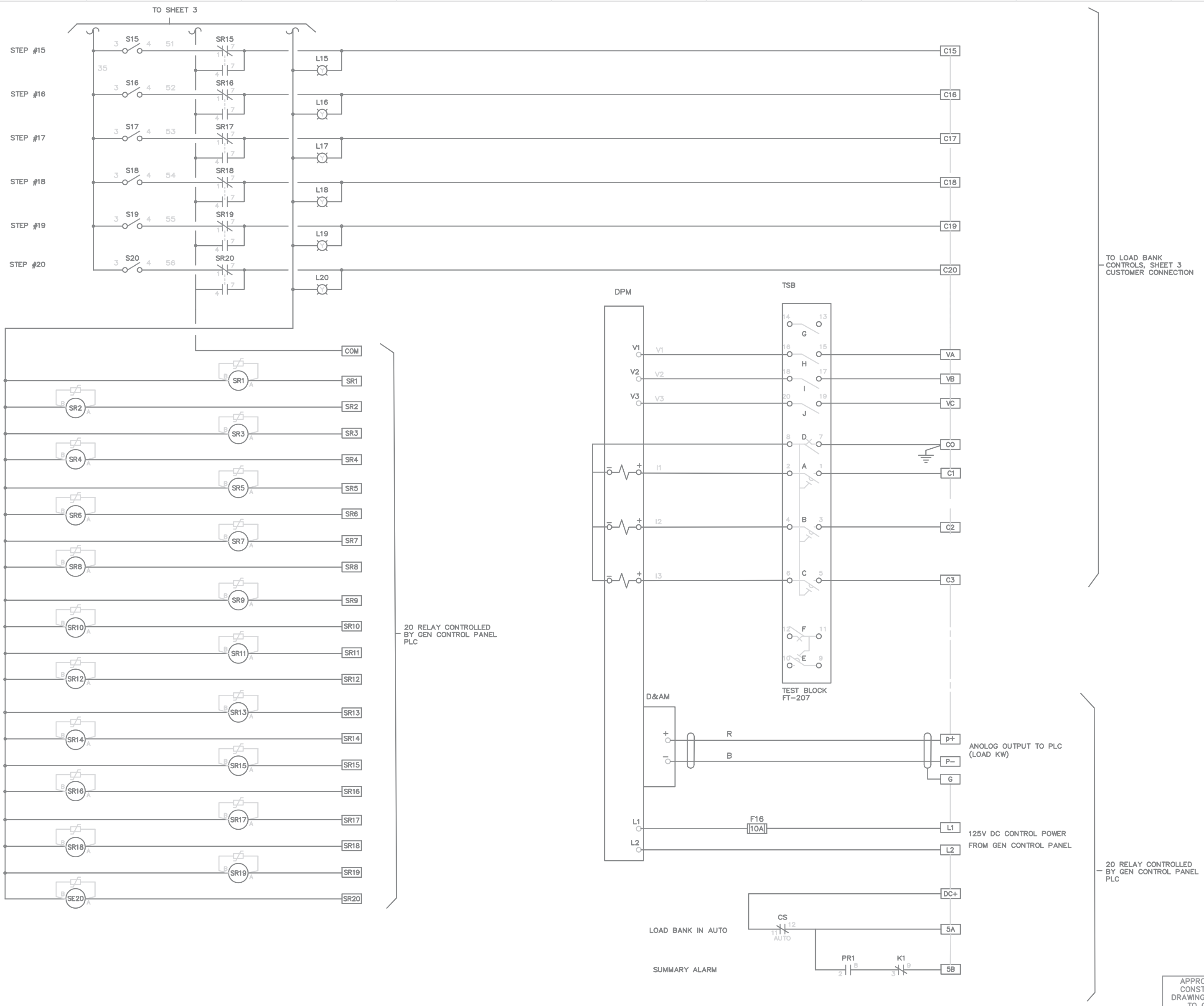
DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER

CUSTOMER ORDER No.	WORK ORDER No.		
C–054107	W–095113		
DRAWN BY	AUTH BY	DATE	REV
MS	XJ	16–07–28	1

DRAWING/FILE No. SSPL160706
SHEET 4

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS



REFER TO SHEET #

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	REVIEW	MS	XJ	2016/8/22
		1	APPROVED	MS	XJ	2016/7/28

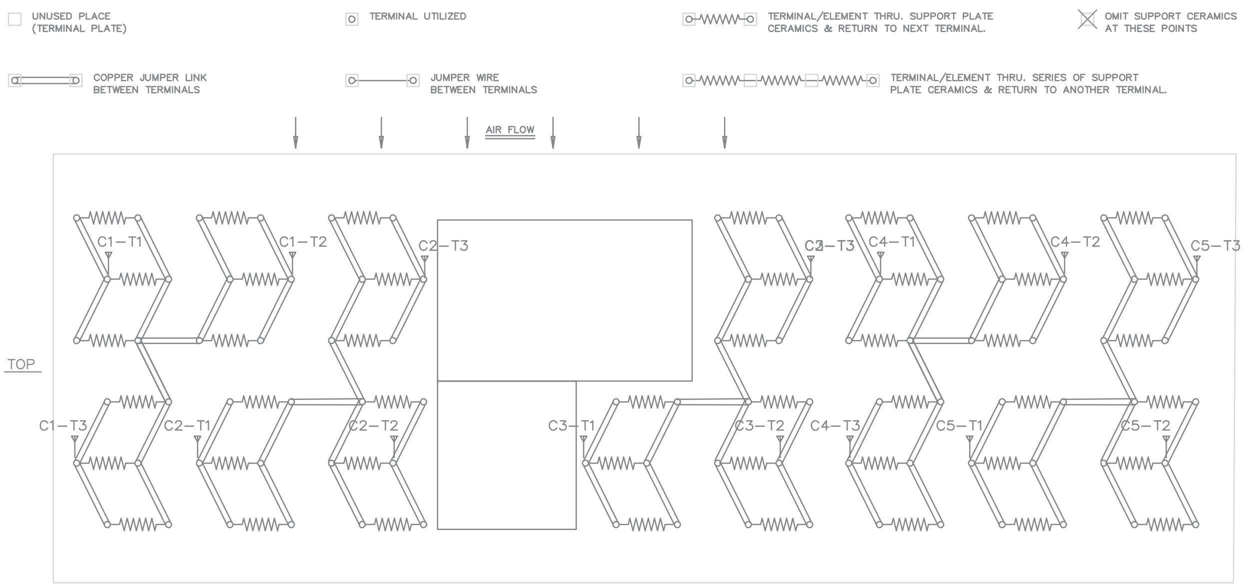
marathon™
Thomson Power Systems

1000KW 600V OUTDOOR LOAD BANK
MODEL LBO-1000H-600V-3-C
LOAD BANK SCHEMATIC DIAGRAM
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER			
CUSTOMER ORDER No. C-054107		WORK ORDER No. W-095113	
DRAWN BY MS	AUTH BY XJ	DATE 16-07-28	REV 1
DRAWING/FILE No. SSPL160706			SHEET 4A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS



ELEMENT IDENTIFICATION	QTY.	COLD RES.	WIRE #	KW	VOLTAGE	AMPS	TIGHT COIL LENGTH	STRETCHED COIL LENGTH
C1–C5	45	22.2 Ω	# 17	5.56	346	16.1	APPROX. 23.2	66"
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
	45	TOTAL # OF ELEMENTS						

90 TERMINAL CERAMICS

648 SUPPORT CERAMICS

70 JUMPER LINKS

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

REFER TO SHEET #

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		1	APPROVED	MS	XJ	16–07–28

marathon™
Thomson Power Systems

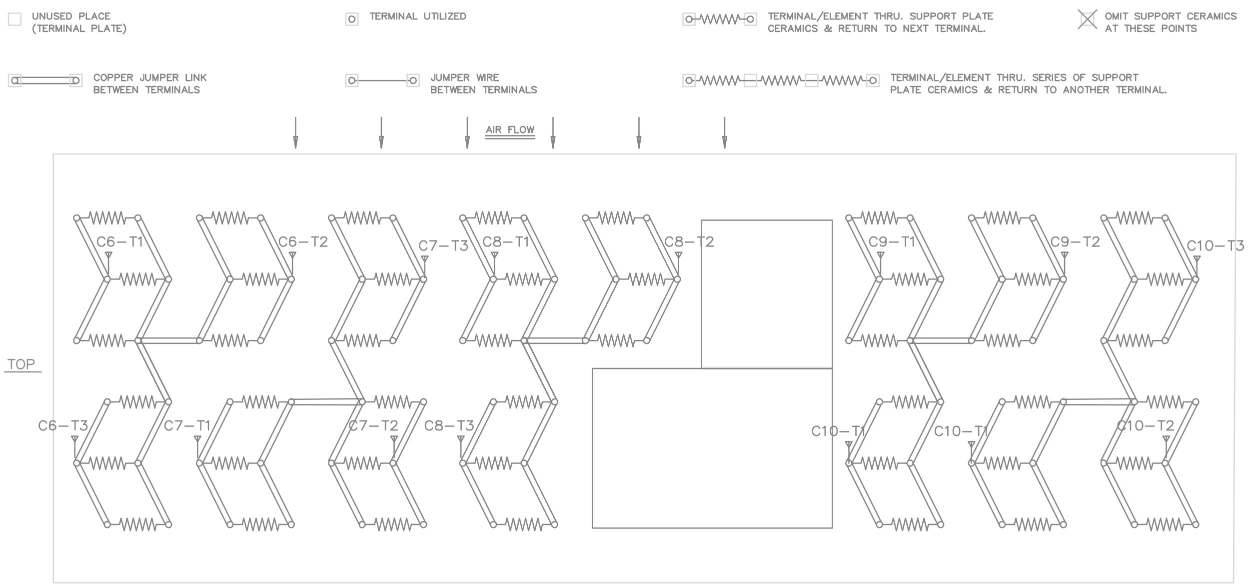
1000kW 600V 60Hz OUTDOOR LOAD BANK
MODEL LBO–1000H–600V–3–C
ELEMENT FRAME LB29L–1
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER

CUSTOMER ORDER No.		WORK ORDER No.	
C–054107		W–095113	
DRAWN BY	AUTH BY	DATE	REV
MS	XJ	16–07–28	1
DRAWING/FILE No.		SHEET	
SSPL160706		5	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS



ELEMENT IDENTIFICATION	QTY.	COLD RES.	WIRE #	KW	VOLTAGE	AMPS	TIGHT COIL LENGTH	STRETCHED COIL LENGTH
C6–C10	45	22.1Ω	# 17	5.56	346	18.1	APPROX. 24.2	66"
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
	45	TOTAL # OF ELEMENTS						

90 TERMINAL CERAMICS

648 SUPPORT CERAMICS

70 JUMPER LINKS

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

REFER TO SHEET #

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		1	APPROVED	MS	XJ	16–07–28

marathon™
Thomson Power Systems

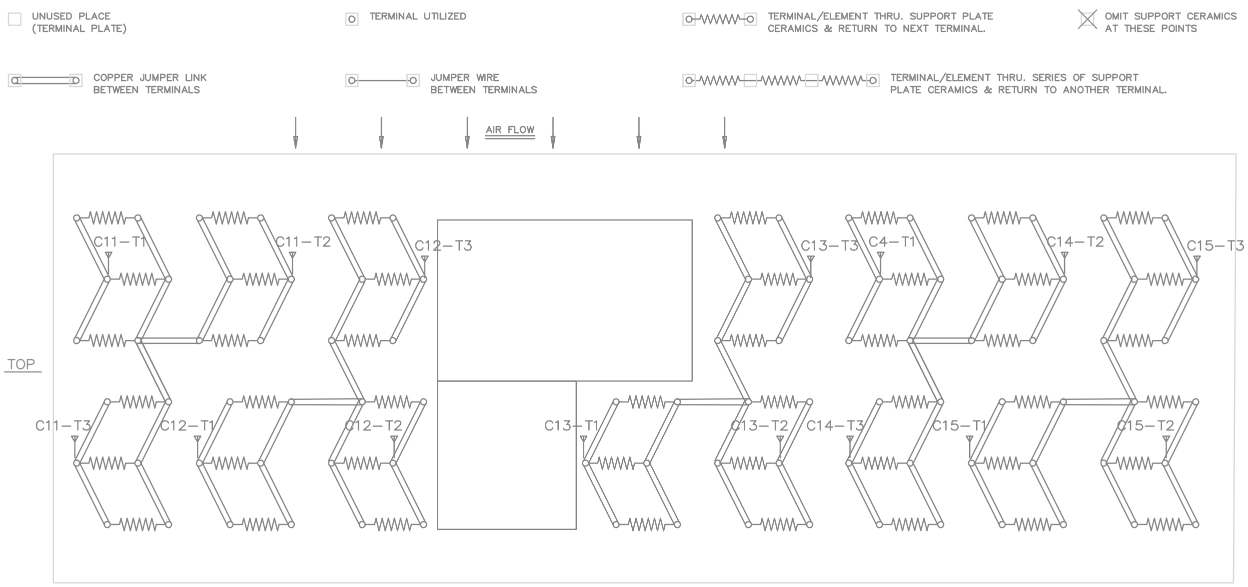
1000kW 600V 60Hz OUTDOOR LOAD BANK
MODEL LBO–1000H–600V–3–C
ELEMENT FRAME LB29L–2
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER

CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095113
DRAWN BY MS
AUTH BY XJ
DATE 16–07–28
REV 1
DRAWING/FILE No. SSPL160706
SHEET 6

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS



ELEMENT IDENTIFICATION	QTY.	COLD RES.	WIRE #	KW	VOLTAGE	AMPS	TIGHT COIL LENGTH	STRETCHED COIL LENGTH
C11–C15	45	22.2 Ω	# 17	5.56	346	16.1	APPROX. 23.2	66"
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
	45	TOTAL # OF ELEMENTS						

90 TERMINAL CERAMICS

648 SUPPORT CERAMICS

70 JUMPER LINKS

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

REFER TO SHEET #

☐ APPROVED FOR CONSTRUCTION
  ☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
  ☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		1	APPROVED	MS	XJ	16–07–28

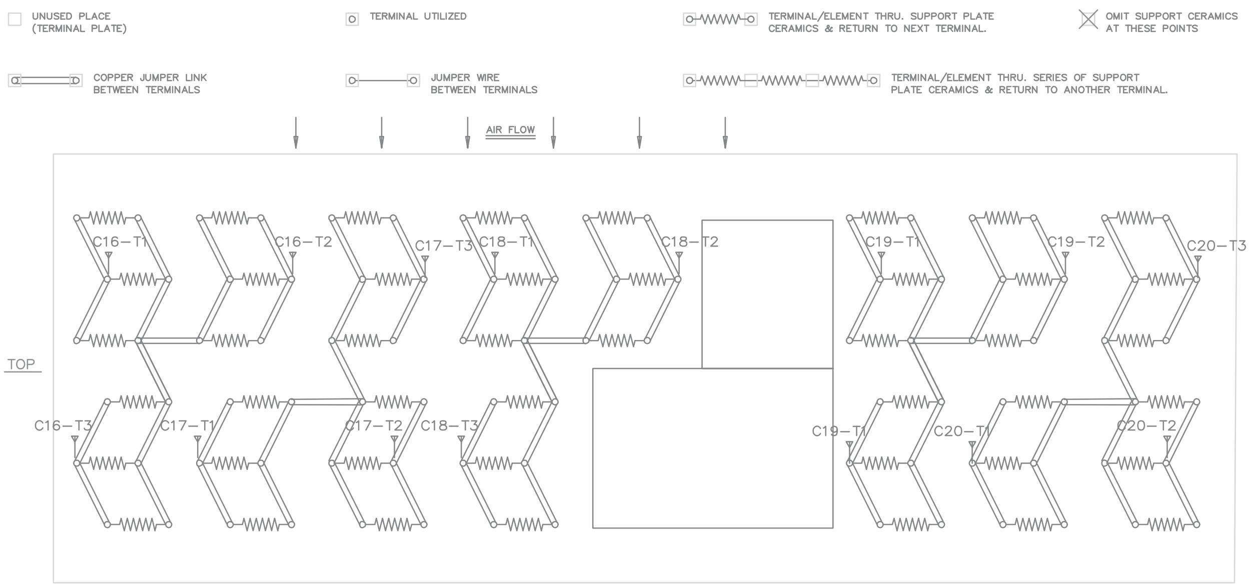
marathon™
Thomson Power Systems

1000kW 600V 60Hz OUTDOOR LOAD BANK
MODEL LBO–1000H–600V–3–C
ELEMENT FRAME LB29L–3
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095113
DRAWN BY MS
AUTH BY XJ
DATE 16–07–28
REV 1
DRAWING/FILE No. SSPL160706
SHEET 7

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS



ELEMENT IDENTIFICATION	QTY.	COLD RES.	WIRE #	KW	VOLTAGE	AMPS	TIGHT COIL LENGTH	STRETCHED COIL LENGTH
C16–C20	45	22.1Ω	# 17	5.56	346	18.1	APPROX. 24.2	66"
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
		Ω	#				APPROX.	
	45	TOTAL # OF ELEMENTS						

90 TERMINAL CERAMICS

648 SUPPORT CERAMICS

70 JUMPER LINKS

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

REFER TO SHEET #

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		1	APPROVED	MS	XJ	16–07–28

marathon™
Thomson Power Systems

1000kW 600V 60Hz OUTDOOR LOAD BANK
MODEL LBO–1000H–600V–3–C
ELEMENT FRAME LB29L–4
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095113
DRAWN BY MS
AUTH BY XJ
DATE 16–07–28
REV 1
DRAWING/FILE No. SSPL160706
SHEET 8

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT: ☐ MEMORANDUM FOR: ☐ APPROVAL ☐ COMMENT
☐ INSTRUCTION ☐ YOUR REVIEW ☐ INFORMATION
☐ FIELD REPORT ☐ ACTION ☒ RECORD
X SUBMITTAL ☐ YOUR USE ☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Dec 16, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 044

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – MV Transformer record Dwg**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**00022A69XAYA r2 (1pgs)**	
1	PDF	**1189610A1444 (1pgs)**	
1	PDF	**4257572C0176 (1pgs)**	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 12 13 item 1.4
Record Drawing

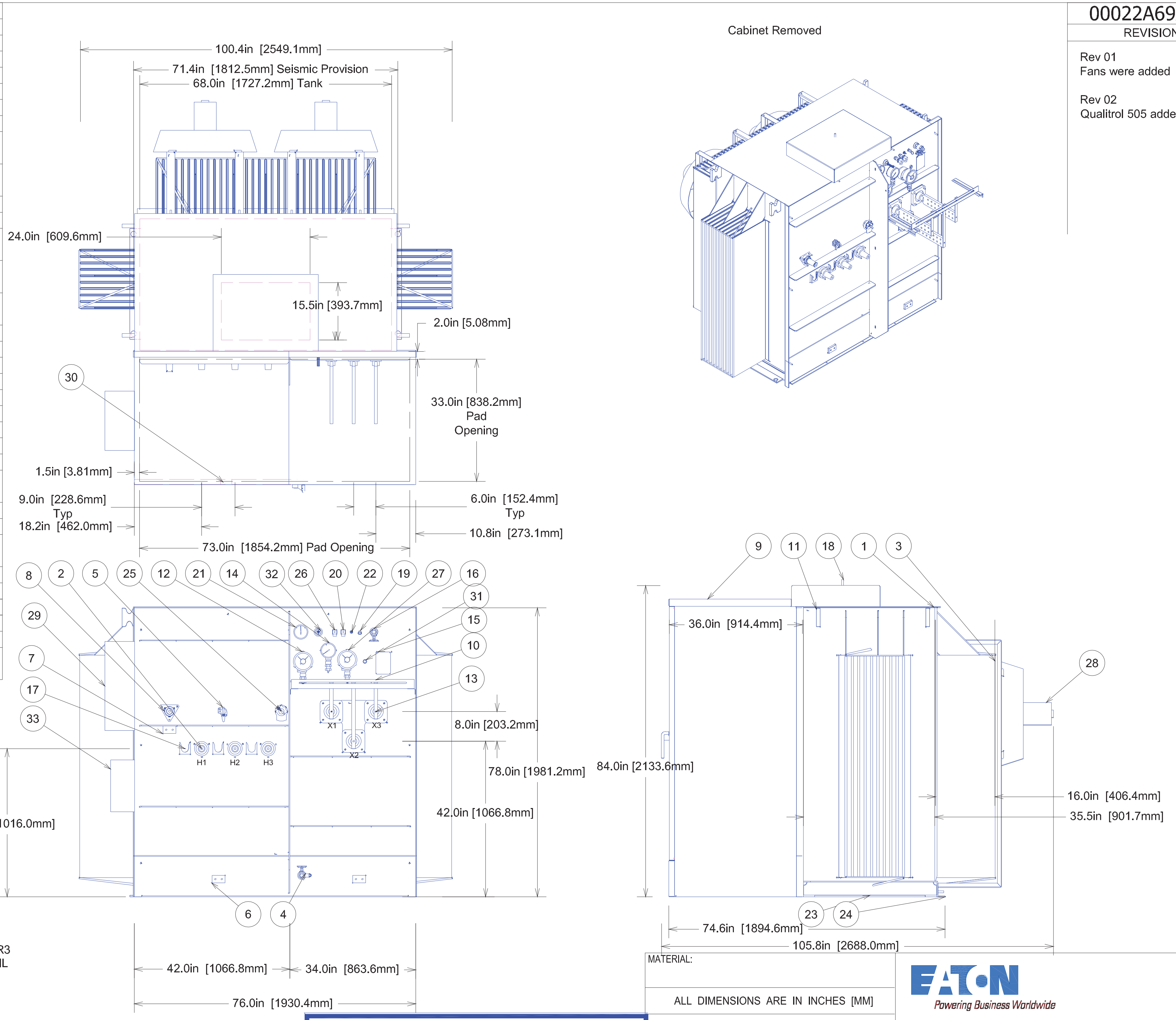
Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

ITE	DESCRIPTION
1	Welded Cover w/ Handhole
2	25kV 600 Amp Deadbreak HV Bushing
3	Cooling Corrugate
4	1" Drain Valve with Sampler
5	Dual Voltage Switch
6	Ground Pad .50-13 Tap
7	Ground Pad .50-13 Tap
8	H0 Bushing - 200 Amp HV Bush Well w/ 25kV insert and Rem Stud
9	High Security Cabinet w/ Pentahead Door Bolts
10	LV Bushing Support
11	Lifting Lug
12	Liquid Temperature Gauge w/ Alarm Contacts
13	1.2kV LV Bushing w/12 Hole Spade Supported
14	Magnetic Oil Level Gauge w/ Alarm Contacts
15	Nameplate
16	One Inch Upper Fill Valve
17	Parking Stand
18	Pressure Relief Device
19	Pressure Relief Valve
20	Pressure Switch w/ Alarm Contacts
21	Pressure Vacuum Gauge
22	Schrader Valve
23	Seismic Anchor Provisions
24	Tank Base w/ Jacking and Rolling Facilities
25	Tap Changer
26	Vacuum Switch w/ Alarm Contacts
27	Winding Temperature Gauge w/ Alarm Contacts
28	FANS
29	NEMA 4X Control Box
30	IR 3" Viewing window to HV side of Cab
31	Resistance Temperature Detector
32	CT Junction Block
33	Intelligent Transformer Monitor, Qualitrol 505 ITM



3PH Padmount Transformer 60Hz
3000.0/3990 kVA KNAN/KNAF 65 AWR FR3
HV 12470Y/7200X24940Y/14400 125 kV BIL
LV 600D 30 kV BIL
5.98 %IZ
Order Number 209775917-20
ANSI 61 Light Gray Topcoat
Mild Steel Construction
UL Listed

S.O number : 209775917
P.O number : 2610-373486
Project Name : ESQUIMALT GRAVING DOCK
AUDIBLE SOUND LEVEL -63 db

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 12 Dec, 2016
REVIEWED by _GW_

00022A69XAYA
REVISIONS

Rev 01
Fans were added

Rev 02
Qualitrol 505 added

MATERIAL:

ALL DIMENSIONS ARE IN INCHES [MM]

THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.

THIS DRAWING HAS BEEN GENERATED FROM A 3D MODEL.

EATON
Powering Business Worldwide

TITLE: Distribution Transformer Outline Drawing
DESC: **COOPER POWER SERIES** THREE-PHASE PAD-MOUNTED COMPARTMENTAL TYPE

DWG:	DATE:	REF:	SHEET #:	SCALE:	REV:
PTP	8/24/2016	P3D V03R07M00	1 OF 1		02

00022A69XAYA

EATON **COOPER POWER** SERIES

3 ϕ DISTRIBUTION
TRANSFORMER ASSEMBLED
IN WAUKESHA, WI U.S.A

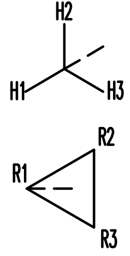
KVA 3000/3990	65°C	60Hz
SER		
MAN CP SER	CAT 00022A69XAYA	
HV 12470Y/7200X24940Y/14400	KNAN/KNAF	
LV 600	5.98 %IZ @85°C	MFG DATE

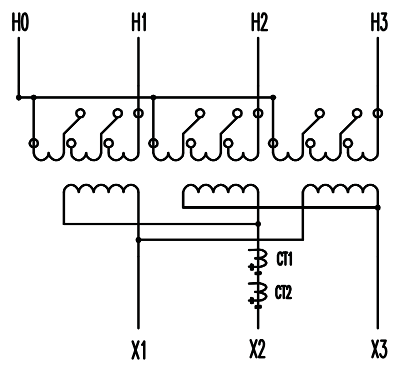
HV KV BIL	125
HV NEUTRAL KV BIL	125
LV KV BIL	30
HV/LV CONDUCTOR	CU/ CU

PCB CONTENT LESS THAN 1 PPM AT TIME OF MANUFACTURE
CAUTION – READ INSTRUCTION MANUAL MN202001EN
DUAL VOLTAGE POSITIONS (1/2) 12470/24940
TC CAN BE IN ANY POS. FOR LV OPERATION

1189610A1444–00

APPROX. WEIGHT IN KGS	
CORE & COIL UNTANKING	4047
TANK & FIT	2024
FLUID: FR3™ LITERS: 2108	1940
TOTAL	8011





TAP	VOLTAGE	%
A	26190	105.0
B	25560	102.5
C	24940	100.0
D	24320	97.5
E	23690	95.0

CT–1
3000:5 FOR WTI

CT–2
3000:5 FOR IED

MAX AMPS AT 3000 KVA
%IZ AT BASE KVA AND RATED VOLTAGE
CSA C802.1–00 EFFICIENCY COMPLIANT
BUILT PER ANSI C57.12.34

c UL US LISTED E234598
17YP
LIQUID–FILLED DISTRIBUTION TRANSFORMER
LIQUID–IMMERSED DISTRIBUTION TRANSFORMER

WARNING: UNIT WAS DESIGNED WITH NO OVERCURRENT PROTECTION. AN EXTERNAL CURRENT–LIMITING DEVICE SHALL BE PROVIDED TO MEET CSA C227.4 SECTION 9.1.3 ITEM S. FAILURE TO COMPLY WITH THIS WARNING CAN RESULT IN DEATH, SEVERE PERSONAL INJURY AND/OR EQUIPMENT DAMAGE.

NOTES: **1) ACTUAL PLATE IS A NEGATIVE OF THE ABOVE DRAWING.**
2) ACTUAL %IZ TO BE STAMPED IN AFTER TESTING.

NAMEPLATE MATERIAL: ALUMINUM

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 12 Dec, 2016
REVIEWED by _GW_
W P

209775917,20

1189610A1444
REVISIONS

MATERIAL:

ALL DIMENSIONS ARE IN INCHES [MM]

THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.

EATON Powering Business Worldwide

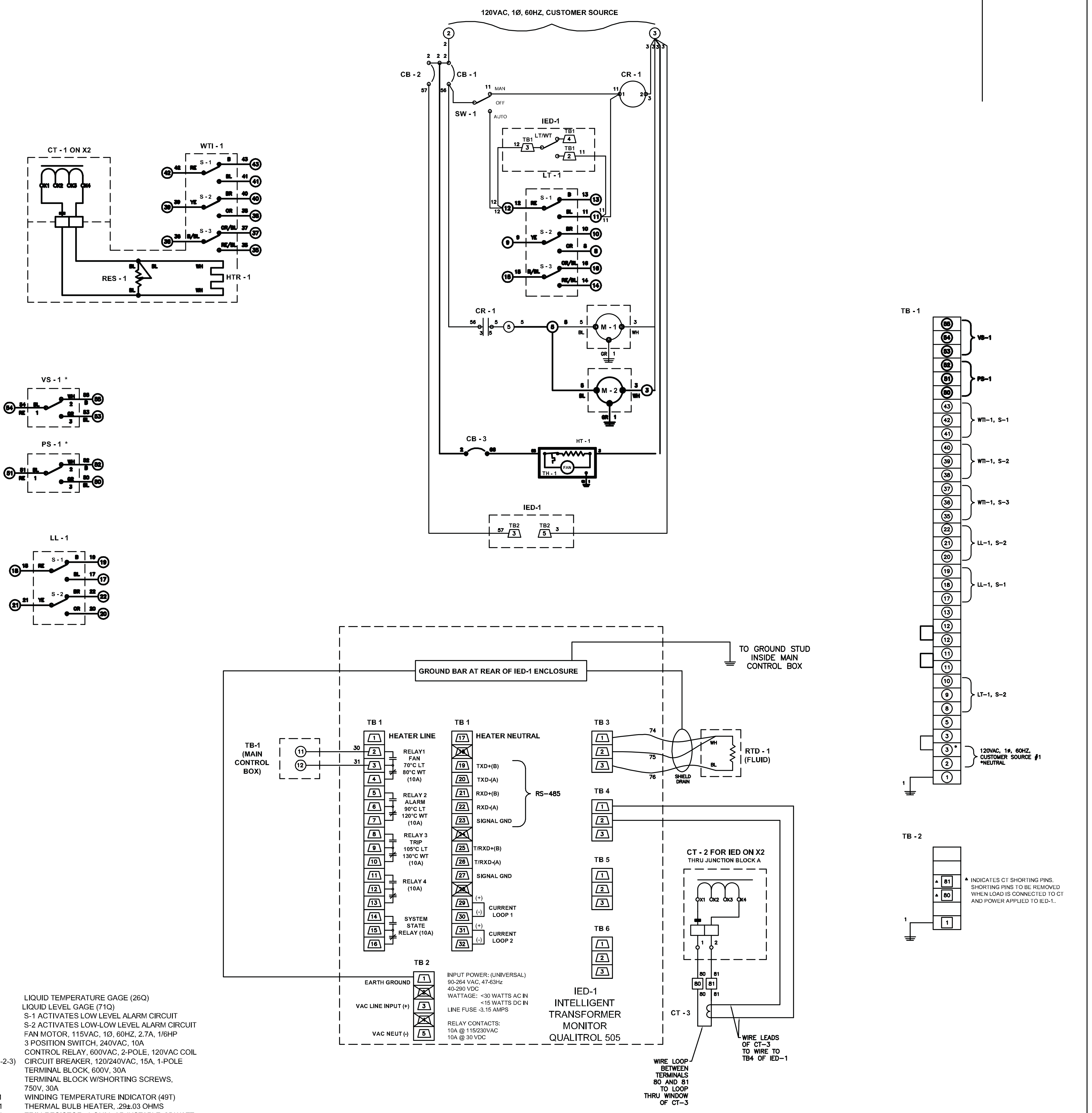
TITLE: LASER NAMEPLATE
DESC: **COOPER POWER SERIES** 00022A69XAYA

DWG:	DATE:	REF:	SHEET #:	SCALE:	REV:
PTP	12/8/2016		1 of 1	1=1	00

1189610A1444

4257572C0176

REVISIONS



LT-1	LIQUID TEMPERATURE GAGE (26Q)
LL-1	LIQUID LEVEL GAGE (71Q) S-1 ACTIVATES LOW LEVEL ALARM CIRCUIT S-2 ACTIVATES LOW-LOW LEVEL ALARM CIRCUIT
M-1-2	FAN MOTOR, 115VAC, 1Ø, 60HZ, 2.7A, 1/6HP
SW-1	3 POSITION SWITCH, 240VAC, 10A
CR-1	CONTROL RELAY, 600VAC, 2-POLE, 120VAC COIL
CB-(1-2-3)	CIRCUIT BREAKER, 120/240VAC, 15A, 1-POLE
TB-1	TERMINAL BLOCK, 600V, 30A
TB-2	TERMINAL BLOCK W/SHORTING SCREWS, 750V, 30A
WTI-1	WINDING TEMPERATURE INDICATOR (49T)
HTR-1	THERMAL BULB HEATER, .29±.03 OHMS
RES-1	TRIM RESISTOR, 1 OHM, ADJUSTABLE, 25 WATT, SET AT .47±.02 OHMS
CT-1	CURRENT TRANSFORMER, 3000:5 ON X2 FOR WTI-1
CT-2	CURRENT TRANSFORMER, 3000:5 ON X2 FOR IED-1
CT-3	CLAMP-ON AUXILIARY CT, 0-10 AMP INPUT
IED-1	INTELLIGENT TRANSFORMER MONITOR, QUALITROL MODEL 505 ITM LT=TOP OIL LIQUID TEMPERATURE WT=SIMULATED WINDING TEMPERATURE CONTACTS FOR RELAYS 1,2,3 ARE SETUP AS NON-FAILSAFE.
RTD-1	RESISTANCE TEMPERATURE DETECTOR, 100 OHM PLATINUM.
PS-1	PRESSURE SWITCH, GEMS PS-E (63PV) ACTIVATES AT +6.0±0.5 PSIG (+41±3 kPa) RISING
VS-1	VACUUM SWITCH, GEMS PS-EV (63PV) ACTIVATES AT -2.5±0.5 PSIG (-17±3 kPa) FALLING
HT-1	CABINET STRIP HEATER 100 WATTS 120VAC 0.9A
TH-1	THERMOSTAT, 120VAC & 10A OR 240VAC & 5A, ACTIVATES AT 24°C (75°F), ADJUSTABLE 10-140°C (50-300°F)

LEGEND

INDICATES PREWIRED DEVICE

INDICATES REMOTE DEVICE

26 INDICATES WIRE HEAT SHRINK NUMBER LABEL

26 OR 26 INDICATES TERMINAL BLOCK CONNECTION

26 INDICATES INTRINSICALLY SAFE TERM BLOCK CONN

12 INDICATES RELAY TERM AND #

INDICATES SPLICE

INDICATES NORMALLY CLOSED CONTACT (NC)

INDICATES NORMALLY OPEN CONTACT (NO)

INDICATES CUSTOMER CONNECTION

POLARITY MARK

▲ INDICATES CT SHORTING PINS - TO BE REMOVED WHEN LOAD IS CONNECTED TO CT

* WIRE COLORS APPLICABLE ONLY WHEN USING CORD CONNECTORS TO SWITCHES

WH - WHITE
GR - GREEN
BL - BLACK
B - BLUE
OR - ORANGE
RE - RED
BR - BROWN
YE - YELLOW

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 12 Dec, 2016
REVIEWED by _GW_

GAGE SWITCH SETTINGS			
DEVICE	LT 55°C AWR	LT 65°C AWR	WTI
S-1 (FANS)	60°C	70°C	80°C
S-2 (ALARM)	80°C	90°C	120°C
S-3 (TRIP)	105°C FIXED	105°C FIXED	130°C FIXED

GAGE SWITCH RATINGS (AMPS)				
DEVICE	120/240VAC	48VDC	125VDC	250VDC
LT/LL/ PRD/RRR	15	1.3	.50	.25
SPC	10	2.0	.50	.25
PS/VS	5	1.0	.40	.20
WTI	15	1.3	.50	.25
TPG	1	--	--	--
LCP	3	--	--	--
U	5	2.0	2.0	N/A

NOTE: AC LOADS = INDUCTIVE P.F. 75%
DC LOADS = NON-INDUCTIVE

MATERIAL:

ALL DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS OTHERWISE SPECIFIED
ONE PLACE DECIMAL ± .1
TWO PLACE DECIMAL ± .06
THREE PLACE DECIMAL ± .030
* CRITICAL DIMENSION ANGULAR ± 2°

[CONFIDENTIAL] MUST NOT BE USED IN ANY WAY DETRIMENTAL TO COOPER POWER SYSTEMS

COOPER Power Systems

TITLE: SCHEMATIC

SUBJ:

DWG:	DATE:	REF:	SHEET #:	SCALE:	REV:
RFG	3/31/2016		1 of 1	N.A.	00

4257572C0176

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: Oct 7, 2016
REVIEWED by _GW_
W P

MATERIAL SAFETY DATA SHEET

1. IDENTIFICATION

Envirotemp® FR3® fluid

Envirotemp FR3 fluid is a dielectric fluid intended for use as an insulation and cooling medium in electrical apparatus such as electrical distribution and power transformers.

Cooper Power Systems
1900 East North Street
Waukesha, Wisconsin 53188-3899 USA

Telephone: +01 262 524 3300
Internet: www.cooperpower.com

Emergency telephone (Chemtrec)
Inside USA: 800 424 9300
Outside USA: +01 703 527 3887

---

2. COMPOSITION/INFORMATION ON INGREDIENTS

Envirotemp FR3 fluid is a proprietary formulation using food-grade vegetable oils combined with performance-enhancing additives. All components are listed in the EINECS inventory.

Component	Proportion (wt%)
Vegetable oil	> 98.5
Antioxidant additive	< 1.0
Cold flow additive	< 1.0
Colorant	< 1.0

---

3. HAZARDS IDENTIFICATION

Envirotemp FR3 fluid is a preparation not classified as dangerous according to Directive 1999/45/EC. Not expected to cause a severe emergency hazard.

Routes of entry

Eyes: Contact may occur as a result of splash or exposure to mist conditions. May cause irritation and redness.

Skin: Typically non-irritating. In some case, a sensitization to vegetable oils may cause localized redness

Ingestion: May cause gastric irritation.

Inhalation: Exposure may occur as a result of mist exposure. May cause respiratory irritation.

Signs and symptoms of exposure: none known

Medical conditions generally aggravated by exposure: There is a very small risk for an allergic reaction to soybean oil in persons allergic to soybeans themselves.

---

4. FIRST AID MEASURES

Inhalation: If inhaled, remove affected person from exposure to mists.

Eye contact: For eye contact, flush the eyes immediately with large amounts of water with the eyelids held away from the eye to ensure thorough rinsing.

Skin contact: For skin contact, remove by washing with soap and water. Get medical attention if irritation persists.

Ingestion: If swallowed, observe for signs of stomach discomfort or nausea. If symptoms persist, seek medical help. Do not induce vomiting.

5. FIRE-FIGHTING MEASURES

Extinguishing media: CO_2 or dry chemical foam

Special fire fighting procedures: Use approved self-contained breathing apparatus with full facemask and full protective equipment in confined areas. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from source of ignition. Application of water to flaming oil can cause spreading.

Unusual fire and explosion hazards: Slight when exposed to flame. Can react with oxidizing materials. Clay materials (Fuller's earth, oil dry products) saturated with Envirotemp FR3 fluid can, under certain conditions, undergo a slow oxidation that releases heat. If the heat so released cannot escape, it is possible that the temperature may increase and ignite combustible materials in close contact.

6. ACCIDENTAL RELEASE MEASURES

Steps to take in case material is released or spilled: Contain and control the leaks or spills with non-combustible absorbent materials such as sand, earth, vermiculite, or diatomaceous earth in drums for waste disposal. Prevent any material from entering drains or waterways. If the product contaminates waterways, rivers or drains, alert the relevant authorities in accordance with statutory procedures.

In the USA, spills into navigable waters must be reported to the National Response Center, 800-424-8802

7. HANDLING AND STORAGE

Precautions to take in handling and storage: Avoid extremes of temperature in storage. Store Envirotemp FR3 fluid in labeled, tightly closed containers in cool, dry, isolated and well-ventilated areas, away from sources of ignition or heat. To maintain fluid for intended use as an electrical insulating fluid, eliminate exposure to oxygen and moisture.

Intermediate bulk storage container (tote): Prolonged exposure to ultraviolet radiation (sunlight) may affect color.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure limit values:

	TWA (mg/m^3)	
	OSHA[1] PEL	**ACGIH [2] TLV**
Vegetable oil mists	–	10
Vegetable oil mists: total dust	15	–
Vegetable oil mists: respirable fraction	5	–

	Health	**Flammability**	**Physical Hazard**
Hazardous Materials Identification System (HMIS):	0	1	0

Respiratory protection: Vaporization is not expected at ambient temperature. Therefore, the need for respiratory protection is not anticipated under normal use conditions and with adequate ventilation. If elevated airborne concentrations above applicable workplace exposure levels are anticipated, a NIOSH-approved organic vapor respirator equipped with a dust/mist prefilter should be used. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134). For extreme cases, use of approved supplied-air respiratory protection may be necessary.

Ventilation: General mechanical ventilation can be used to control or reduce airborne concentrations of oil.

Protective gloves: Use gloves constructed of chemical resistant materials such as neoprene or heavy nitrile rubber if frequent or prolonged contact is expected. Use heat-protective gloves when handling product at elevated temperatures.

Eye protection: Wear safety glasses or goggles to prevent eye contact. Eye baths should be readily available in the area of handling Envirotemp FR3 fluid.

---

[1] U.S. Occupational Health and Safety Administration

[2] American Conference of Governmental Industrial Hygienists

Other protective clothing or equipment: Wear regularly laundered coveralls or lab coat to minimize skin exposure.

Workplace hygienic practices: Wash with soap and water after contact. Avoid exposure to mists.

Environmental exposure controls: Have oil-absorbent materials easily available.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and odor: clear light-green liquid with slight vegetable oil odor
Closed cup flash point: 310 – 320°C
Boiling point: >360°C
Vapor pressure (mm Hg): < 0.01 @ 20°C
Vapor density (air = 1): n/a
Solubility in water: negligible; < 0.1%
Viscosity: 33 – 35 mm^2/s at 40°C

pH: neutral
Autoignition temperature: 401 – 404°C
Relative density (H_2O = 1): 0.92
Pour point: -18 to -24°C
Evaporation rate (butyl acetate = 1): nil
Volatile organic compounds: < 0.001 g/L
Miscibility: mixes with other dielectric fluids except silicone

10. STABILITY AND REACTIVITY

Stability: Envirotemp FR3 fluid is stable under normal conditions of use.

Incompatibility (materials to avoid): Avoid contact with strong oxidizing agents.

Hazardous decomposition products: none

Hazardous Polymerization: will not occur

Stabilizers: not required

Hazardous exothermic reaction: Slight when exposed to flame; can react with oxidizing materials. Class III B liquid. Clay materials (Fuller's earth, oil dry products) saturated with Envirotemp FR3 fluid can, under certain conditions, undergo a slow oxidation that releases heat. If the heat so released cannot escape, it is possible that the temperature may increase and ignite combustible materials in close contact.

11. TOXICOLOGICAL INFORMATION

Carcinogenicity: none **NTP:** no **IARC monographs:** no **OSHA regulated:** no

Envirotemp FR3 fluid base oils are "generally recognized as safe" (GRAS) by the U.S. Food and Drug Administration and allowed for human consumption as a food and as a component that is allowed in contact with human food.

12. ECOLOGICAL INFORMATION

Acute oral toxicity (OECD 420 - rats): LD_{50} >2000 mg/kg

Acute aquatic toxicity (OECD 203 - trout): LC_{50} >1000 mg/kg; NOAEC >1000 mg/kg

Aquatic biodegradation (OPPTS 835.3110): readily biodegradable, >99%

Biological oxidation demand (5-Day SM5210B): 250 ppm

Chemical oxygen demand (SM5220D): 560 ppm **BOD/COD ratio:** 45%

Petroleum hydrocarbon content: none

Environmental physical hazard: Envirotemp FR3 fluid shares physical hazards common to all oils such as coating feathers, fur, and gills.

13. DISPOSAL CONSIDERATIONS

Recycling: Consult with local used oil recyclers, restaurant grease recyclers, fat rendering companies, or biodiesel producers.

Hazardous Waste: Envirotemp FR3 fluid itself, when discarded or disposed of, is not a hazardous waste.

Disposal: Incinerate or landfill in accordance with local regulations. Do not pour into drains or waterways.

14. TRANSPORT INFORMATION

Harmonized System Tariff Classification (Schedule B): 1507.90.4050

National Motor Freight Classification (NMFC): 155250

Euro Tariff: 15 07 90 00 00

15. REGULATORY INFORMATION

Envirotemp FR3 fluid itself, when discarded or disposed of, is not listed as a hazardous waste per 40 CFR 261 and is not a used oil per 40 CFR 279. Envirotemp FR3 fluid is a preparation not classified as dangerous according to Directive 1999/45/EC.

16. OTHER INFORMATION

Technical information available at the Cooper Power Systems website: www.cooperpower.com

This Material Safety Data Sheet has been prepared in order to help the users of Envirotemp FR3 fluid. The data contained herein is, to the best of our knowledge, accurate as of the date of preparation of this sheet.

Effective Date: September 22, 2011

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Oct 12, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 034

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – 6SES-SP-0**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	**File Type**	**File Name and Description**	**Status**
1	PDF	**6SES-SP-0 (4pgs)**	RAR
1	PDF	**Custom WP Enclosure #3277 (1pgs)**	RVW

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section – Dwg notes
Seismic anchoring will follow under separate cover.

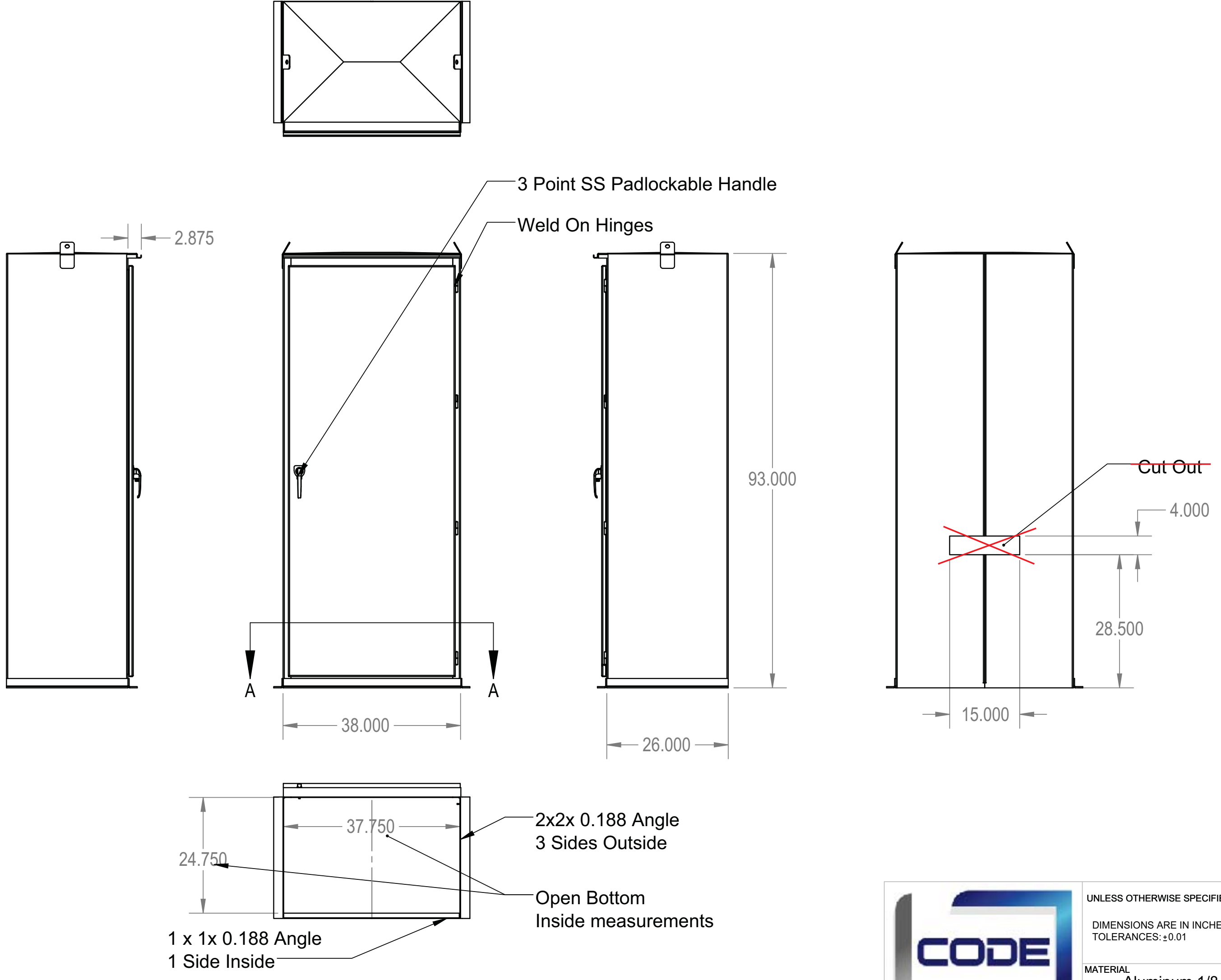
Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

WP Enclosure 6SES-SP-0



CODE
ELECTRIC PRODUCTS LTD

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES TOLERANCES: ±0.01	DRAWN	E.P.	9/28/2016
	CHECKED	E.P.	
MATERIAL Aluminum 1/8	COMMENTS: Type 3R Weatherproof Enclosure Solid welded and gasketed		
FINISH Natural			
DO NOT SCALE DRAWING	IND-3R-A		

TITLE:
CUSTOM ENCLOSURE

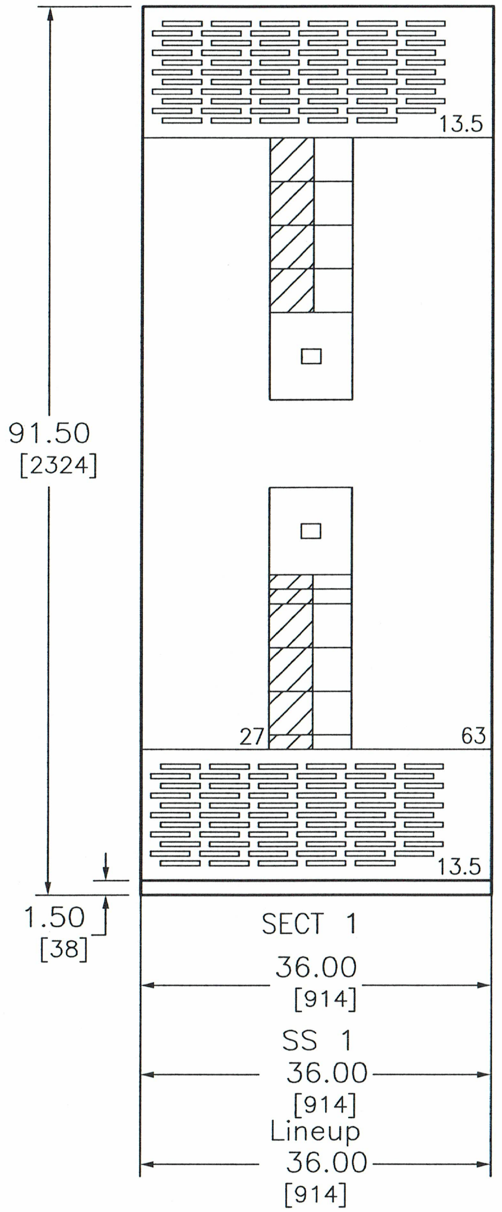
SIZE *93 x 38 x 26*

SIZE	DWG. NO.		REV
B	3277	WPE	
SCALE: 1:24	WEIGHT:		SHEET 1 OF 1

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CODE ELECTRIC PRODUCTS LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CODE ELECTRIC PRODUCTS IS PROHIBITED.

REV	DESCRIPTION	BY	DATE									
–	----	--	--/--	–	----	--	--/--	–	----	--	--/--
				–	----	--	--/--	–	----	--	--/--

No T-bus



SWITCHBOARD GENERAL NOTES

PRODUCT DESCRIPTION & RATINGS

Power System Data

600Y/347V 3Ph 4W 60Hz / 3 Phase Wye
Solidly Grounded
System Short Circuit Current Rating: 42kA RMS
Incoming Section 1 Cable Through the Bottom Left of Lineup

Bus System Data

1600A Silver Plated Copper Single Section with No Main Bus
(1) .25x.875 IN/6x22 mm Cu Ground Bus

Enclosure Data

Type 1 Free Standing
TOP PLATE
Sprinklered Equipment per CEC Part 1 Rule 26–008
Exterior Paint Color: ANSI 49
Front Accessibility Only Required
Handling: Rollers & Lifting Assemblies

Estimated Shipping Weight

Shipping Split 1 745.00 lbs / 337.93 kgs
Complete Lineup 745.00 lbs / 337.93 kgs

Code Standards

CSA C22.2 NO. 31
Not Suitable for Service Entrance
Not Suitable for Mounting on Combustible Floor

Rating Nameplates

ST1–Section Bus 1600A

PRODUCT INFORMATION

Wiring

All Gray SIS Wire and Min Size #14 Unless Otherwise Noted, and #12 Ground Wire.
NOTE: (90 Deg. C) insulated conductors must be sized per the (75 Deg. C) column of the CE Code Tables.

Instruction Bulletins

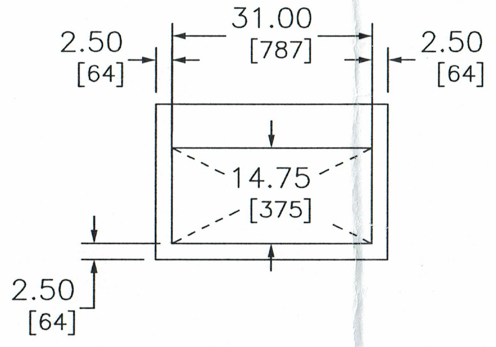
Reference 80043–055 For Handling, Installation, Anchoring, Inspection And Maintenance Information

Product Accessories/Options

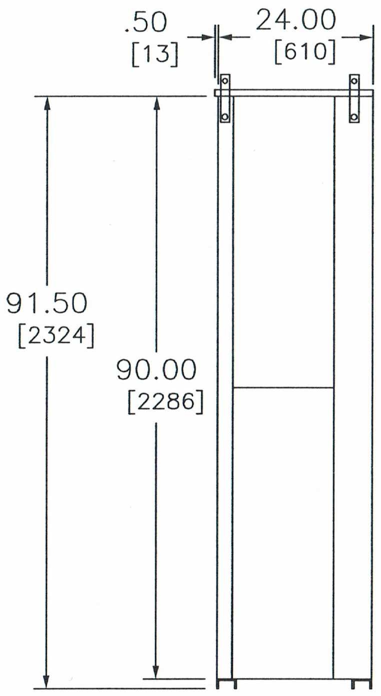
DUAL DIMENSIONS: INCHES
MILLIMETERS

JOB NAME:	ESQUIMALT GRAVING DOCK STANDBY	EQUIPMENT DESIGNATION:	6SES–SP–0
JOB LOCATION:	ESQUIMALT BC	EQUIPMENT TYPE:	QED SWITCHBOARD
DRAWN BY:	ASHISH UPPAL	DRAWING TYPE:	ELEVATION VIEW
ENGR:	ALIREZA MOAYER	SQUARE D by Schneider Electric	
DATE:	NOVEMBER 28, 2016		
DRAWING STATUS:	RECORD	DWG# F38802251–001–01	PG 1 OF 2 REV –

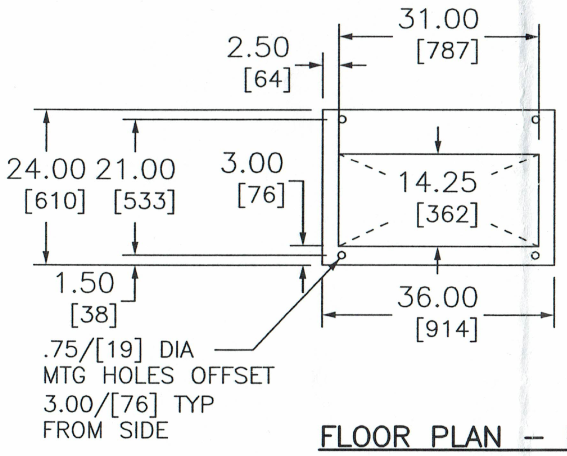
REV	DESCRIPTION	BY	DATE	-	----	--	--/--	-	----	--	--/--
-	----	--	--/--	-	----	--	--/--	-	----	--	--/--



TOP VIEW – FRONT



LEFT SIDE VIEW

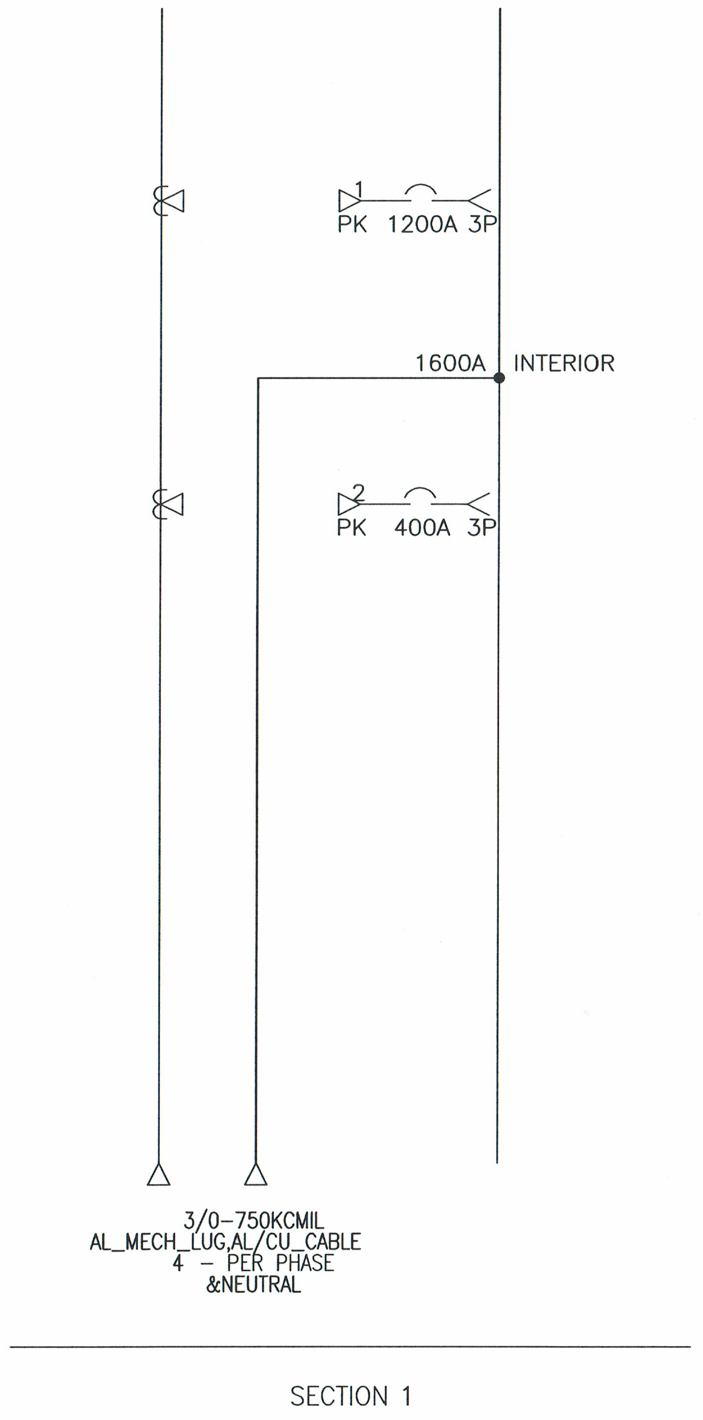


FLOOR PLAN – FRONT

DUAL DIMENSIONS: INCHES
MILLIMETERS

JOB NAME:	ESQUIMALT GRAVING DOCK STANDBY	EQUIPMENT DESIGNATION:	6SES-SP-0
JOB LOCATION:	ESQUIMALT BC	EQUIPMENT TYPE:	QED SWITCHBOARD
DRAWN BY:	ASHISH UPPAL	DRAWING TYPE:	SIDE, TOP VIEW & FLOOR PLAN
ENGR:	ALIREZA MOAYER	SQUARE D by Schneider Electric	
DATE:	NOVEMBER 28, 2016		
DRAWING STATUS:	RECORD	DWG# F38802251-001-01	PG 2 OF 2 REV –

REV	DESCRIPTION	BY	DATE								
–	----	--	--/--	–	----	--	--/--	–	----	--	--/--
				–	----	--	--/--	–	----	--	--/--



JOB NAME:	ESQUIMALT GRAVING DOCK STANDBY	EQUIPMENT DESIGNATION:	6SES–SP–0
JOB LOCATION:	ESQUIMALT BC	EQUIPMENT TYPE:	QED SWITCHBOARD
DRAWN BY:	ASHISH UPPAL	DRAWING TYPE:	ONE LINE
ENGR:	ALIREZA MOAYER		SQUARE D by Schneider Electric
DATE:	NOVEMBER 28, 2016		
DRAWING STATUS:	RECORD	DWG# 038802251–001–01	PG 1 OF 2 REV –

REV	DESCRIPTION	BY	DATE										
A	MINOR REVISION	KP	12/21/2016	–	----	--	--/--	–	----	--	--/--		
				–	----	--	--/--	–	----	--	--/--		

POWER STYLE QED–2 SWITCHBOARD

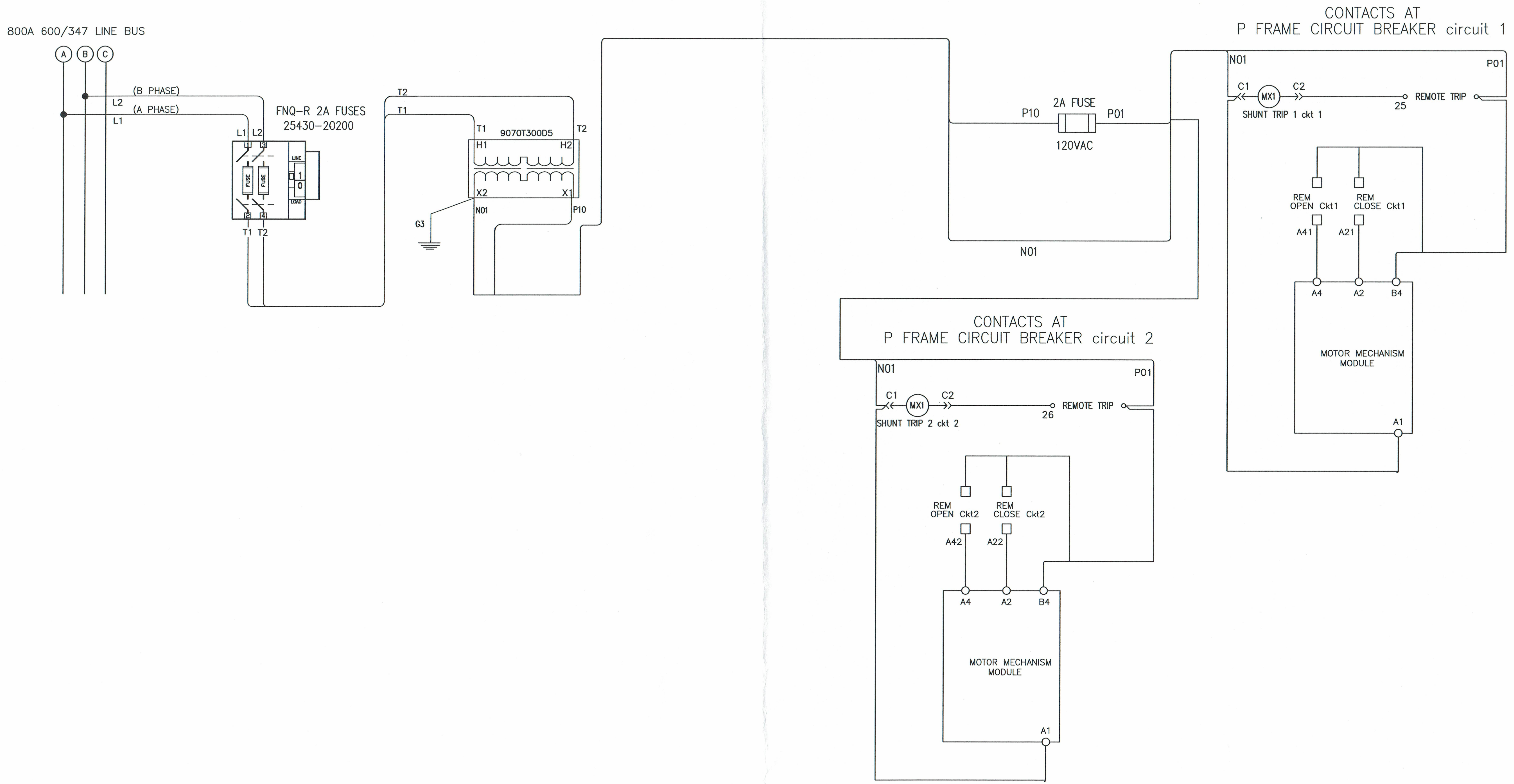
CT NO	CKT NO	GMD HEIGHT	DEVICE/FRAME RATING	TRIP AMP	FUSE/ TRIP	#P	DESIGNATION	N/P	LUG/WIRE INFORMATION				ACCESSORIES / NOTES
									QTY	PHASE WIRE RANGE	QTY	NEUT WIRE RANGE	
1	–	–	Incoming Connection	–	–	–	–	–	4	3/0 – 750 kcmil	4	3/0 – 750 kcmil	
1	1	9 in	PK 1200A Plug A	1200A	A–LSIG	3P		No	4	3/0 – 500 kcmil	4	3/0 – 500kcmil	GF,MX,MO PLA
1	2	9 in	PK 400A Plug A	400A	A–LSIG	3P		No	3	3/0 – 500 kcmil	3	3/0 – 500kcmil	GF,MX,MO PLA

LEGEND

EN	Argos Power Supply
GF	Ground Fault
PLA	Padlock Attachment–Fixed
MX	Shunt Trip
MO	Motor Operated

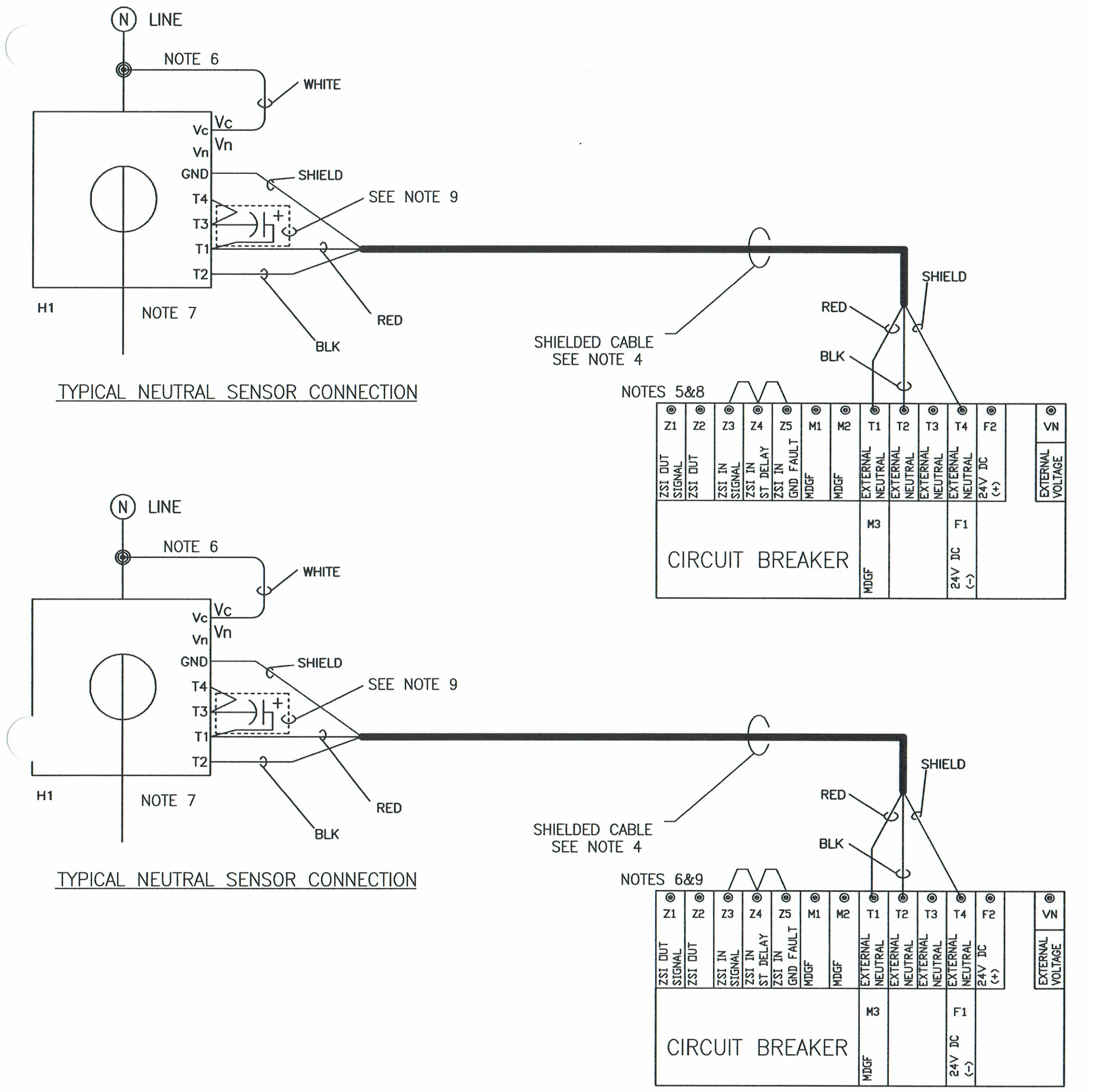
JOB NAME:	ESQUIMALT GRAVING DOCK STANDBY	EQUIPMENT DESIGNATION:	6SES–SP–0
JOB LOCATION:	ESQUIMALT BC	EQUIPMENT TYPE:	QED SWITCHBOARD
DRAWN BY:	ASHISH UPPAL	DRAWING TYPE:	SCHEDULE
ENGR:	ALIREZA MOAYER		SQUARE D by Schneider Electric
DATE:	NOVEMBER 28, 2016		
DRAWING STATUS:	RECORD	DWG# 038802251–001–01	PG 2 OF 2 REV A

REV	DESCRIPTION	BY	DATE	–	----	--	--/--	–	----	--	--/--
–	----	--	--/--	–	----	--	--/--	–	----	--	--/--



JOB NAME:	ESQUIMALT GRAVING DOCK STANDBY	EQUIPMENT DESIGNATION:	6SES-SP-0
JOB LOCATION:	ESQUIMALT BC	EQUIPMENT TYPE:	QED SWITCHBOARD
DRAWN BY:	ASHISH UPPAL	DRAWING TYPE:	WIRING DIAGRAM
ENGR:	ALIREZA MOAYER	Schneider Electric	
DATE:	NOVEMBER 28, 2016		
DRAWING STATUS:	RECORD	DWG# W38802251-001-01	PG 1 OF 2 REV –

REV	DESCRIPTION	BY	DATE	–	----	--	--/--	–	----	--	--/--
–	----	--	--/--	–	----	--	--/--	–	----	--	--/--



NOTES:

1. REFER TO BREAKER MANUAL FOR COMPLETE BREAKER TERMINAL INFORMATION
2. REFER TO ONELINE/SCHEDULE DRAWING FOR ACCESSORIES PROVIDED.
3. ALL WIRES ARE #16 MTM, UNLESS NOTED OTHERWISE.
4. INSTALL 3/4 INCH FLEXIBLE CONDUIT AROUND SHIELDED CONDUCTORS.
5. REMOVE THE FACTORY INSTALLED JUMPER BETWEEN T1 & T2.
6. THIS NEUTRAL CONNECTION IS PROVIDED BY VENDOR.
7. HI OF NEUTRAL CT ALWAYS POINTS TO BOTTOM.
8. DO NOT REMOVE FACTORY INSTALLED Z3-Z4 OR Z3-Z5 JUMPER UNLESS DICTATED BY SYSTEM ZSI WIRING.
9. INSTALL 2.2 nF CAPACITOR & JUMPER IF NOT ALREADY PRESENT.
10. REFERENCE BULLETIN 48041-082-XX FOR ADDITIONAL CT CONNECTION INFORMATION.

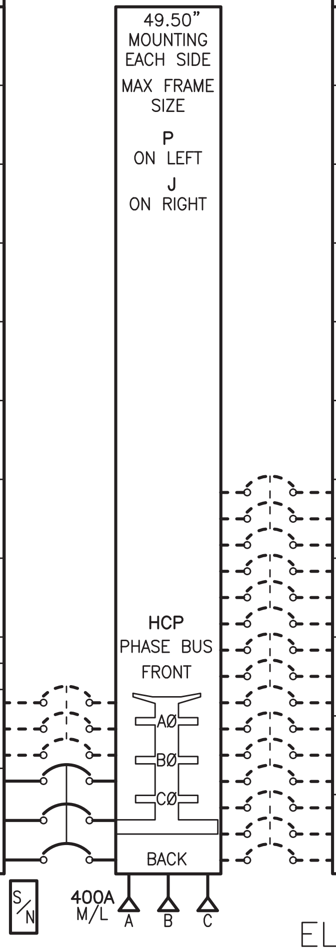
2 TRIP UNITS SHOWN
(TYPICAL CONNECTIONS)

(PP in I/L with GF only)

JOB NAME:	ESQUIMALT GRAVING DOCK STANDBY	EQUIPMENT DESIGNATION:	6SES-SP-0
JOB LOCATION:	ESQUIMALT BC	EQUIPMENT TYPE:	QED SWITCHBOARD
DRAWN BY:	ASHISH UPPAL	DRAWING TYPE:	WIRING DIAGRAM
ENGR:	ALIREZA MOAYER	Schneider Electric	
DATE:	NOVEMBER 28, 2016		
DRAWING STATUS:	RECORD	DWG# W38802251-001-01	PG 2 OF 2 REV –

REV	DESCRIPTION	BY	DATE	–	----	--	--/--/--
–	----	--	--/--/--	–	----	--	--/--/--

CKT NO	ACCESSORIES	TYPE	RATING AMP/P	PHASE BUS CONN
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	1.50" BLANK			
	1.50" BLANK			
1	PS 4.50" FP	HD	100/3	ABC
3	Std. LSI 80%	LD	400AS 300AT/3	ABC



PHASE BUS CONN	RATING AMP/P	TYPE	ACCESSORIES	CKT NO
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
ABC	100 /3	HD	PS 4.50" FP	2
ABC	100 /3	HD	PS 4.50" FP	4
ABC	100 /3	HD	PS 4.50" FP	6
ABC	100 /3	HD	PS 4.50" FP	8
ABC	100 /3	HD	PS 4.50" FP	10

PHYSICAL DATA

ENCLOSURE Type 1
Surface with Door
FRONT CAT#: HCW86TSD
BOX CAT#: HC4286DB
DIMENSIONS:
86''H x 42''W x 9.5''D
WIRE BENDING SPACE:
TOP – 11.66
BOTTOM – 17.50
LEFT SIDE – 8.66
RIGHT SIDE – 8.77
PBA: 418
BUSSING: Copper
Tin Plated
OPTIONAL FEATURES:
SHIP COMPLETELY ASSEMBLED
BRANCH USER PLACEMENT
Copper GROUND BAR
COPPER SOLID NEUTRAL

ELECTRICAL DATA

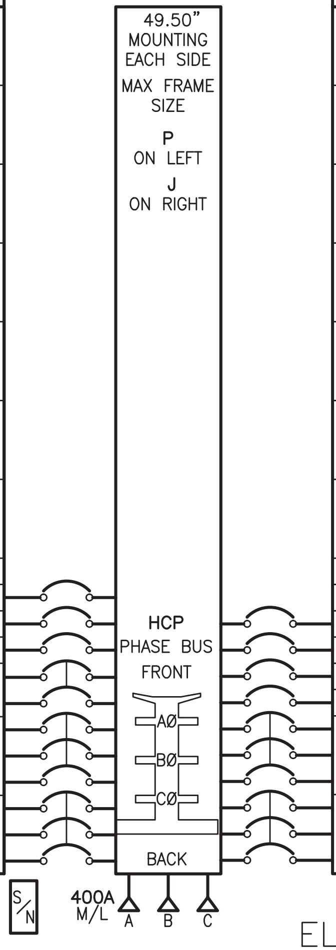
SYSTEM: 600Y/347V 3Ph 4W 60Hz
System Ampacity: 400A
42kA SYMS. SCCR
Series Rated w/ LL
MAIN: MAIN LUGS : 400A
Bottom FEED
INCOMING CONDUCTORS(S) PER NEC
Wire Bending Space:
(2) #4 – 600 kcmil
BRANCH MOUNTING TYPE: PLUG–ON
------------BRANCH SUMMATION------------
6 – 100A/3P–PS HD 1 – 300A/3P LD STD LSI

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: **SSES Standby Power**
WPE# **C847**
Date: **9 Nov, 2016**
W P
REVIEWED by _GW_

JOB NAME:	ESQUIMALT GRAVING DOCK STANDBY	EQUIPMENT DESIGNATION:	6SES–SP–2
JOB LOCATION:	Esquimalt BC	EQUIPMENT TYPE:	I–Line (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:			
DATE:	November 09 2016		
DRAWING STATUS:	QUOTE	DWG# 038802251–01	PG 1 OF 1 REV –

REV	DESCRIPTION	BY	DATE	–	----	--	--/--/--
–	----	--	--/--/--	–	----	--	--/--/--

CKT NO	ACCESSORIES	TYPE	RATING AMP/P	PHASE BUS CONN
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	1.50" BLANK			
1		FA	15 /1	A
3		FA	15 /1	B
5		FA	15 /1	A
7		FA	20/2	AB
9		FA	50/3	ABC
11		FA	50/3	ABC



PHASE BUS CONN	RATING AMP/P	TYPE	ACCESSORIES	CKT NO
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			4.50" BLANK	
			1.50" BLANK	
			1.50" BLANK	
C	15 /1	FA		2
B	15 /1	FA		4
C	20 /1	FA		6
C	20 /1	FA		8
ABC	50 /3	FA		10
ABC	50 /3	FA		12

PHYSICAL DATA

ENCLOSURE Type 1
Surface with Door
FRONT CAT#: HCW86TSD
BOX CAT#: HC4286DB
DIMENSIONS:
86"H x 42"W x 9.5"D
WIRE BENDING SPACE:
TOP – 11.66
BOTTOM – 17.50
LEFT SIDE – 8.66
RIGHT SIDE – 8.77
PBA: 418
BUSSING: Copper
Tin Plated
OPTIONAL FEATURES:
SHIP COMPLETELY ASSEMBLED
BRANCH USER PLACEMENT
Copper GROUND BAR
COPPER SOLID NEUTRAL

ELECTRICAL DATA

SYSTEM: 208Y/120V 3Ph 4W 60Hz
System Ampacity: 400A
10kA SYMS. SCCR
Series Rated w/ LD
MAIN: MAIN LUGS : 400A
Bottom FEED
INCOMING CONDUCTORS(S) PER NEC
Wire Bending Space:
(2) #4 – 600 kcmil
BRANCH MOUNTING TYPE: PLUG–ON
-----------BRANCH SUMMATION-----------
5 – 15A/1P FA
4 – 50A/3P FA
1 – 20A/2P FA
2 – 20A/1P FA

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: **SSES Standby Power**
WPE# **C847**
Date: **9 Nov, 2016**
REVIEWED by _GW_

JOB NAME: ESQUIMALT GRAVING DOCK STANDBY
JOB LOCATION: Esquimalt BC
DRAWN BY: (Q2C)
ENGR:
DATE: November 09 2016
DRAWING STATUS: QUOTE

EQUIPMENT DESIGNATION: 2-SES-SP-2
EQUIPMENT TYPE: I-Line (Circuit Breaker Type) PANEL 1 OF 1
DRAWING TYPE: ONE LINE DIAGRAM

DWG# 038802251-01 PG 1 OF 1 REV –

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Oct 7, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 032

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – Panel 6A & 6C Custom**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**6A (1pgs)**	RAN
1	PDF	**6C (1pgs)**	RAN

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section – Dwg notes
Custom design due to space limitations.

AES ENGINEERING LTD.
REVIEWED ONLY
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. APPROVAL OF DIMENSIONS AND OTHER GENERAL CONSTRUCTION FEATURES IS NOT IMPLIED.
☐ REVIEWED
☐ REVISE AND RESUBMIT
☒ REVIEWED AS MODIFIED
☐ NOT REVIEWED
Project Number: 1-16-008 Date: 2016-10-18
Reviewed By: Jacob Bielin

Sincerely,

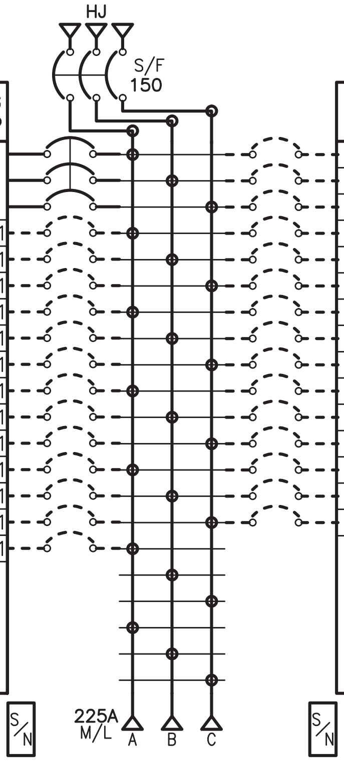
Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

REV	DESCRIPTION	BY	DATE	–	----	--	--/--/--
–	----	--	--/--/--	–	----	--	--/--/--

CKT NO	ACCESSORIES	TYPE	RATING AMP/P	RATING AMP/P	TYPE	ACCESSORIES	CKT NO
1		EJB	50/3	20/1	EJB	PREPARED SPACE	2
3				20/1	EJB	PREPARED SPACE	4
5				20/1	EJB	PREPARED SPACE	6
7	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	8
9	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	10
11	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	12
13	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	14
15	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	16
17	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	18
19	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	20
21	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	22
23	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	24
25	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	26
27	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	28
29	PREPARED SPACE	EJB	20/1	20/1	EJB	PREPARED SPACE	30
31	PREPARED SPACE	EJB	20/1				32
33							34
35							36
37							38
39							40
41	BLANK					BLANK	42



This is dependant on your contractor's proposed wiring solution

PHYSICAL DATA

ENCLOSURE Type 2
Surface with Door
FRONT CAT#: NC62S
BOX CAT#: MH62H
DIMENSIONS:
62''H x 20''W x 5.75''D
WIRE BENDING SPACE:
TOP – 5
BOTTOM – 13.25
SIDE – 4.1
PBA: 550
BUSSING: Copper
Silver/Tin Plated
OPTIONAL FEATURES:
SHIP COMPLETELY ASSEMBLED
DRIP HOOD
ALUMINUM SOLID NEUTRAL
ALUMINUM GROUND BAR

ELECTRICAL DATA

SYSTEM: 600Y/347V 3Ph 4W 60Hz
System Ampacity: 225A
25kA SYMS. SCCR
MAIN: MAIN LUGS : 225A
Bottom FEED
INCOMING CONDUCTORS(S) PER NEC
Wire Bending Space:
#6 – 350 kcmil
BRANCH MOUNTING TYPE: BOLT–ON
-----------BRANCH SUMMATION-----------
1 – 150A/3P HJ 1 – 50A/3P EJB
28 – 20A/1P–PS EJB

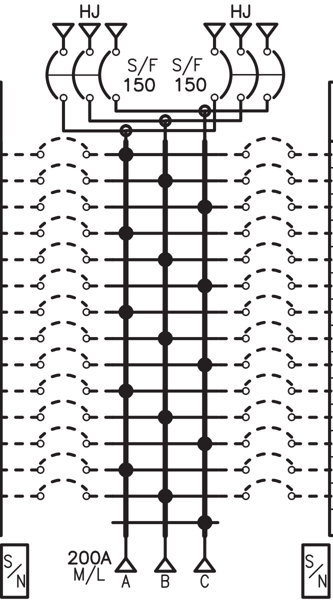
Copper

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: **SSES Standby Power**
WPE# **C847**
Date: **Oct 7, 2016**
REVIEWED by _GW_

JOB NAME:	ESQUIMALT GRAVING DOCK	EQUIPMENT DESIGNATION:	6A
JOB LOCATION:	VICTORIA BC	EQUIPMENT TYPE:	NF (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:			
DATE:	October 07 2016		
DRAWING STATUS:	QUOTE	DWG# 038637637–01	PG 1 OF 1 REV –

REV	DESCRIPTION	BY	DATE	–	––––	––	––/––/––
–	––––	––	––/––/––	–	––––	––	––/––/––

CKT NO	ACCESSORIES	TYPE	RATING AMP/P
1	PREPARED SPACE	EJB	20/1
3	PREPARED SPACE	EJB	20/1
5	PREPARED SPACE	EJB	20/1
7	PREPARED SPACE	EJB	20/1
9	PREPARED SPACE	EJB	20/1
11	PREPARED SPACE	EJB	20/1
13	PREPARED SPACE	EJB	20/1
15	PREPARED SPACE	EJB	20/1
17	PREPARED SPACE	EJB	20/1
19	PREPARED SPACE	EJB	20/1
21	PREPARED SPACE	EJB	20/1
23	PREPARED SPACE	EJB	20/1
25	PREPARED SPACE	EJB	20/1
27	PREPARED SPACE	EJB	20/1
29	BLANK		



RATING AMP/P	TYPE	ACCESSORIES	CKT NO
20/1	EJB	PREPARED SPACE	2
20/1	EJB	PREPARED SPACE	4
20/1	EJB	PREPARED SPACE	6
20/1	EJB	PREPARED SPACE	8
20/1	EJB	PREPARED SPACE	10
20/1	EJB	PREPARED SPACE	12
20/1	EJB	PREPARED SPACE	14
20/1	EJB	PREPARED SPACE	16
20/1	EJB	PREPARED SPACE	18
20/1	EJB	PREPARED SPACE	20
20/1	EJB	PREPARED SPACE	22
20/1	EJB	PREPARED SPACE	24
20/1	EJB	PREPARED SPACE	26
20/1	EJB	PREPARED SPACE	28
		BLANK	30

This is dependant on your contractor's proposed wiring solution

PHYSICAL DATA

ENCLOSURE Type 2
Surface with Door
FRONT CAT#: NC68VS
BOX CAT#: MH68H
DIMENSIONS:
68''H x 20''W x 5.75''D
WIRE BENDING SPACE:
TOP – 12.25
BOTTOM – 17
SIDE – 4.1
PBA: 551
BUSSING: Copper
Silver/Tin Plated
OPTIONAL FEATURES:
SHIP COMPLETELY ASSEMBLED
DRIP HOOD
ALUMINUM SOLID NEUTRAL
ALUMINUM GROUND BAR

ELECTRICAL DATA

SYSTEM: 600Y/347V 3Ph 4W 60Hz
System Ampacity: 200A
25kA SYMS. SCCR
MAIN: MAIN LUGS : 200A
Bottom FEED
INCOMING CONDUCTORS(S) PER NEC
Wire Bending Space:
#6 – 350 kcmil
BRANCH MOUNTING TYPE: BOLT–ON
––––––––––––BRANCH SUMMATION––––––––––––
2 – 150A/3P HJ   28 – 20A/1P–PS EJB

Copper

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: **SSES Standby Power**
WPE# **C847**
Date: **Oct 7, 2016**
REVIEWED by _GW_

JOB NAME:	ESQUIMALT GRAVING DOCK	EQUIPMENT DESIGNATION:	6C
JOB LOCATION:	VICTORIA BC	EQUIPMENT TYPE:	NF (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:			
DATE:	October 07 2016		
DRAWING STATUS:	QUOTE	DWG# 038637637–01	PG 1 OF 1 REV –

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Aug 12, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 011

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – Existing PNL Modifications**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**Panel Board 6A**	RAR
1	PDF	**Panel Board 6C**	RAR
1	PDF	**Manual Transfer Switch 6A & 6C**	REJ
1	PDF	**Main Breaker 6A & 6C**	RVW

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference DWG 8430 details 5 & 6

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

PowerPact™ Circuit Breakers

H- and J-Frame Circuit Breakers

Main Breakers 6A & 6C

Class **611** / Refer to Catalog **0611CT1001**

HD and HG 2 Pole
Thermal-Magnetic Trip Unit

H-Frame
Thermal-Magnetic Trip Unit

H-frame 150 A Thermal-magnetic CSA/UL Current-Limiting ▼ Circuit Breakers (600 Vac) with Factory Sealed Trip Unit Suitable for Reverse Connection ■▲

Current Rating @ 40° C	AC Magnetic Trip Setting		D Interrupting		G Interrupting		J Interrupting ▼		L Interrupting ▼		Terminal Wire Range
	Hold	Trip	Catalogue Number ▲	Price	Catalogue Number ▲	Price	Catalogue Number ▲	Price	Catalogue Number ▲	Price	
2-pole, 600 Vac 50/60 Hz											
15	350	750	HDL26015		HGL26015		HJL26015		HLL26015		AL150HD #14–#3/0 AWG Cu or Al
20	350	750	HDL26020		HGL26020		HJL26020		HLL26020		
25	350	750	HDL26025		HGL26025		HJL26025		HLL26025		
30	350	750	HDL26030		HGL26030		HJL26030		HLL26030		
35	400	850	HDL26035		HGL26035		HJL26035		HLL26035		
40	400	850	HDL26040		HGL26040		HJL26040		HLL26040		
45	400	850	HDL26045		HGL26045		HJL26045		HLL26045		
50	400	850	HDL26050		HGL26050		HJL26050		HLL26050		
60	800	1450	HDL26060		HGL26060		HJL26060		HLL26060		
70	800	1450	HDL26070		HGL26070		HJL26070		HLL26070		
80	800	1450	HDL26080		HGL26080		HJL26080		HLL26080		
90	800	1450	HDL26090		HGL26090		HJL26090		HLL26090		
100	900	1700	HDL26100		HGL26100		HJL26100		HLL26100		
110	900	1700	HDL26110		HGL26110		HJL26110		HLL26110		
125	900	1700	HDL26125		HGL26125		HJL26125		HLL26125		
150	900	1700	HDL26150		HGL26150		HJL26150		HLL26150		
3-pole, 600 Vac 50/60 Hz											
15	350	750	HDL36015		HGL36015		HJL36015		HLL36015		AL150HD #14–#3/0 AWG Cu or Al
20	350	750	HDL36020		HGL36020		HJL36020		HLL36020		
25	350	750	HDL36025		HGL36025		HJL36025		HLL36025		
30	350	750	HDL36030		HGL36030		HJL36030		HLL36030		
35	400	850	HDL36035		HGL36035		HJL36035		HLL36035		
40	400	850	HDL36040		HGL36040		HJL36040		HLL36040		
45	400	850	HDL36045		HGL36045		HJL36045		HLL36045		
50	400	850	HDL36050		HGL36050		HJL36050		HLL36050		
60	800	1450	HDL36060		HGL36060		HJL36060		HLL36060		
70	800	1450	HDL36070		HGL36070		HJL36070		HLL36070		
80	800	1450	HDL36080		HGL36080		HJL36080		HLL36080		
90	800	1450	HDL36090		HGL36090		HJL36090		HLL36090		
100	900	1700	HDL36100		HGL36100		HJL36100		HLL36100		
110	900	1700	HDL36110		HGL36110		HJL36110		HLL36110		
125	900	1700	HDL36125		HGL36125		HJL36125		HLL36125		
150	900	1700	HDL36150		HGL36150		HJL36150		HLL36150		

Main Brk 6A

Main Brk 6C

J-frame 250 A Thermal-magnetic (600 Vac) Factory Sealed Trip Unit Suitable for Reverse Connection ■▲

Current Rating @ 40° C	AC Magnetic Trip Setting		D Interrupting		G Interrupting		J Interrupting ▼		L Interrupting ▼		R Interrupting ▼		Terminal Wire Range
	Low	High	Catalogue Number ▲	Price	Catalogue Number ▲	Price	Catalogue Number ▲	Price	Catalogue Number ▲	Price	Catalogue Number ▲	Price	
2-pole, 600 Vac 50/60 Hz													
150	750	1500	JDL26150		JGL26150		JJL26150		JLL26150		–		AL175JD #4–4/0 AWG Al or Cu
175	875	1750	JDL26175		JGL26175		JJL26175		JLL26175		–		
200	1000	2000	JDL26200		JGL26200		JJL26200		JLL26200		–		AL250JD #3/0–350 kcmil Al or Cu
225	1125	2250	JDL26225		JGL26225		JJL26225		JLL26225		–		
250	1250	2500	JDL26250		JGL26250		JJL26250		JLL26250		–		
3-pole, 600 Vac 50/60 Hz													
150	750	1500	JDL36150		JGL36150		JJL36150		JLL36150		JRL36150		AL175JD #4–4/0 AWG Al or Cu
175	875	1750	JDL36175		JGL36175		JJL36175		JLL36175		JRL36175		
200	1000	2000	JDL36200		JGL36200		JJL36200		JLL36200		JRL36200		AL250JD #3/0–350 kcmil Al or Cu
225	1125	2250	JDL36225		JGL36225		JJL36225		JLL36225		JRL36225		
250	1250	2500	JDL36250		JGL36250		JJL36250		JLL36250		JRL36250		

■ See catalogue for circuit breakers with field interchangeable trip units.

▲ For 100% rated circuit breakers, add a "C" in the 9th character place (for example, HDL36015C or JDL26150C). 100% rated circuit breakers have copper lugs and can only be used with copper wire.

▼ Circuit breakers with J, L, and R interrupting ratings are CSA/UL certified as current limiting.

Interrupting Ratings (kA)

Voltage	D	G	J	L	R
240 V	25	65	100	125	200
480 V	18	35	65	100	200
600 V	14	18	25	50	100

Accessories - DE3-39
Dimensions - DE3-55
Enclosures - DE3-56

H- and J-frame Termination Options

- A-I-Line (see Section 5)
- F = No Lugs (includes terminal nut kit)
- L = Lugs both ends
- M = Lugs "ON" end Terminal Nut Kit "Off" end
- P = Lugs "OFF" end Terminal Nut Kit "On" end
- N = Plug-in♦
- D = Drawout♦
- S = Rear Connected ♦

♦ For N,D, and S details see page DE3-45, DE3-41

Plug-in

Drawout

Rear Connected

I-Line®

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 11 Aug, 2016
W P 06/12
REVIEWED by _GW_

Schneider Electric

Moulded Case Circuit Breakers

Enclosures—Accessories, Dimensions

Accessories
Insulated Groundable Neutral Assembly

Circuit Breaker		Neutral Assembly For Use With						Terminal Lug Data—Total Available (Line plus Load) AWG/kcmil
Cat. No. Prefix	Ampere Rating	NEMA 1 & 3R		NEMA 4, 4X, 5, 12 & 12K		NEMA 7 & 9		
		Cat. No.	Price	Cat. No.	Price	Cat. No.	Price	
FAL, FHL, FCL FAL, FHL, FIL	100 100	SN100FA —		SN100FA —		— 100SNA		(4) 14–1/0 Cu or (4) 12–1/0 Al FA060X/Y—(1) 14– 6 Cu, plus (1) 14–4 Cu FA100X/Y—(1) 14– 3 Cu, plus (1) 14–4 Cu
HDL,HGL,HJL,HLL	15–100	SN100FA		SN100FA		—		(4) 14–1/0 Cu or (4) 12–1/0 Al
HDL,HGL,HJL,HLL	125-150	SN400LA		SN400LA		—		(2) 1–600 or (4) 1–250 Al/Cu, plus (2) 4–300 Al/Cu
JDL,JGL,JJL,JLL	150–250	SN400LA		SN400LA		—		(2) 1–600 or (4) 1–250 Al/Cu, plus (2) 4–300 Al/Cu
KAL, KHL	225	SN225KA		—		—		(2) 4–300 Al/Cu, plus (2) 14–1/0 Al/Cu
KAL, KHL, KIL, KCL	225	—		SN225KA		—		(2) 4–300 Al/Cu, plus (2) 14–1/0 Al/Cu
KAL, KHL	225	—		—		225SNA		(4) 6–300 Cu
KAL, KHL, KIL, KCL	250	—		SN400LA		—		(2) 1–600 or (4) 1–250 Al/Cu, plus (2) 4–300 Al/Cu
LAL, LHL, Q4L LAL, LHL, Q4L, LCL, LIL LXL, LXIL	400 400	400SN —		— SN400LA		— —		(2) 1–600 or (4) 1–250 Al/Cu, plus (2) 4–300 Al/Cu (2) 1–600 or (4) 1–250 Al/Cu, plus (2) 4–300 Al/Cu
LCL, LIL, LXL ■, LXIL ■	400	—		SNC400LX ◆		—		(2) 2–600 Cu, plus (2) 6–250 Cu
LCL, LXL LIL, LXIL, LEL	600	—		SNC800LX ◆		—		(4) 2–600 Cu, plus (1) 2–4/0 Cu
MG, MJ ▼	300–800 A	AL800SN		AL800SN		AL800SN		(6) 3/0–500 Al/Cu, plus (2) 6–250 Al/Cu
PG, PJ, PL ❑	600–1200 A	SN1200		SN1200		—		(8) 750 Max. Al/Cu, plus (2) 350 Max. Al/Cu

◆ All Cu neutral assembly.
▼ For 200% neutral applications order Jumper kit SN800SNI and 2 of kit SN1200.
❑ For applications with integral ground fault protection order Neutral Mounting Kit S33576MK and Neutral CT on page DE3-34.

Equipment Ground Kits

Circuit Breaker Cat. No. Prefix	Ground Bar Cat. No.	Number of Terminals	Conductors Per Terminal	Wire Range AWG/kcmil	Price
QBL, QDL, QGL, QJL FAL, FHL, FCL, FIL, KAL, KHL, KCL, KIL, LAL, LHL, Q4L	PK0GTA2	2	1	10–2/0 Cu or 6–2/0 Al	
HDL,HGL,HJL,HLL,JDL,JGL,JJL,JLL	PKOGTJ250	2	1	6–300 Al/Cu	
LCL, LEL, LIL, LXL, LXIL MG, MJ PG, PJ, PL	PK0GTA4	4	1	6–250 Al or Cu	

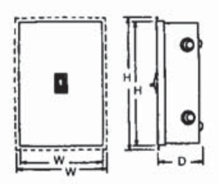
Dimensions (inches)

Cat. No.	Approximate Dimension						
	Series	H		W		D	
		in.	mm	in.	mm	in.	mm
FA060X◊	E1	16.00	406	9.88	251	7.00	178
FA060Y◊	E1	16.00	406	9.88	251	7.00	178
FA100AWK	E2	19.50	495	9.13	232	4.88	124
FA100DS	E2	19.50	495	9.13	232	4.88	124
FA100F	E2	19.50	495	9.88	251	4.13	105
FA100RB	E2	18.00	457	8.88	226	4.88	124
FA100S	E2	18.13	461	8.63	219	4.13	105
FA100X◊	E1	16.00	406	9.88	251	7.00	178
FA100Y◊	E1	16.00	406	9.88	251	7.00	178
IK250AWK	E2	42.25	1073	13.88	353	7.50	191
IK250DS	E2	42.25	1073	13.88	353	7.50	191
J250F	A01	32.40	823	15.40	391	6.00	152
J250S	A01	31.36	797	14.36	365	6.00	152
J250R	A01	31.05	789	14.47	368	6.28	160
J250DS	A01	32.26	819	9.72	247	7.94	202
J250AWK	A01	32.26	819	9.72	247	7.94	202
KA225AWK	E2	25.25	641	9.50	241	5.38	137
KA225DS	E2	25.25	641	9.50	241	5.38	137
KA225F	E2	29.88	759	13.75	349	5.38	137
KA225RB	E2	28.38	721	12.50	318	6.13	156
KA225S	E2	28.50	724	12.38	314	5.38	137

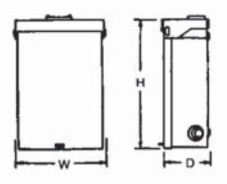
Dimensions (inches)

Cat. No.	Approximate Dimension						
	Series	H		W		D	
		in.	mm	in.	mm	in.	mm
KA225X ◆	C2	22.63	575	10.88	276	7.75	197
KA225Y ◆	A2	21.88	556	11.00	279	7.50	191
KA250SWB	E2	20.00	508	19.00	483	5.63	143
KA250RWB	E2	20.25	514	19.00	483	7.12	181
LA400AWK	E2	42.25	1073	13.75	349	7.25	184
LA400DS	E2	42.25	1073	13.75	349	7.25	184
LA400F	E2	45.63	1159	16.50	419	6.50	165
LA400R	E2	44.00	1118	15.38	391	7.88	200
LA400S	E2	44.50	1130	15.38	391	6.50	165
LX600AWK	E3	57.50	1461	20.38	518	8.25	210
M800S	A1	40-3/8	1025.52	21	533.4	9-3/4	247.65
M800R	A1	40-3/8	1025.52	21	533.4	9-3/4	247.65
M800DS	A1	40-7/8	1036.96	20-3/4	527.05	9-1/2	241.3
M800AWK	A1	40-7/8	1036.96	20-3/4	527.05	9-1/2	241.3
P1200S	A1	52-1/8	1323.98	21	533.4	9-3/4	247.65
P1200R	A1	52-1/8	1323.98	21	533.4	9-3/4	247.65
P1200AWK	A1	53	1346.20	20-3/4	527.05	9-1/2	241.3
Q22200NRB	E3	23.38	594	7.63	194	4.75	121
Q22200NS	E3	23.13	588	7.63	194	4.25	108
Q23225NF	E3	26.25	667	9.88	251	4.75	121
Q23225NRB	E3	26.25	667	9.88	251	5.50	140
Q23225NS	E3	26.25	667	9.88	251	4.75	121

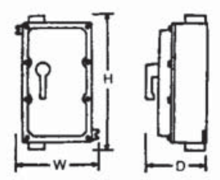
◆ Tapped conduit opening, top and bottom endwall: FA060X/Y–3⁄4", FA100X/Y–1-1⁄4", KA225X/Y–2-1⁄2".



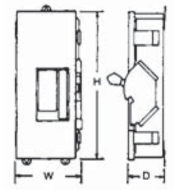
Type 1
Q2, FA, J, KA, LA, MG, PG



Type 3r
Q2, FA, J, KA, LA, MG, PG



Type 7, Type 9
FA, KA



Type 4, 4X, 5, 12, 12K
Ik, FA, J, KA, LA, LX, MG, PG

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 11 Aug, 2016
REVIEWED by _GW_

Enclosures

FA100S

FA100RB

KA225DS

Circuit breaker enclosures are UL Listed, CSA Certified and are suitable for use as service entrance equipment. The short circuit current rating of an enclosed circuit breaker is equal to the interrupting rating at the supply voltage marked on the circuit breaker installed. Exceptions and restrictions are footnoted. Breakers are ordered and shipped separately for field installation. For ground bars and neutral assemblies, refer to page DE3-32.

Circuit Breaker			Type 1 Flush		Type 1 Surface		Type 3R▲	
Catalogue Number Prefix	Ampere Rating	Number of Poles	Enclosure Catalogue No.	Price	Enclosure Catalogue No.	Price	Enclosure Catalogue No.	Price
FAL, FHL, FCL	15-100	1, 2, 3	FA100F		FA100S		FA100RB	
QBL, QDL, QGL, QJL	100-225	2, 3	Q23225NFC†		Q23225NSC†		Q23225NRBC†	
HDL,HGL,HJL, HLL✖	15-150		J250F		J250S		J250R	6C
JDL, JGL, JJL, JLL✖	150-250							
KAL, KHL, FCL, FAL, FHL	70-225	2, 3	KA225F		KA225S		KA225RB	
LAL, LHL, Q4L KAL, KHL	125-400	2, 3	LA400F		LA400S		LA400R	
MG, MJ, PG, PJ, PL	300-800	2, 3			M800S		M800R	
PG, PJ, PL	600-1200	2, 3			P1200S		P1200R	

▲ Enclosures with NRB or RB suffix have provisions for 3≠4" through 21≠2" bolt-on hubs in top endwall. Enclosures with R suffix have blank endwalls and require field cut opening.

† Factory installed groundable neutral assembly includes (2) ground lugs and (2) neutral lugs. Equipment ground kit is also included.

Circuit Breaker			Type 4, 4X, 5 Stainless Steel		Without Knockouts✷ (Type 12/3R)	
Catalogue Number Prefix	Ampere Rating	Number of Poles	Enclosure Catalogue No.	Price	Catalogue No.	Price
FAL, FHL, FCL	15-100	1, 2, 3	FA100DS		FA100AWK	
KAL, KHL▲, FIL■	20-225	2, 3	KA225DS		KA225AWK	
HDL,HGL,HJL, HLL✖	15-150		J250DS		J250AWK	6A
JDL, JGL, JJL, JLL✖	150-250					
KIL■, KCL, KAL, KHL	110-250		IK250DS		IK250AWK	
LAL, LHL, Q4L	125-400		LA400DS		LA400AWK	
LEL✦, LXL, LXIL	100-600	3			LX600AWK	
LCL, LIL	300-600	2, 3			LX600AWK	
MG, MJ, PG, PJ, PL	300-800		M800DS		M800AWK	
PG, PJ, PL	600-1200				P1200AWK	

✷ Suitable for rainproof Type 3R application by removing drain screw from bottom endwall.

▲ Wire bending space provided for 250 kcmil (Al/Cu) 75˚C conductors maximum.

✦ LEL 100% rated circuit breaker except for 600 Amp frame.

■ Short circuit rating is 100,000 AIR at 480Vac maximum.

✖ HLL & JLL breakers in the J250 enclosures are rated for 240Vac only.

FA100X

FA100Y

Circuit Breaker			Type 7✷ Cast Aluminum		Type 9■ Cast Aluminum	
Catalogue Number Prefix	Ampere Rating	Number of Poles	Enclosure Catalogue No.	Price	Enclosure Catalogue No.	Price
FAL, FHL▲	15-60	1, 2, 3	FA060X▼		FA060Y①	
	15-100	1, 2, 3	FA100X▼		FA100Y①	

✷ NEMA Type 7 – Indoor Hazardous Locations – Class I, Groups C and/or D, Divisions 1 or 2.

■ NEMA Type 9 – Indoor Hazardous Locations – Class II, Groups E and/or G, Class III, Divisions 1 or 2.

▼ Suitable for rainproof applications–includes PKDB-1 breather and drain kit.

▲ Use 75˚C Cu conductors only.

① Not CSA certified

Note: Circuit breaker enclosures not to be used with MAG-GARD breakers.

Accessories - DE3-28
Dimensions - DE3-28

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS

PROJECT: **SSES Standby Power**
WPE# **C847**
Date: **11 Aug, 2016**

REVIEWED by _GW_

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
☒ APPROVAL
☒ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☒ INFORMATION
☒ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: May 10, 2017
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 056

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – EGD Standby Generation PSS Configuration**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**Q2C:39022265-001 rev 1.0 (34pg)**	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 29 23.02 item 1.3

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

Schneider Canada Services & Projects

Document Ref: 1.0

Esquimalt Graving Dock: Standby Generation SCADA Integration

Q2C: 39022265-001

Date: 08/05/2017

Revision: 1.0

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS

PROJECT: SSES Standby Power

WPE# C847

Date: May 10, 2017

REVIEWED by _GW_

W P

Branch office:
Schneider Electric Canada, Inc.
Energy Management and Sustainability Services
2195 Keating Cross Road
Canada V8M 2A5
Tel: 250-652-7100

Main office:
Schneider Electric Canada, Inc.
5985 McLaughlin Road
Mississauga, ON L5R 1B8
Tel: 1-800-565-6699
www.schneider-electric.com

Revision no.	Date	Comments
1.0	May 8, 2017	Initial document

Table of Contents

Table of Figures

1 Introduction

Schneider Electric Canada Inc., sub-contracted through WPE, integrated new equipment, listed below, for data acquisition and monitoring of newly installed standby generation and TSC systems into the existing PSS located at the EGD PWGSC site.

The following equipment was directly integrated of the standby generation system

(4) PowerLogic ION7650 Power Quality Meters

(1) PM8000 Energy Meter

(4) SEL 700G protection relays

(4) Kohler DM550 Generator Controllers

(1) Prosoft TCS PLC

Note: No materials were ordered or installed by Schneider Electric Canada under this project.

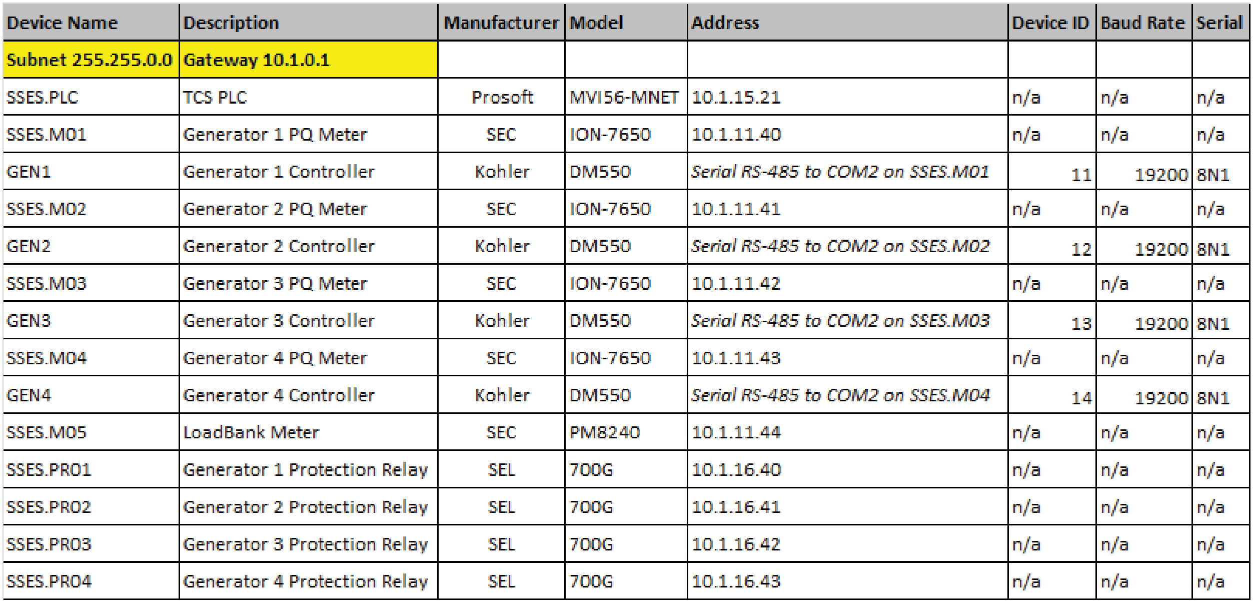
Single line, load bank, TCS PLC, and protection relay pop-ups were created/updated to display relevant data and alarm points.

The PSS is not providing any automatic control functionality under the SOW for this project.

The PSS is directly polling Modbus data points from the Prosoft TCS PLC, ION7650 PQ meters, P8240 and Kohler generator controllers to displace. Generator running status, alarms, and miscellaneous measurements pertaining to breaker and utility status are all rendered in the PSS HMI. Functionality of the PSS and integrated devices pertaining to this project are explained in the sections below.

1.1 Device List

The figure below lists all of the devices that have been integrated into the PSS system under this current project



Device Name	Description	Manufacturer	Model	Address	Device ID	Baud Rate	Serial
Subnet 255.255.0.0	Gateway 10.1.0.1						
SSES.PLC	TCS PLC	Prosoft	MVI56-MNET	10.1.15.21	n/a	n/a	n/a
SSES.M01	Generator 1 PQ Meter	SEC	ION-7650	10.1.11.40	n/a	n/a	n/a
GEN1	Generator 1 Controller	Kohler	DM550	*Serial RS-485 to COM2 on SSES.M01*	11	19200	8N1
SSES.M02	Generator 2 PQ Meter	SEC	ION-7650	10.1.11.41	n/a	n/a	n/a
GEN2	Generator 2 Controller	Kohler	DM550	*Serial RS-485 to COM2 on SSES.M02*	12	19200	8N1
SSES.M03	Generator 3 PQ Meter	SEC	ION-7650	10.1.11.42	n/a	n/a	n/a
GEN3	Generator 3 Controller	Kohler	DM550	*Serial RS-485 to COM2 on SSES.M03*	13	19200	8N1
SSES.M04	Generator 4 PQ Meter	SEC	ION-7650	10.1.11.43	n/a	n/a	n/a
GEN4	Generator 4 Controller	Kohler	DM550	*Serial RS-485 to COM2 on SSES.M04*	14	19200	8N1
SSES.M05	LoadBank Meter	SEC	PM8240	10.1.11.44	n/a	n/a	n/a
SSES.PR01	Generator 1 Protection Relay	SEL	700G	10.1.16.40	n/a	n/a	n/a
SSES.PR02	Generator 2 Protection Relay	SEL	700G	10.1.16.41	n/a	n/a	n/a
SSES.PR03	Generator 3 Protection Relay	SEL	700G	10.1.16.42	n/a	n/a	n/a
SSES.PR04	Generator 4 Protection Relay	SEL	700G	10.1.16.43	n/a	n/a	n/a

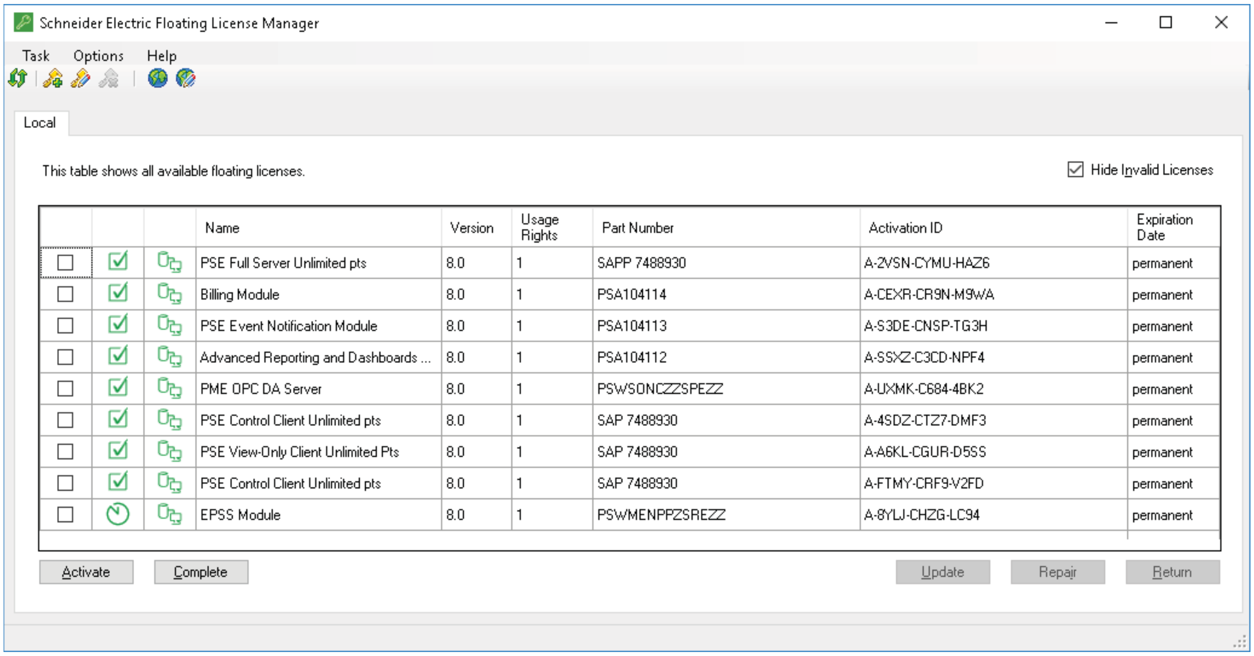
Figure 1: Project device list

1.2 Software and licenses

The existing PSS consists of (2) Schneider Electric StruxureWare applications which are seamlessly integrated:

Power Monitoring Expert 8.1 and Power SCADA Expert 8.1

The EPSS reporting module license was supplied and activated.



This table shows all available floating licenses.

☑ Hide Invalid Licenses

			Name	Version	Usage Rights	Part Number	Activation ID	Expiration Date
☐	☑	⧉	PSE Full Server Unlimited pts	8.0	1	SAPP 7488930	A-2VSN-CYMU-HAZ6	permanent
☐	☑	⧉	Billing Module	8.0	1	PSA104114	A-CEXR-CR9N-M9WA	permanent
☐	☑	⧉	PSE Event Notification Module	8.0	1	PSA104113	A-S3DE-CNSP-TG3H	permanent
☐	☑	⧉	Advanced Reporting and Dashboards ...	8.0	1	PSA104112	A-SSXZ-C3CD-NPF4	permanent
☐	☑	⧉	PME OPC DA Server	8.0	1	PSWSONCZZSPEZZ	A-UXMK-C684-4BK2	permanent
☐	☑	⧉	PSE Control Client Unlimited pts	8.0	1	SAP 7488930	A-4SDZ-CTZ7-DMF3	permanent
☐	☑	⧉	PSE View-Only Client Unlimited Pts	8.0	1	SAP 7488930	A-A6KL-CGUR-D5SS	permanent
☐	☑	⧉	PSE Control Client Unlimited pts	8.0	1	SAP 7488930	A-FTMY-CRF9-V2FD	permanent
☐	◷	⧉	EPSS Module	8.0	1	PSWMENPPZSREZZ	A-8YLJ-CHZG-LC94	permanent

Figure 2: PSS software licenses

The EPSS reporting module enables users to generate test reports for verifying that the generators are operating within normal specification when there is a scheduled test run.

2 Device frameworks

Custom frameworks were programmed and uploaded into the PowerLogic ION7650 and PM8240 devices installed. The below sections describe only the customizations to the frameworks. Please refer to the devices user manuals for information regarding the default meter functionality.

2.1 ION7650 frameworks

The ION7650 device’s native proprietary protocol is ION which allows access to all datapoints available in the device include complex data types such waveform data and historical trends. The ION7650 also supports Modbus TCP protocol and the register configuration is completely customizable to enable access to select datapoints in the device. The sub-sections below indicate the customizations to the default meter frameworks.

No control functionality has been configured in the ION7650s as all control is managed by the TCS.

2.1.1 Common Basic Meter configuration

The table below lists Basic Meter settings configured:

Table 1: Generator 1-4 device basic device settings

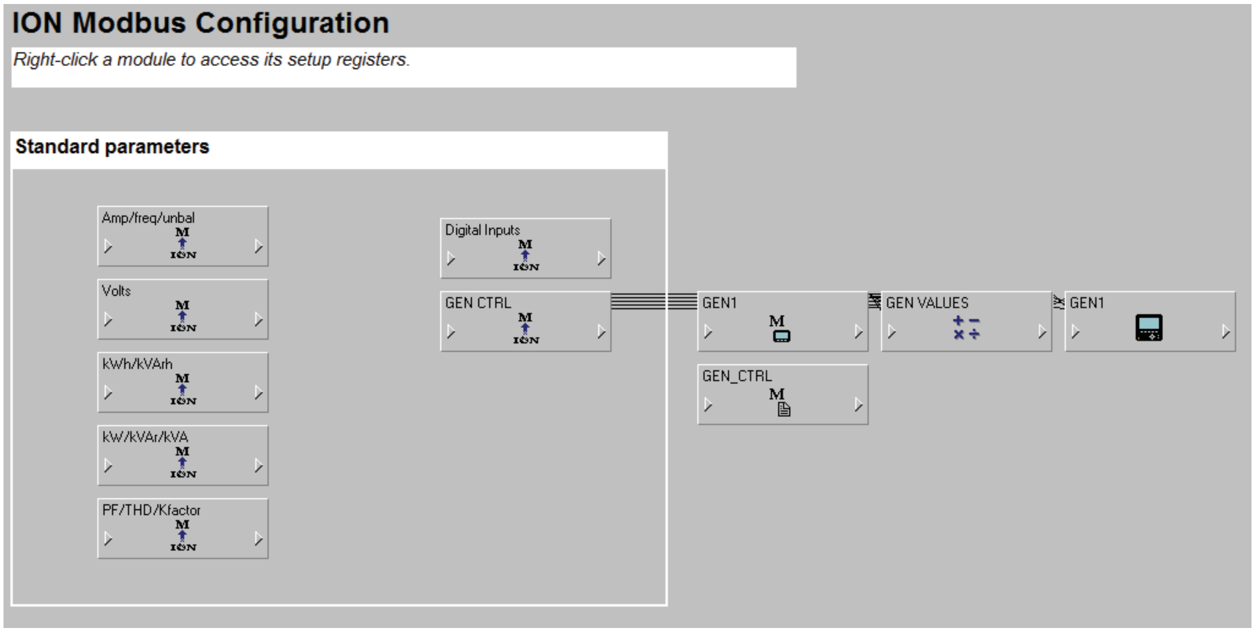
Volts Mode: 4-Wire Wye	
PT Primary: 600	PT Secondary: 120
CT Primary: 1000	CT Secondary: 5
I4 CT Primary: 500	I4 CT Secondary: 5
Sag/Swell: DISABLED	

2.1.2 Common Modbus Master configuration

COM2 on the ION7650 devices are configured as the Modbus Master port to poll data from the Kohler generation controllers. The Modbus register map for the generator controller was supplied by Frontier and programmed into the ION7650s:

Table 2: Kohler DM550 registers polled by ION7650s

Label	Address	Format	Scaling
Coolant Temp F	40034	SINT16	S1
Engine RPM	40035	UINT16	S1
Battery V DC	40036	UINT16	S10
Fuel Vol %	40065	UINT16	S1



ION Modbus Configuration

Right-click a module to access its setup registers.

Figure 3: ION7650 Modbus Framework view in Designer

Total Fuel Volume is not read directly from the controller. It is being calculated using the total volume capacity of the fuel tank (10824 L) and factoring that with the fuel volume % read from the controller. Total Fuel Volume is then being written to the Thomson TCS in order to calculate estimated fuel run times.

A custom display screen was create on each ION7650 to display the generator breaker status and above data points read. In turn the Kohler controller values including the calculating total fuel volume values are mapped internally to the ION7650.

2.1.3 Common Modbus Slave

The table below lists the Modbus Registers that have been configured for the ION7650 devices:

Table 3: Modbus register map

Parameter	Address	Regs	Format	Scaling	InZero	InFull	OutZero	OutFull
I a	40150	1	UINT16	10	0	6000	0	60000
I b	40151	1	UINT16	10	0	6000	0	60000
I c	40152	1	UINT16	10	0	6000	0	60000
I 4	40153	1	UINT16	10	0	6000	0	60000
I 5	40154	1	UINT16	10	0	6000	0	60000
I avg	40155	1	UINT16	10	0	6000	0	60000
I avg mn	40156	1	UINT16	10	0	6000	0	60000
I avg mx	40157	1	UINT16	10	0	6000	0	60000
I avg mean	40158	1	UINT16	10	0	6000	0	60000
Freq	40159	1	UINT16	10	0	6000	0	60000
Freq mn	40160	1	UINT16	10	0	6000	0	60000
Freq mx	40161	1	UINT16	10	0	6000	0	60000
Freq mean	40162	1	UINT16	10	0	6000	0	60000
V unbal	40163	1	UINT16	10	0	6000	0	60000
I unbal	40164	1	UINT16	10	0	6000	0	60000
Phase Rev	40165	1	UINT16	10	0	6000	0	60000
Vln a	40166	2	UINT32	1	0	1000000	0	10000000
Vln b	40168	2	UINT32	1	0	1000000	0	10000000
Vln c	40170	2	UINT32	1	0	1000000	0	10000000
Vln avg	40172	2	UINT32	1	0	1000000	0	10000000
Vll ab	40178	2	UINT32	1	0	1000000	0	10000000
Vll bc	40180	2	UINT32	1	0	1000000	0	10000000
Vll ca	40182	2	UINT32	1	0	1000000	0	10000000
Vll avg	40184	2	UINT32	1	0	1000000	0	10000000
Vll avg mean	40188	2	UINT32	1	0	1000000	0	10000000
kW a	40198	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW b	40200	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW c	40202	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW tot	40204	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW sd del	40206	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR a	40208	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR b	40210	2	INT32	1	-1000000000	1000000000	-1000000	1000000

kVAR c	40212	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR tot	40214	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR sd del-rec	40216	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA a	40218	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA b	40220	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA c	40222	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA tot	40224	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA sd del+rec	40226	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kWh del	40230	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kWh rec	40232	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVARh del	40234	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVARh rec	40236	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAh del+rec	40238	2	INT32	1	-1000000000	1000000000	-1000000	1000000
PF sign a	40262	1	INT16	100	-100	100	-10000	10000
PF sign b	40263	1	INT16	100	-100	100	-10000	10000
PF sign c	40264	1	INT16	100	-100	100	-10000	10000
PF sign tot	40265	1	INT16	100	-100	100	-10000	10000
V1 THD mx	40266	1	INT16	100	-100	100	-10000	10000
V2 THD mx	40267	1	INT16	100	-100	100	-10000	10000
V3 THD mx	40268	1	INT16	100	-100	100	-10000	10000
I1 THD mx	40269	1	INT16	100	-100	100	-10000	10000
I2 THD mx	40270	1	INT16	100	-100	100	-10000	10000
I3 THD mx	40271	1	INT16	100	-100	100	-10000	10000
DI-S1 State	41001	1	UINT16	1	0	1	0	1
DI-S2 State	41002	1	UINT16	1	0	1	0	1
DI-S3 State	41003	1	UINT16	1	0	1	0	1
DI-S4 State	41004	1	UINT16	1	0	1	0	1
DI-S5 State	41005	1	UINT16	1	0	1	0	1
DI-S6 State	41006	1	UINT16	1	0	1	0	1
DI-S7 State	41007	1	UINT16	1	0	1	0	1
DI-S8 State	41008	1	UINT16	1	0	1	0	1
Fuel Vol %	41051	1	UINT16	1	0	1	0	1
Engine RPM	41052	1	UINT16	1	0	1	0	1
Battery V DC	41053	1	UINT16	1	0	1	0	1
Coolant Temp F	41054	1	UINT16	1	0	1	0	1
Fuel Vol L	41055	1	UINT16	1	0	1	0	1

The digital input signals varies for each device. The table below references that actual input (label) of the digital input mapped to the DI-x state register.

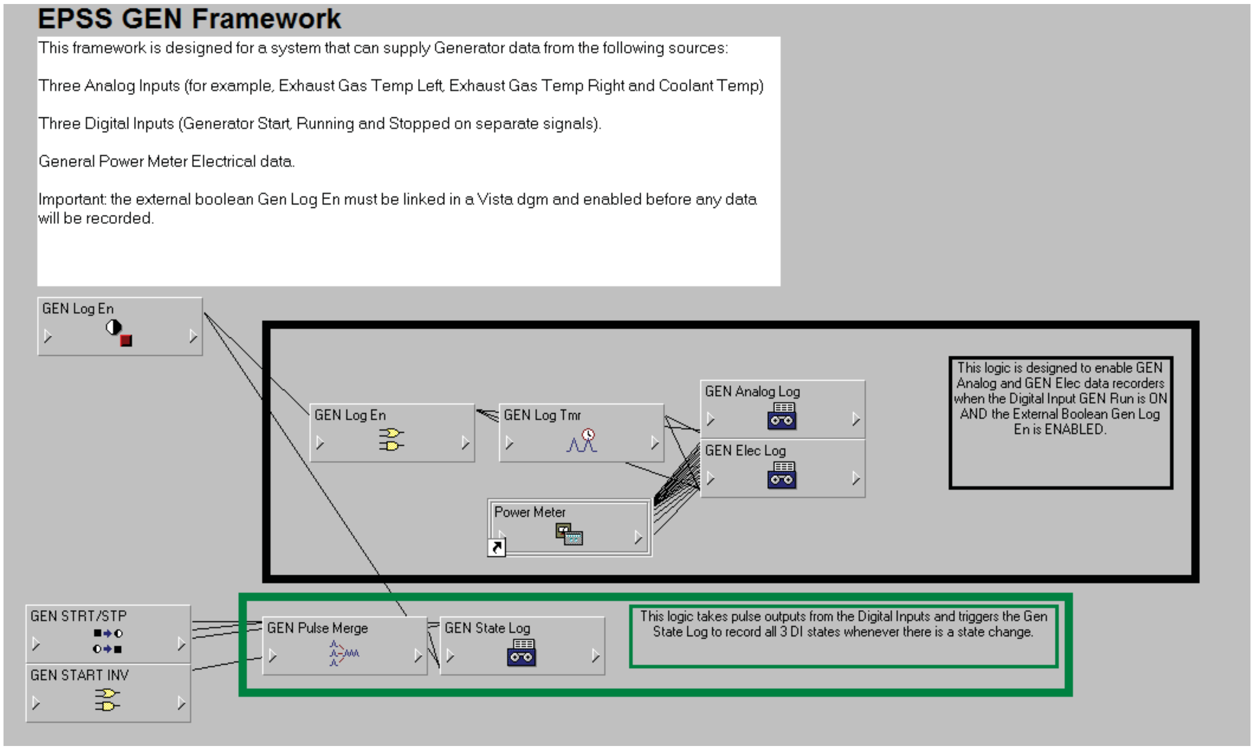
Table 4: Digital Input label mapping for each respective device.

	SSES.M01	**SSES.M02**	**SSES.M03**	**SSES.M04**
DI-S1 State	GEN BRK	GEN BRK	GEN BRK	GEN BRK
DI-S2 State	GEN RUNNING	GEN RUNNING	GEN RUNNING	GEN RUNNING
DI-S3 State	DND UTIL BRK	DI-S3 State	DI-S3 State	DI-S3 State
DI-S4 State	BCH1 UTIL BRK	DI-S4 State	DI-S4 State	DI-S4 State
DI-S5 State	BCH2 UTIL BRK	DI-S5 State	DI-S5 State	DI-S5 State
DI-S6 State	GEN1 MAIN BRK	DI-S6 State	DI-S6 State	DI-S6 State
DI-S7 State	TIE BRK	DI-S7 State	DI-S7 State	DI-S7 State
DI-S8 State	GEN START	GEN START	GEN START	GEN START

2.1.4 EPSS Framework

This framework is used by the EPSS Test reporting module as it records key data points when the generators are in used. The framework has been enabled on only the meters monitoring generators (disabled on meter SSES.M04 as there is not generator 4).

When the generator start trigger is initiated the framework will start logging all per phase RMS voltage, current , power, power factor, generator miscellaneous measurements and generator run status points.



EPSS GEN Framework

This framework is designed for a system that can supply Generator data from the following sources:

Three Analog Inputs (for example, Exhaust Gas Temp Left, Exhaust Gas Temp Right and Coolant Temp)

Three Digital Inputs (Generator Start, Running and Stopped on separate signals).

General Power Meter Electrical data.

Important: the external boolean Gen Log En must be linked in a Vista dgm and enabled before any data will be recorded.

This logic is designed to enable GEN Analog and GEN Elec data recorders when the Digital Input GEN Run is ON AND the External Boolean Gen Log En is ENABLED.

This logic takes pulse outputs from the Digital Inputs and triggers the Gen State Log to record all 3 DI states whenever there is a state change.

Figure 4: ION7650 EPSS framework

The start/stop signal is only a single input wired into the ION7650. As per information supplied by TTI an ON status on the Start input triggers a start, and an OFF state triggers a stop. The input will remain in that position when in either a start/running and stop state.

2.1.5 Analog output

The TCS PLC is monitoring the generator power output via the 4-20mA analog output port A01 on each respective ION7650. Scaling is configured as follows to correspond with the PLC configuration.

0 mA =-255kW

20 mA = 900kW

A 4mA signal will indicate 0 kW.

2.2 PM8240 framework

The (1) PM8240 integrated in this project is used to monitor the load bank power draw and output the kW via a 4-20mA analog signal to the TCS PLC.

The under/over voltage function on this device has been disabled to prevent nuisance PQ disturbance alarms. The 600V bus will only become energized when the generator(s) is running and generator breaker(s) are closed.

No additional provisions have been wired to this device.

2.2.1 Common Basic Meter configuration

The table below lists Basic Meter settings configured:

Table 5: Generator 1-4 device basic device settings

Volts Mode: Delta	
PT Primary: 600	PT Secondary: 600
CT Primary: 1200	CT Secondary: 5
Sag/Swell: DISABLED	

2.2.2 Modbus Slave configuration

Table 6: Modbus Register Map configuration

Parameter	Address	Regs	Format	Scaling	InZero	InFull	OutZero	OutFull
I a	150	1	UINT16	10	0	6000	0	60000
I b	151	1	UINT16	10	0	6000	0	60000
I c	152	1	UINT16	10	0	6000	0	60000
I 4	153	1	UINT16	10	0	6000	0	60000
I 5	154	1	UINT16	10	0	6000	0	60000
I avg	155	1	UINT16	10	0	6000	0	60000
I avg mn	156	1	UINT16	10	0	6000	0	60000

I avg mx	157	1	UINT16	10	0	6000	0	60000
I avg avg	158	1	UINT16	10	0	6000	0	60000
Freq	159	1	UINT16	10	0	6000	0	60000
Freq mn	160	1	UINT16	10	0	6000	0	60000
Freq mx	161	1	UINT16	10	0	6000	0	60000
Freg avg	162	1	UINT16	10	0	6000	0	60000
V unbal	163	1	UINT16	10	0	6000	0	60000
I unbal	164	1	UINT16	10	0	6000	0	60000
Phase Rev	165	1	UINT16	10	0	6000	0	60000
Vln a	166	2	UINT32	1	0	1000000	0	10000000
Vln b	168	2	UINT32	1	0	1000000	0	10000000
Vln c	170	2	UINT32	1	0	1000000	0	10000000
Vln avg	172	2	UINT32	1	0	1000000	0	10000000
Vll avg avg	174	2	UINT32	1	0	1000000	0	10000000
Vll ab	178	2	UINT32	1	0	1000000	0	10000000
Vll bc	180	2	UINT32	1	0	1000000	0	10000000
Vll ca	182	2	UINT32	1	0	1000000	0	10000000
Vll avg	184	2	UINT32	1	0	1000000	0	10000000
Vll avg avg	186	2	UINT32	1	0	1000000	0	10000000
I avg sd	188	2	UINT32	1	0	1000000	0	10000000
kW a	198	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW b	200	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW c	202	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW tot	204	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kW sd del	206	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR a	208	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR b	210	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR c	212	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR tot	214	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAR sd del-rec	216	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA a	218	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA b	220	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA c	222	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA tot	224	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVA sd del+rec	226	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kWh del	230	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kWh rec	232	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVARh del	234	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVARh rec	236	2	INT32	1	-1000000000	1000000000	-1000000	1000000
kVAh del+rec	238	2	INT32	1	-1000000000	1000000000	-1000000	1000000
PF sign a	262	1	INT16	100	-100	100	-10000	10000
PF sign b	263	1	INT16	100	-100	100	-10000	10000
PF sign c	264	1	INT16	100	-100	100	-10000	10000

PF sign tot	265	1	INT16	100	-100	100	-10000	10000
V1 THD mx	266	1	INT16	100	-100	100	-10000	10000
V2 THD mx	267	1	INT16	100	-100	100	-10000	10000
V3 THD mx	268	1	INT16	100	-100	100	-10000	10000
I1 THD mx	269	1	INT16	100	-100	100	-10000	10000
I2 THD mx	270	1	INT16	100	-100	100	-10000	10000
I3 THD mx	271	1	INT16	100	-100	100	-10000	10000
S1 State	1001	1	UINT16	1	0	1	0	1
S2 State	1002	1	UINT16	1	0	1	0	1
Port S3	1003	1	UINT16	1	0	1	0	1
A S1 State	1004	1	UINT16	1	0	1	0	1
A S2 State	1005	1	UINT16	1	0	1	0	1
A S3 State	1006	1	UINT16	1	0	1	0	1
A S4 State	1007	1	UINT16	1	0	1	0	1
A S5 State	1008	1	UINT16	1	0	1	0	1

2.2.3 Analog output

The TCS PLC is monitoring the load bank power draw via the 4-20mA analog output port AQ1 from device SSES.M05. Scaling is configured as follows to correspond with the PLC configuration.

0 mA =-250kW

20 mA = 1000kW

A 4mA signal will indicate 0 kW.

3 SCADA device drivers

Device Profiles are used by PSE to poll specific “tags” from devices that are integrated into the SCADA system. Profiles have been created for the following device types:

- ION7650_Modbus
- PM8240_Modbus
- SEL700G
- Prosoft TCS PLC

PSE will read all the tags defined in the device profiles using either the default or custom scan time intervals.

Scan times are configured using the default setting of 500msec.

The function code column refers to the configuration PSE uses to read the specific Modbus register. The function defines the register, register address, bit mask, number of registers to read, scaling, priority, and signed/unsigned read or write register type for example.

Refer to the PSE system’s integrator’s manual for more information regarding device profiles and function codes. Below is an example of a function code used to read a tag from a Modbus register.

T:MV;m:155:u1;N:-1;E:2;L:P:33

- Type : Measured Value
- Holding register: Register address: number of registers
- Register scaling
- Polling priority level
- Singed scaled register

Minimalist Modbus driver were created for the ION7650 and PM8240 devices as to only display relevant breaker and realtime data points on the SCADA HMI. The backend reporting system, PME, uses the native ION protocol to perform all historical data acquisition and access instantaneous data *on-demand* when required.

Recall that the PME is the Advanced Reporting and Dashboard module for the PSS solution. Metering data from only the ION7650s and PM8240 is being logged. These device types are native to the PME application and therefore no custom device drivers are required.

As mentioned earlier custom device profiles are specifically configured in order to poll relevant register tags from devices integrated into PSE.

Separate device profiles were created for the generator equipment from the main TCS PLC. Each separate device can have alarms and event associated with the device profile added to PSE.

Therefore by creating individual profiles for the generators, the SCADA system can differential alarms more easily rather than using complex filters. The generators pop-ups in the HMI are accessing individual device profiles.

All of the utility, load bank, and generator data is originating from the TCS PLC. As explained above, select registers were configured for the generator profiles.

Table 7: PSE device profile summary

Full Equipment Device Name	Profile Description	Address
EGD.SSES.PLC	TCS PLC	10.1.15.21
HMI		10.1.15.22
EGD.SSES.M01	Generator 1 PQ Meter	10.1.11.40
EGD.SSES.GENERATOR1	Generator 1	10.1.15.21
EGD.SSES.M02	Generator 2 PQ Meter	10.1.11.41
EGD.SSES.GENERATOR2	Generator 2	10.1.15.21
EGD.SSES.M03	Generator 3 PQ Meter	10.1.11.42
EGD.SSES.GENERATOR3	Generator 3	10.1.15.21
EGD.SSES.M04	Generator 4 PQ Meter	10.1.11.43
EGD.SSES.M05	LoadBank Meter	10.1.11.44
EGD.SSES.PR01	Generator 1 Protection Relay	10.1.16.40
EGD.SSES.PR02	Generator 2 Protection Relay	10.1.16.41
EGD.SSES.PR03	Generator 3 Protection Relay	10.1.16.42
EGD.SSES.PR04	Generator 4 Protection Relay	10.1.16.43

The table below lists the register tags configured in the PSS specifically for the ION7650 devices monitoring the generator breakers.

Table 8: PSE Generator PQ Meter (ION7650) device profile

Tag	Data Type	Function Code	Label
Gen_Fuel_Volume	REAL	T:MV;m:1051:u1;E:2;L:P:32	@(Generator Fuel Vol %)
Gen_Engine_Speed	REAL	T:MV;m:1052:u1;E:2;L:P:32	@(Generator Speed)
Gen_Battery_VDC	REAL	T:MV;m:1053:u1;E:2;L:P:32	@(Generator Battery Voltage)
Gen_Coolant_Temp	REAL	T:MV;m:1054:u1;E:2;L:P:32	@(Generator Coolant Temp)
MMXU1\A\zavg	REAL	T:MV;m:155:u1;N:-1;E:2;L:P:33	@(Current Avg)
MMXU1\Hz	REAL	T:MV;m:159:u1;N:-1;E:2;L:P:33	@(Frequency)
MMXU1\PPV\zavg	REAL	T:MV;m:184:u2;E:2;L:P:33	@(Voltage L-L Avg)
MMXU1\TotW	REAL	T:MV;m:204:u2;E:2;L:P:32	@(Active Power)
MSTA1\AvW	REAL	T:MV;m:206:u2;E:2;L:P:32	@(Demand Active Power)
MMXU1\TotVA	REAL	T:MV;m:224:u2;E:2;L:P:32	@(Apparent Power)
MSTA1\AvVA	REAL	T:MV;m:226:u2;E:2;L:P:32	@(Demand Apparent Power)
MMXU1\TotPF	REAL	T:MV;m:265:u1;N:-4;E:2;L:P:32	@(Power Factor)
GGIO1\Ind1	DIGITAL	T:SS;m:1001:1;E:2;L:P:28	@(Input 01 Status)
GGIO1\Ind2	DIGITAL	T:SS;m:1002:1;E:2;L:P:28	@(Input 02 Status)
GGIO1\Ind3	DIGITAL	T:SS;m:1003:1;E:2;L:P:28	@(Input 03 Status)
GGIO1\Ind4	DIGITAL	T:SS;m:1004:1;E:2;L:P:28	@(Input 04 Status)
GGIO1\Ind5	DIGITAL	T:SS;m:1005:1;E:2;L:P:28	@(Input 05 Status)
GGIO1\Ind6	DIGITAL	T:SS;m:1006:1;E:2;L:P:28	@(Input 06 Status)
GGIO1\Ind7	DIGITAL	T:SS;m:1007:1;E:2;L:P:28	@(Input 07 Status)
GGIO1\Ind8	DIGITAL	T:SS;m:1008:1;E:2;L:P:28	@(Input 08 Status)
Gen_Fuel_Volume_L	REAL	T:MV;m:1055:u1;E:2;L:P:32	@(Generator Fuel Vol L)

The table below lists the register tags configured in the PSS specifically for the PM2840 monitoring the load bank breakers.

Table 9: PSE PM240 device profile

Tag	Data Type	Function Code	Label
GGIO1\SPCSO1\ctlVal	DIGITAL	C:NO;T:SS;m:52034:1;E:1;L:P:101;T:SS;m:52034:1;E:1;L:P:101	@(Output 01 Operate)
MMXU1\A\zavg	REAL	T:MV;m:155:u1;N:-1;E:2;L:P:33	@(Current Avg)
MMXU1\PPV\zavg	REAL	T:MV;m:184:u2;E:2;L:P:33	@(Voltage L-L Avg)
MMXU1\TotW	REAL	T:MV;m:204:u2;E:2;L:P:32	@(Active Power)
MMXU1\TotPF	REAL	T:MV;m:265:u1;N:-4;E:2;L:P:32	@(Power Factor)

The majority of the datapoints for the Prosoft TCS PLC configured by Thomson System, as described in the document name “C-054107 Esquimalt - SeqOp_Rev1.pdf”, have been integrated into the PSS.

The table below lists the TCP PLC tags configured in the PSS. All of the TCS PLC tags are asscociate with a single device in the PLC.

Table 10: PSE PM240 device profile

Tag	**Function Code**	**Data Type**	**Label**
BCH1\Breaker_Closed	T:SS;m:201:10;E:2;L:P:28	DIGITAL	@(Utility BCH1 Breaker Closed)
BCH1\fail_time	T:MV;m:204:u1;E:2;L:P:33	REAL	@(Utility BCH1 Fail Time)
BCH1\fail_to_close	T:SS;m:203:1;E:2;L:P:28	DIGITAL	@(Utility BCH1 Fail to Close)
BCH1\fail_to_open	T:SS;m:203:2;E:2;L:P:28	DIGITAL	@(Utility BCH1 Fail to Open)
BCH1\fail_to_unload	T:SS;m:203:4;E:2;L:P:28	DIGITAL	@(Utility BCH1 Fail to Unload)
BCH1\kW	T:MV;m:205:u1;E:2;L:P:33	REAL	@(Utility BCH1 kW)
BCH1\mslc_alarm	T:SS;m:202:10;E:2;L:P:28	DIGITAL	@(Utility BCH1 MSLC Alarm)
BCH1\out_of_limits	T:SS;m:201:4;E:2;L:P:28	DIGITAL	@(Utility BCH1 Out of Limits)
BCH1\preferred	T:SS;m:201:8;E:2;L:P:28	DIGITAL	@(Utility BCH1 Preferred)
BCH1\protection_tripped	T:SS;m:202:2;E:2;L:P:28	DIGITAL	@(Utility BCH1 Protection Tripped)
BCH1\retransfer_time	T:MV;m:206:u1;E:2;L:P:33	REAL	@(Utility BCH1 Retransfer Time)
BCH1\sync_attempts	T:MV;m:207:u1;E:2;L:P:33	REAL	@(Utility BCH1 Sync Attempts)
BCH1\sync_output	T:SS;m:201:1;E:2;L:P:28	DIGITAL	@(Utility BCH1 Synchronize Output)
BCH1\sync_time	T:MV;m:208:u1;E:2;L:P:33	REAL	@(Utility BCH1 Sync Time)
BCH1\utility_failed	T:SS;m:202:8;E:2;L:P:28	DIGITAL	@(Utility BCH1 Utility Failed)
BCH1\utility_na	T:SS;m:201:2;E:2;L:P:28	DIGITAL	@(Utility BCH1 N/A)
BCH2\Breaker_Closed	T:SS;m:221:10;E:2;L:P:28	DIGITAL	@(Utility BCH2 Breaker Closed)
BCH2\Fail_Time	T:MV;m:224:u1;E:2;L:P:33	REAL	@(Utility BCH2 Fail Time)
BCH2\Fail_to_Close	T:SS;m:223:1;E:2;L:P:28	DIGITAL	@(Utility BCH2 Fail to Close)
BCH2\Fail_to_Open	T:SS;m:223:2;E:2;L:P:28	DIGITAL	@(Utility BCH2 Fail to Open)
BCH2\Fail_to_Unload	T:SS;m:223:4;E:2;L:P:28	DIGITAL	@(Utility BCH2 Fail to Unload)
BCH2\kW	T:MV;m:225:u1;E:2;L:P:33	REAL	@(Utility BCH2 kW)
BCH2\MSLC_Alarm	T:SS;m:222:10;E:2;L:P:28	DIGITAL	@(Utility BCH2 MSLC Alarm)
BCH2\Out_of_Limits	T:SS;m:221:4;E:2;L:P:28	DIGITAL	@(Utility BCH2 Out of Limits)
BCH2\Preferred	T:SS;m:221:8;E:2;L:P:28	DIGITAL	@(Utility BCH2 Preferred)
BCH2\Protection_Tripped	T:SS;m:222:2;E:2;L:P:28	DIGITAL	@(Utility BCH2 Protection Tripped)
BCH2\Retransfer_Time	T:MV;m:226:u1;E:2;L:P:33	REAL	@(Utility BCH2 Retransfer Time)
BCH2\Sync_Attempts	T:MV;m:227:u1;E:2;L:P:33	REAL	@(Utility BCH2 Sync Attempts)
BCH2\Sync_Output	T:SS;m:221:1;E:2;L:P:28	DIGITAL	@(Utility BCH2 Synchronize Output)
BCH2\Sync_Time	T:MV;m:228:u1;E:2;L:P:33	REAL	@(Utility BCH2 Sync Time)
BCH2\utility_failed	T:SS;m:222:8;E:2;L:P:28	DIGITAL	@(Utility BCH2 Utility Failed)

BCH2\Utility_NA	T:SS;m:221:2;E:2;L:P:28	DIGITAL	@(Utility BCH2 N/A)
DND\Breaker_Closed	T:SS;m:241:10;E:2;L:P:28	DIGITAL	@(Utility DND Breaker Closed)
DND\Fail_Time	T:MV;m:244:u1;E:2;L:P:33	REAL	@(Utility DND Fail Time)
DND\Fail_to_Close	T:SS;m:243:1;E:2;L:P:28	DIGITAL	@(Utility DND Fail to Close)
DND\Fail_to_Open	T:SS;m:243:2;E:2;L:P:28	DIGITAL	@(Utility DND Fail to Open)
DND\Fail_to_Unload	T:SS;m:243:4;E:2;L:P:28	DIGITAL	@(Utility DND Fail to Unload)
DND\kW	T:MV;m:245:u1;E:2;L:P:33	REAL	@(Utility DND kW)
DND\MSLC_Alarm	T:SS;m:242:10;E:2;L:P:28	DIGITAL	@(Utility DND MSLC Alarm)
DND\Out_of_Limits	T:SS;m:241:4;E:2;L:P:28	DIGITAL	@(Utility DND Out of Limits)
DND\Preferred	T:SS;m:241:8;E:2;L:P:28	DIGITAL	@(Utility DND Preferred)
DND\Protection_Tripped	T:SS;m:242:2;E:2;L:P:28	DIGITAL	@(Utility DND Protection Tripped)
DND\Retransfer_Time	T:MV;m:246:u1;E:2;L:P:33	REAL	@(Utility DND Retransfer Time)
DND\Sync_Attempts	T:MV;m:247:u1;E:2;L:P:33	REAL	@(Utility DND Sync Attempts)
DND\Sync_Output	T:SS;m:241:1;E:2;L:P:28	DIGITAL	@(Utility DND Synchronize Output)
DND\Sync_Time	T:MV;m:248:u1;E:2;L:P:33	REAL	@(Utility DND Sync Time)
DND\utility_failed	T:SS;m:242:8;E:2;L:P:28	DIGITAL	@(Utility DND Utility Failed)
DND\Utility_NA	T:SS;m:241:2;E:2;L:P:28	DIGITAL	@(Utility DND N/A)
GENBUS\capacity_online_gens	T:MV;m:55:u1;E:2;L:P:33	REAL	@(600V Gen Bus Capacity of Online Gens)
GENBUS\gen_bus_load	T:MV;m:51:u1;E:2;L:P:33	REAL	@(600V Gen Bus Load)
GENBUS\gen_bus_load_perc	T:MV;m:52:u1;E:2;L:P:33	REAL	@(600V Gen Bus Load %)
GENBUS\gen_bus_reserve	T:MV;m:53:u1;E:2;L:P:33	REAL	@(600V Gen Bus Reserve kW)
GENBUS\HMI_load_dmd_dly_strt	T:MV;m:57:u1;E:2;L:P:33	REAL	@(600V Gen Bus Load Dmd HMI Load Dmd Dly Strt)
GENBUS\HMI_load_dmd_im_start	T:MV;m:56:u1;E:2;L:P:33	REAL	@(600V Gen Bus Load Dmd HMI Load Dmd Im Start)
GENBUS\HMI_load_dmd_stop	T:MV;m:58:u1;E:2;L:P:33	REAL	@(600V Gen Bus Load Dmd HMI Load Dmd Stop)
GENBUS\HMI_load_dmd_stop_time	T:MV;m:60:u1;E:2;L:P:33	REAL	@(600V Gen Bus Load Dmd HMI Load Dmd Stop Time)
GENBUS\HMI_load_dmd_strt_dly_t	T:MV;m:59:u1;E:2;L:P:33	REAL	@(600V Gen Bus Load Dmd HMI Load Dmd Dly Strt T)
GENBUS\load_shed_loads_shed	T:SS;m:61:8;E:2;L:P:28	DIGITAL	@(600V Gen Bus Load Shed Loads have been Shed)
GENBUS\load_shed_on_dead_bus	T:SS;m:61:1;E:2;L:P:28	DIGITAL	@(600V Gen Bus Load Shed Load Shed on Dead Bus)
GENBUS\load_shed_on_overload	T:SS;m:61:2;E:2;L:P:28	DIGITAL	@(600V Gen Bus Load Shed Load Shed on Overload)
GENBUS\load_shed_on_under_freq	T:SS;m:61:4;E:2;L:P:28	DIGITAL	@(600V Gen Bus Load Shed Load Shed on Under F)
GENBUS\num_gens_online	T:MV;m:54:u1;E:2;L:P:33	REAL	@(600V Gen Bus No of Generators Online)
LOADBANK\ALARM	T:SS;m:91:80;E:2;L:P:28	DIGITAL	@(Load Bank Alarm)
LOADBANK\DUMPOP	T:SS;m:91:8;E:2;L:P:28	DIGITAL	@(Load Bank Dump Output)
LOADBANK\ENLST1	T:SS;m:92:2;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 1)
LOADBANK\ENLST10	T:SS;m:92:400;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 10)
LOADBANK\ENLST11	T:SS;m:92:800;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 11)
LOADBANK\ENLST12	T:SS;m:92:1000;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 12)
LOADBANK\ENLST13	T:SS;m:92:2000;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 13)
LOADBANK\ENLST14	T:SS;m:92:4000;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 14)
LOADBANK\ENLST15	T:SS;m:92:8000;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 15)
LOADBANK\ENLST16	T:SS;m:93:1;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 16)
LOADBANK\ENLST17	T:SS;m:93:2;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 17)
LOADBANK\ENLST18	T:SS;m:93:4;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 18)
LOADBANK\ENLST19	T:SS;m:93:8;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 19)
LOADBANK\ENLST2	T:SS;m:92:4;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 2)
LOADBANK\ENLST20	T:SS;m:93:10;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 20)
LOADBANK\ENLST3	T:SS;m:92:8;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 3)
LOADBANK\ENLST4	T:SS;m:92:10;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 4)
LOADBANK\ENLST5	T:SS;m:92:20;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 5)
LOADBANK\ENLST6	T:SS;m:92:40;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 6)
LOADBANK\ENLST7	T:SS;m:92:80;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 7)
LOADBANK\ENLST8	T:SS;m:92:100;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 8)
LOADBANK\ENLST9	T:SS;m:92:200;E:2;L:P:28	DIGITAL	@(Load Bank Energize Load Step 9)
LOADBANK\LBKWCALC	T:MV;m:99:u1;E:2;L:P:33	REAL	@(Load Bank Load Bank kW Calculated)

LOADBANK\LSO	T:MV;m:97:u1;E:2;L:P:33	REAL	@(Load Bank Load Steps Online)
LOADBANK\LSR	T:MV;m:96:u1;E:2;L:P:33	REAL	@(Load Bank Load Steps Required)
LOADBANK\MCRE	T:SS;m:91:10;E:2;L:P:28	DIGITAL	@(Load Bank Master Control Relay is Energized)
LOADBANK\MCS1	T:SS;m:94:2;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 1)
LOADBANK\MCS10	T:SS;m:94:400;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 10)
LOADBANK\MCS11	T:SS;m:94:800;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 11)
LOADBANK\MCS12	T:SS;m:94:1000;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 12)
LOADBANK\MCS13	T:SS;m:94:2000;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 13)
LOADBANK\MCS14	T:SS;m:94:4000;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 14)
LOADBANK\MCS15	T:SS;m:94:8000;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 15)
LOADBANK\MCS16	T:SS;m:95:1;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 16)
LOADBANK\MCS17	T:SS;m:95:2;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 17)
LOADBANK\MCS18	T:SS;m:95:4;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 18)
LOADBANK\MCS19	T:SS;m:95:8;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 19)
LOADBANK\MCS2	T:SS;m:94:4;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 2)
LOADBANK\MCS20	T:SS;m:95:10;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 20)
LOADBANK\MCS3	T:SS;m:94:8;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 3)
LOADBANK\MCS4	T:SS;m:94:10;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 4)
LOADBANK\MCS5	T:SS;m:94:20;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 5)
LOADBANK\MCS6	T:SS;m:94:40;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 6)
LOADBANK\MCS7	T:SS;m:94:80;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 7)
LOADBANK\MCS8	T:SS;m:94:100;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 8)
LOADBANK\MCS9	T:SS;m:94:200;E:2;L:P:28	DIGITAL	@(Load Bank Manual Close Step 9)
LOADBANK\NIAUTOALRM	T:SS;m:91:100;E:2;L:P:28	DIGITAL	@(Load Bank Not In Auto Alarm)
LOADBANK\OK2ASIMAN	T:SS;m:91:40;E:2;L:P:28	DIGITAL	@(Load Bank Okay to Add Steps in MANUAL)
LOADBANK\OK2ASSIA	T:SS;m:91:20;E:2;L:P:28	DIGITAL	@(Load Bank Okay to Add/Subtract Steps in AUTO)
LOADBANK\OLSPKWI	T:MV;m:98:u1;E:2;L:P:32	REAL	@(Load Bank Optimum Load Setpoint Internal)
LOADBANK\PLCCONAUTO	T:SS;m:91:2;E:2;L:P:28	DIGITAL	@(Load Bank PLC Control AUTO)
LOADBANK\PLCCONMAN	T:SS;m:91:4;E:2;L:P:28	DIGITAL	@(Load Bank PLC Control MANUAL)
LOADBANK\SWAUTO	T:SS;m:91:1;E:2;L:P:28	DIGITAL	@(Load Bank Switch in AUTO)
MAINBRK\gen_main_brk_closed	T:SS;m:77:2;E:2;L:P:28	DIGITAL	@(25kV Gen Main Breaker Closed)
MISCBRK\gen_main_brk_close_fail	T:SS;m:79:1;E:2;L:P:28	DIGITAL	@(25kV Gen Main Breaker Fail to Close)
MISCBRK\gen_main_brk_kw	T:MV;m:80:u1;E:2;L:P:33	REAL	@(25kV Gen Main Breaker kW)
MISCBRK\gen_main_brk_MSLC	T:SS;m:78:8;E:2;L:P:28	DIGITAL	@(25kV Gen Main Breaker MSLC Alarm)
MISCBRK\gen_main_brk_open_fail	T:SS;m:79:2;E:2;L:P:28	DIGITAL	@(25kV Gen Main Breaker Fail to Open)
MISCBRK\gen_main_brk_sync_att	T:MV;m:81:u1;E:2;L:P:33	REAL	@(25kV Gen Main Breaker Sync Attempts)
MISCBRK\gen_main_brk_sync_time	T:MV;m:82:u1;E:2;L:P:33	REAL	@(25kV Gen Main Breaker Sync Time)
MISCBRK\gen_main_brk_tripped	T:SS;m:75:2;E:2;L:P:28	DIGITAL	@(25kV Gen Main Breaker Protection Tripped)
MISCBRK\gen_main_brk_unload_fail	T:SS;m:79:4;E:2;L:P:28	DIGITAL	@(25kV Gen Main Breaker Fail to Unload)
MISCBRK\loadbank_brk_closed	T:SS;m:75:1;E:2;L:P:28	DIGITAL	@(Load Bank Breaker Breaker Closed)
MISCBRK\loadbank_brk_kw	T:MV;m:76:u1;E:2;L:P:33	REAL	@(Load Bank Breaker Power)
MISCBRK\main_gen_brk_sync	T:SS;m:77:1;E:2;L:P:28	DIGITAL	@(25kV Gen Main Breaker Synchronize Output)
MISCBRK\SES6_SP2_closed	T:SS;m:74:1;E:2;L:P:28	DIGITAL	@(Feeder Breaker 6SES-SP-2 Closed)
MISCBRK\tie_brk_close_fail	T:SS;m:73:1;E:2;L:P:28	DIGITAL	@(25kV Bus Tie Breaker Fail to Close)
MISCBRK\tie_brk_closed	T:SS;m:71:1;E:2;L:P:28	DIGITAL	@(25kV Bus Tie Breaker Closed)
MISCBRK\tie_brk_fail_open	T:SS;m:73:1;E:2;L:P:28	DIGITAL	@(25kV Bus Tie Breaker Fail to Open)
MISCBRK\tie_brk_tripped	T:SS;m:72:2;E:2;L:P:28	DIGITAL	@(25kV Bus Tie Breaker Protection Tripped)
PSSWRITE\ABNOAC_R	T:SS;m:1011:10;E:2;L:P:28	DIGITAL	@(Anticipated But Not Online R- Air Compressors)
PSSWRITE\ABNOAC_W	C:NO;T:SS;m:1011:10;E:1;L:P:103; T:SS;m:1011:10;E:1;L:P:102	DIGITAL	@(Anticipated But Not Online W- Air Compressors)
PSSWRITE\ABNOAD_R	T:SS;m:1011:4;E:2;L:P:28	DIGITAL	@(Anticipated But Not Online R- Aux Dewatering)
PSSWRITE\ABNOAD_W	C:NO;T:SS;m:1011:4;E:1;L:P:103; T:SS;m:1011:4;E:1;L:P:102	DIGITAL	@(Anticipated But Not Online W- Aux Dewatering)
PSSWRITE\ABNOBL_R	T:SS;m:1011:20;E:2;L:P:28	DIGITAL	@(Anticipated But Not Online R- Building Loads)

PSSWRITE\ABNOBL_W	C:NO;T:SS;m:1011:20;E:1;L:P:103; T:SS;m:1011:20;E:1;L:P:102	DIGITAL	@(Anticipated But Not Online W- Building Loads)
PSSWRITE\ABNOMD_R	T:SS;m:1011:2;E:2;L:P:28	DIGITAL	@(Anticipated But Not Online R- Main Dewatering)
PSSWRITE\ABNOMD_W	C:NO;T:SS;m:1011:2;E:1;L:P:103; T:SS;m:1011:2;E:1;L:P:102	DIGITAL	@(Anticipated But Not Online W- Main Dewatering)
PSSWRITE\ABNOTC_R	T:SS;m:1011:8;E:2;L:P:28	DIGITAL	@(Anticipated But Not Online R- Travelling Crane)
PSSWRITE\ABNOTC_W	C:NO;T:SS;m:1011:8;E:1;L:P:103; T:SS;m:1011:8;E:1;L:P:102	DIGITAL	@(Anticipated But Not Online W- Travelling Crane)
PSSWRITE\ALAC	T:MV;m:1005:u1;E:2;L:P:120	LONG	@(Anticipated Load - Air Compressors)
PSSWRITE\ALADP	T:MV;m:1003:u1;E:2;L:P:120	LONG	@(Anticipated Load - Aux Dewatering Pumps)
PSSWRITE\ALBL	T:MV;m:1006:u1;E:2;L:P:120	LONG	@(Anticipated Load - Building Loads)
PSSWRITE\ALMDP	T:MV;m:1002:u1;E:2;L:P:120	LONG	@(Anticipated Load - Main Dewatering Pumps)
PSSWRITE\ALTC	T:MV;m:1004:u1;E:2;L:P:120	LONG	@(Anticipated Load - Travelling Cranes)
PSSWRITE\Gen_1_Fuel_Vol_L	T:MV;m:1021:u1;E:2;L:P:120	LONG	@(Generator 1 Fuel Volume)
PSSWRITE\Gen_2_Fuel_Vol_L	T:MV;m:1022:u1;E:2;L:P:120	LONG	@(Generator 2 Fuel Volume)
PSSWRITE\Gen_3_Fuel_Vol_L	T:MV;m:1023:u1;E:2;L:P:120	LONG	@(Generator 3 Fuel Volume)
PSSWRITE\WV	T:MV;m:1001:u1;E:2;L:P:110	REAL	@(Watchdog value)
SETPOINTS\CLOSEDTRANS	T:SS;m:11:400;E:2;L:P:28	DIGITAL	@(Closed Transition Selected)
SETPOINTS\COMALRMACT	T:SS;m:11:1;E:2;L:P:28	DIGITAL	@(Common Alarm Action)
SETPOINTS\F2CDLY	T:MV;m:22:u1;E:2;L:P:33	REAL	@(Fail to Close Delay Preset)
SETPOINTS\F2ODLY	T:MV;m:23:u1;E:2;L:P:33	REAL	@(Fail to Open Delay Preset)
SETPOINTS\F2STRTDLY	T:MV;m:25:u1;E:2;L:P:33	REAL	@(Fail to Start Delay Preset)
SETPOINTS\F2SYNCDLY	T:MV;m:24:u1;E:2;L:P:33	REAL	@(Fail to Sync Delay Preset)
SETPOINTS\F2ULDLY	T:MV;m:26:u1;E:2;L:P:33	REAL	@(Fail to Unload Delay Preset)
SETPOINTS\FAILSTART	T:SS;m:11:4;E:2;L:P:28	DIGITAL	@(Fail to Start Action)
SETPOINTS\FAILSYNC	T:SS;m:11:2;E:2;L:P:28	DIGITAL	@(Fail to Sync Action)
SETPOINTS\FDRULSP	T:MV;m:19:u1;E:2;L:P:33	REAL	@(Feeder Unloaded Setpoint)
SETPOINTS\GENEXTRT	T:MV;m:21:u1;E:2;L:P:33	REAL	@(Gen Extended Runtime Preset)
SETPOINTS\GENWARMUPTIME	T:MV;m:38:u1;E:2;L:P:33	REAL	@(Gen Warm Up Time Preset)
SETPOINTS\LBDLY	T:MV;m:31:u1;E:2;L:P:33	REAL	@(Live Bus Delay Preset)
SETPOINTS\LBINITDLY	T:MV;m:28:u1;E:2;L:P:33	REAL	@(Load Bank Initial Delay Timer Preset)
SETPOINTS\LBSTEPADDDLY	T:MV;m:27:u1;E:2;L:P:33	REAL	@(Load Bank Step Add Delay Timer Preset)
SETPOINTS\LBSTEPFSUBDLY	T:MV;m:30:u1;E:2;L:P:33	REAL	@(Load Bank Step Fast Subtract Delay Timer Pres)
SETPOINTS\LBSTEPSUBDLY	T:MV;m:29:u1;E:2;L:P:33	REAL	@(Load Bank Step Subtract Delay Timer Preset)
SETPOINTS\LDDLYSTP	T:MV;m:33:u1;E:2;L:P:33	REAL	@(Load Demand Delayed Stop Timer Preset)
SETPOINTS\LDMDALEN	T:SS;m:11:10;E:2;L:P:28	DIGITAL	@(Load Demand - Anticipated Loads Enabled)
SETPOINTS\LDMDDLYSTPSP	T:MV;m:16:u1;E:2;L:P:33	REAL	@(Load Demand Delayed Stop Setpoint)
SETPOINTS\LDMDDLYSTRT	T:MV;m:32:u1;E:2;L:P:33	REAL	@(Load Demand Delayed Start Timer Preset)
SETPOINTS\LDMDDLYSTRTSP	T:MV;m:15:u1;E:2;L:P:33	REAL	@(Load Demand Delayed Start Setpoint)
SETPOINTS\LDMDEN	T:SS;m:11:20;E:2;L:P:28	DIGITAL	@(Load Demand Enabled)
SETPOINTS\LDMDIMSTRTSP	T:MV;m:17:u1;E:2;L:P:33	REAL	@(Load Demand Immediate Start Setpoint)
SETPOINTS\LDMDN1EN	T:SS;m:11:40;E:2;L:P:28	DIGITAL	@(Load Demand - N+1 Redundancy Enabled)
SETPOINTS\LFSP	T:MV;m:12:u1;E:2;L:P:33	REAL	@(Low Fuel Alarm Setpoint)
SETPOINTS\LOADBANKOPTSP	T:MV;m:14:u1;E:2;L:P:33	REAL	@(Load Bank Optimum Load Setpoint)
SETPOINTS\LOADSHEDDBUS	T:SS;m:11:80;E:2;L:P:28	DIGITAL	@(Load Shed on Dead Bus Enabled)
SETPOINTS\LOADSHEDOL	T:SS;m:11:100;E:2;L:P:28	DIGITAL	@(Load Shed on Overload Enabled)
SETPOINTS\LOADSHEDOLSP	T:MV;m:18:u1;E:2;L:P:33	REAL	@(Load Shed Overload Setpoint)
SETPOINTS\LOADSHEDUFREQ	T:SS;m:11:200;E:2;L:P:28	DIGITAL	@(Load Shed on Underfrequency Enabled)
SETPOINTS\LOWFUEL	T:SS;m:11:8;E:2;L:P:28	DIGITAL	@(Low Fuel Action)
SETPOINTS\MINRT	T:MV;m:34:u1;E:2;L:P:33	REAL	@(Minimum Run Time Preset)
SETPOINTS\NDLY	T:MV;m:35:u1;E:2;L:P:33	REAL	@(Neutral Delay Preset)
SETPOINTS\NGENREQ4TRAN	T:MV;m:13:u1;E:2;L:P:33	REAL	@(Number of generators required for transfer)
SETPOINTS\SRCFDLY	T:MV;m:20:u1;E:2;L:P:33	REAL	@(Source Failure Delay Preset)
SETPOINTS\UTILRETRANAUTO	T:SS;m:11:800;E:2;L:P:28	DIGITAL	@(Utility Retransfer in Auto)

SETPOINTS\UTILRETRANDLY	T:MV;m:36:u1;E:2;L:P:33	REAL	@(Utility Retransfer Delay Preset)
SETPOINTS\W4REQGEN	T:MV;m:37:u1;E:2;L:P:33	REAL	@(Wait For Required Gens Timer Preset)
SYSPLC\B1LIVE	T:SS;m:1:20;E:2;L:P:28	DIGITAL	@(25kV Bus 1 Live Bus)
SYSPLC\B2LIVE	T:SS;m:1:40;E:2;L:P:28	DIGITAL	@(25kV Bus 2 Live Bus)
SYSPLC\BSTM	T:SS;m:1:8;E:2;L:P:28	DIGITAL	@(Block the System TEST Mode)
SYSPLC\GENBLIVE	T:SS;m:1:80;E:2;L:P:28	DIGITAL	@(600V Generator Bus Live Bus)
SYSPLC\SMSA	T:SS;m:1:1;E:2;L:P:28	DIGITAL	@(System Mode Switch - AUTO)
SYSPLC\SMSM	T:SS;m:1:2;E:2;L:P:28	DIGITAL	@(System Mode Switch - MANUAL)
SYSPLC\SMSS	T:SS;m:1:4;E:2;L:P:28	DIGITAL	@(System Mode Switch - START)
SYSPLC\SMST	T:SS;m:1:8;E:2;L:P:28	DIGITAL	@(System Mode Switch - TEST)

Generator tags are read from the TCS PLC however to facilitate the pop-up functionality, the register list was broken out into individual device profiles: Generator1, Genertor2 and Generator4. Since Generator 4 does not presently exist its profile has not been added however is can be added at any time as the profile is configured as per the below.

Generator tags and alarms are displayed in the pop-up window example shown in figure 6.

Table 11: PSE Generator source profile

Tag	Function Code	Data Type	Label
SSES_Generator1\Gen_Entered_Priority	REAL	T:MV;m:124:u1;E:2;L:P:33	@(Generator Entered Priority)
SSES_Generator1\MMXU1\TotW	REAL	T:MV;m:125:u1;E:2;L:P:33	@(Active Power)
SSES_Generator1\Gen_Fuel_Consumption	REAL	T:MV;m:126:u1;E:2;L:P:33	@(Generator Fuel Consumption)
SSES_Generator1\Gen_Fuel_Time_Rem_Hour	REAL	T:MV;m:127:u1;E:2;L:P:33	@(Generator Fuel Time Remaining Hours)
SSES_Generator1\Gen_Fuel_Time_Rem_Min	REAL	T:MV;m:128:u1;E:2;L:P:33	@(Generator Fuel Time Remaining Minutes)
SSES_Generator1\Gen_Fuel_Volume	REAL	T:MV;m:129:u1;E:2;L:P:33	@(Generator Fuel Volume)
SSES_Generator1\Gen_Sync_Attempts	REAL	T:MV;m:130:u1;E:2;L:P:33	@(Generator Sync Attempts)
SSES_Generator1\Gen_Sync_Time	REAL	T:MV;m:131:u1;E:2;L:P:33	@(Generator Sync Time)
SSES_Generator1\Gen_Warmup_Time	REAL	T:MV;m:132:u1;E:2;L:P:33	@(Generator WarmupTime)
SSES_Generator1\Gen_Available	DIGITAL	T:SS;m:121:1;E:2;L:P:28	@(Generator Available)
SSES_Generator1\Gen_Running	DIGITAL	T:SS;m:121:10;E:2;L:P:28	@(Generatror Running)
SSES_Generator1\Gen_Brk_Closed	DIGITAL	T:SS;m:121:20;E:2;L:P:28	@(Generator Breaker Closed)
SSES_Generator1\Gen_Engine_Start	DIGITAL	T:SS;m:121:4;E:2;L:P:28	@(Generator Engine Start)
SSES_Generator1\Gen_Sync_to_Bus	DIGITAL	T:SS;m:121:8;E:2;L:P:28	@(Generator Sync to Bus)
SSES_Generator1\Gen_Common_Alarm	DIGITAL	T:SS;m:122:1;E:2;L:P:28	@(Generator Common Alarm)
SSES_Generator1\Gen_Brk_WIthdrwawn	DIGITAL	T:SS;m:122:10;E:2;L:P:28	@(Generator Breaker WIthdrawn)
SSES_Generator1\Gen_Common_Shutdown	DIGITAL	T:SS;m:122:2;E:2;L:P:28	@(Generator Common Shutdown)
SSES_Generator1\Gen_Protection_Tripped	DIGITAL	T:SS;m:122:20;E:2;L:P:28	@(Generator Protection Tripped)
SSES_Generator1\Gen_Local_Brk_Open	DIGITAL	T:SS;m:122:4;E:2;L:P:28	@(Generator Local Breaker Open)
SSES_Generator1\Gen_Protectiion_Relay_Alarm	DIGITAL	T:SS;m:122:40;E:2;L:P:28	@(Generator Protection Relay Alarm)
SSES_Generator1\Gen_Not_In_Auto	DIGITAL	T:SS;m:122:8;E:2;L:P:28	@(Generator Not In Auto)
SSES_Generator1\Gen_DSLC_Alarm	DIGITAL	T:SS;m:122:80;E:2;L:P:28	@(Generator DSLC Alarm)
SSES_Generator1\Gen_Fail_to_Close	DIGITAL	T:SS;m:123:1;E:2;L:P:28	@(Generator Fail to Close)
SSES_Generator1\Gen_Low_Fuel_Alarm	DIGITAL	T:SS;m:123:10;E:2;L:P:28	@(Generator Low Fuel Alarm)
SSES_Generator1\Gen_Fail_to_Open	DIGITAL	T:SS;m:123:2;E:2;L:P:28	@(Generator Fail to Open)
SSES_Generator1\Gen_Fail_to_Unload	DIGITAL	T:SS;m:123:4;E:2;L:P:28	@(Generator Fail to Unload)
SSES_Generator1\Gen_Fail_to_Start_Alarm	DIGITAL	T:SS;m:123:8;E:2;L:P:28	@(Generator Fail to Start Alarm)
SSES_Generator2\Gen_Entered_Priority	REAL	T:MV;m:144:u1;E:2;L:P:33	@(Generator Entered Priority)
SSES_Generator2\MMXU1\TotW	REAL	T:MV;m:145:u1;E:2;L:P:33	@(Active Power)
SSES_Generator2\Gen_Fuel_Consumption	REAL	T:MV;m:146:u1;E:2;L:P:33	@(Generator Fuel Consumption)
SSES_Generator2\Gen_Fuel_Time_Rem_Hour	REAL	T:MV;m:147:u1;E:2;L:P:33	@(Generator Fuel Time Remaining Hours)
SSES_Generator2\Gen_Fuel_Time_Rem_Min	REAL	T:MV;m:148:u1;E:2;L:P:33	@(Generator Fuel Time Remaining Minutes)

SSES_Generator2\Gen_Fuel_Volume	REAL	T:MV;m:149:u1;E:2;L:P:33	@(Generator Fuel Volume)
SSES_Generator2\Gen_Sync_Attempts	REAL	T:MV;m:150:u1;E:2;L:P:33	@(Generator Sync Attempts)
SSES_Generator2\Gen_Sync_Time	REAL	T:MV;m:151:u1;E:2;L:P:33	@(Generator Sync Time)
SSES_Generator2\Gen_Warmup_Time	REAL	T:MV;m:152:u1;E:2;L:P:33	@(Generator WarmupTime)
SSES_Generator2\Gen_Available	DIGITAL	T:SS;m:141:1;E:2;L:P:28	@(Generator Available)
SSES_Generator2\Gen_Running	DIGITAL	T:SS;m:141:10;E:2;L:P:28	@(Generatror Running)
SSES_Generator2\Gen_Brk_Closed	DIGITAL	T:SS;m:141:20;E:2;L:P:28	@(Generator Breaker Closed)
SSES_Generator2\Gen_Engine_Start	DIGITAL	T:SS;m:141:4;E:2;L:P:28	@(Generator Engine Start)
SSES_Generator2\Gen_Sync_to_Bus	DIGITAL	T:SS;m:141:8;E:2;L:P:28	@(Generator Sync to Bus)
SSES_Generator2\Gen_Common_Alarm	DIGITAL	T:SS;m:142:1;E:2;L:P:28	@(Generator Common Alarm)
SSES_Generator2\Gen_Brk_WIthdrwawn	DIGITAL	T:SS;m:142:10;E:2;L:P:28	@(Generator Breaker WIthdrawn)
SSES_Generator2\Gen_Common_Shutdown	DIGITAL	T:SS;m:142:2;E:2;L:P:28	@(Generator Common Shutdown)
SSES_Generator2\Gen_Protection_Tripped	DIGITAL	T:SS;m:142:20;E:2;L:P:28	@(Generator Protection Tripped)
SSES_Generator2\Gen_Local_Brk_Open	DIGITAL	T:SS;m:142:4;E:2;L:P:28	@(Generator Local Breaker Open)
SSES_Generator2\Gen_Protectiion_Relay_Alarm	DIGITAL	T:SS;m:142:40;E:2;L:P:28	@(Generator Protection Relay Alarm)
SSES_Generator2\Gen_Not_In_Auto	DIGITAL	T:SS;m:142:8;E:2;L:P:28	@(Generator Not In Auto)
SSES_Generator2\Gen_DSLC_Alarm	DIGITAL	T:SS;m:142:80;E:2;L:P:28	@(Generator DSLC Alarm)
SSES_Generator2\Gen_Fail_to_Close	DIGITAL	T:SS;m:143:1;E:2;L:P:28	@(Generator Fail to Close)
SSES_Generator2\Gen_Low_Fuel_Alarm	DIGITAL	T:SS;m:143:10;E:2;L:P:28	@(Generator Low Fuel Alarm)
SSES_Generator2\Gen_Fail_to_Open	DIGITAL	T:SS;m:143:2;E:2;L:P:28	@(Generator Fail to Open)
SSES_Generator2\Gen_Fail_to_Unload	DIGITAL	T:SS;m:143:4;E:2;L:P:28	@(Generator Fail to Unload)
SSES_Generator2\Gen_Fail_to_Start_Alarm	DIGITAL	T:SS;m:143:8;E:2;L:P:28	@(Generator Fail to Start Alarm)
SSES_Generator3\Gen_Entered_Priority	REAL	T:MV;m:164:u1;E:2;L:P:33	@(Generator Entered Priority)
SSES_Generator3\MMXU1\TotW	REAL	T:MV;m:165:u1;E:2;L:P:33	@(Active Power)
SSES_Generator3\Gen_Fuel_Consumption	REAL	T:MV;m:166:u1;E:2;L:P:33	@(Generator Fuel Consumption)
SSES_Generator3\Gen_Fuel_Time_Rem_Hour	REAL	T:MV;m:167:u1;E:2;L:P:33	@(Generator Fuel Time Remaining Hours)
SSES_Generator3\Gen_Fuel_Time_Rem_Min	REAL	T:MV;m:168:u1;E:2;L:P:33	@(Generator Fuel Time Remaining Minutes)
SSES_Generator3\Gen_Fuel_Volume	REAL	T:MV;m:169:u1;E:2;L:P:33	@(Generator Fuel Volume)
SSES_Generator3\Gen_Sync_Attempts	REAL	T:MV;m:170:u1;E:2;L:P:33	@(Generator Sync Attempts)
SSES_Generator3\Gen_Sync_Time	REAL	T:MV;m:171:u1;E:2;L:P:33	@(Generator Sync Time)
SSES_Generator3\Gen_Warmup_Time	REAL	T:MV;m:172:u1;E:2;L:P:33	@(Generator WarmupTime)
SSES_Generator3\Gen_Available	DIGITAL	T:SS;m:161:1;E:2;L:P:28	@(Generator Available)
SSES_Generator3\Gen_Running	DIGITAL	T:SS;m:161:10;E:2;L:P:28	@(Generatror Running)
SSES_Generator3\Gen_Brk_Closed	DIGITAL	T:SS;m:161:20;E:2;L:P:28	@(Generator Breaker Closed)
SSES_Generator3\Gen_Engine_Start	DIGITAL	T:SS;m:161:4;E:2;L:P:28	@(Generator Engine Start)
SSES_Generator3\Gen_Sync_to_Bus	DIGITAL	T:SS;m:161:8;E:2;L:P:28	@(Generator Sync to Bus)
SSES_Generator3\Gen_Common_Alarm	DIGITAL	T:SS;m:162:1;E:2;L:P:28	@(Generator Common Alarm)
SSES_Generator3\Gen_Brk_WIthdrwawn	DIGITAL	T:SS;m:162:10;E:2;L:P:28	@(Generator Breaker WIthdrawn)
SSES_Generator3\Gen_Common_Shutdown	DIGITAL	T:SS;m:162:2;E:2;L:P:28	@(Generator Common Shutdown)
SSES_Generator3\Gen_Protection_Tripped	DIGITAL	T:SS;m:162:20;E:2;L:P:28	@(Generator Protection Tripped)
SSES_Generator3\Gen_Local_Brk_Open	DIGITAL	T:SS;m:162:4;E:2;L:P:28	@(Generator Local Breaker Open)
SSES_Generator3\Gen_Protectiion_Relay_Alarm	DIGITAL	T:SS;m:162:40;E:2;L:P:28	@(Generator Protection Relay Alarm)
SSES_Generator3\Gen_Not_In_Auto	DIGITAL	T:SS;m:162:8;E:2;L:P:28	@(Generator Not In Auto)
SSES_Generator3\Gen_DSLC_Alarm	DIGITAL	T:SS;m:162:80;E:2;L:P:28	@(Generator DSLC Alarm)
SSES_Generator3\Gen_Fail_to_Close	DIGITAL	T:SS;m:163:1;E:2;L:P:28	@(Generator Fail to Close)
SSES_Generator3\Gen_Low_Fuel_Alarm	DIGITAL	T:SS;m:163:10;E:2;L:P:28	@(Generator Low Fuel Alarm)
SSES_Generator3\Gen_Fail_to_Open	DIGITAL	T:SS;m:163:2;E:2;L:P:28	@(Generator Fail to Open)
SSES_Generator3\Gen_Fail_to_Unload	DIGITAL	T:SS;m:163:4;E:2;L:P:28	@(Generator Fail to Unload)
SSES_Generator3\Gen_Fail_to_Start_Alarm	DIGITAL	T:SS;m:163:8;E:2;L:P:28	@(Generator Fail to Start Alarm)

Four SEL700G generator protection relays are integrated under this project. The device profile tags are limited to the protection functions that are enabled on the protection relay, the LED status used to mimic the front panel display and the remote trip reset.

Table 12: PSE SEL700G device profile

Tag	Function Code	Data Type	Label
BRKRST	C:NO;T:SS;m:262:1;E:1;L:P:101; T:SS;m:262:1;E:1;L:P:101	Digital	@(Breaker Trip Reset)
PHOC50	T:SS;m:902:1;E:2;L:P:28	Digital	@(Phase Over Current Trip)
TOC51	T:SS;m:902:8;E:2;L:P:28	Digital	@(Time Over Current Trip)
UV27	T:SS;m:903:1;E:2;L:P:28	Digital	@(Under Voltage Trip)
UOFREQ81	T:SS;m:903:10;E:2;L:P:28	Digital	@(Under/Over Frequency Trip)
OV59	T:SS;m:903:2;E:2;L:P:28	Digital	@(Over Voltage Trip)
PE27	T:SS;m:903:8;E:2;L:P:28	Digital	@(Power Element Trip)
FL40	T:SS;m:903:800;E:2;L:P:28	Digital	@(Loss of Field Trip)
TRIP	T:SS;m:903:8000;E:2;L:P:28	Digital	@(General Breaker Trip)
TLED_06	T:SS;m:972:1;E:2;L:P:28	Digital	@(SEL LED - 06)
TLED_02	T:SS;m:972:10;E:2;L:P:28	Digital	@(SEL LED - 02)
TLED_05	T:SS;m:972:2;E:2;L:P:28	Digital	@(SEL LED - 05)
TLED_01	T:SS;m:972:20;E:2;L:P:28	Digital	@(SEL LED - 01)
TLED_04	T:SS;m:972:4;E:2;L:P:28	Digital	@(SEL LED - 04)
TRIP_LED	T:SS;m:972:40;E:2;L:P:28	Digital	@(SEL LED - Trip)
TLED_03	T:SS;m:972:8;E:2;L:P:28	Digital	@(SEL LED - 03)
EN_LED	T:SS;m:972:80;E:2;L:P:28	Digital	@(SEL LED - Enabled)

Trip status and protection alarms are displayed in a pop-up window for each protection relay. Trip alarms are date/time stamped with the time the PSS picks up the alarm. The SEL700G popup window is displayed in the section below.

4 PSS HMI screens

HMI screens are configured to correspond with the one lines and data points monitored by the devices and PLC.

The PSS navigation menu bar was updated to accommodate additional navigation buttons. Upon launching the SCADA application users may access the standby generation diagrams under the Single Lines / Standby Generation SSES diagram menu. Navigation for the new HMI screens pertaining to the new standby generators is as follows:

- Single Lines
    - Standby Generators: SSES
        - SSES 600V (one line for
        - Loadbank (displays status of load bank from PLC)
        - TCS: Utility Info (displays utility and breaker status points monitored by PLC)
        - TCS: PLS Setpoints (displays the PLC setpoints programmed from the Thomson HMI touchscreen)
        - TCS: PSS Write (displays the values are written to the PLC by the PSS)

Single Meters:

- Standby Generators (access to the individual SEC device templates)
    - *Individual meter templates*

4.1 Single Lines

The SSES 600V page below displays in real-time the status for the generator breakers, generator run, and instantaneous values. Real-time metering and status details pertaining to each equipment is accessible by clicking on the device icon. This is the same existing functionality configured under the PHS/SES SCADA upgrade project. The icons are configured with URLs that open the device diagram template using web styled popup. Generator status, monitored via the digital inputs on the ION7650, will show 3 main states: Stopped, Starting, and Running. The Starting status will only be displayed momentarily as the generator startup only required ~3 seconds to start.

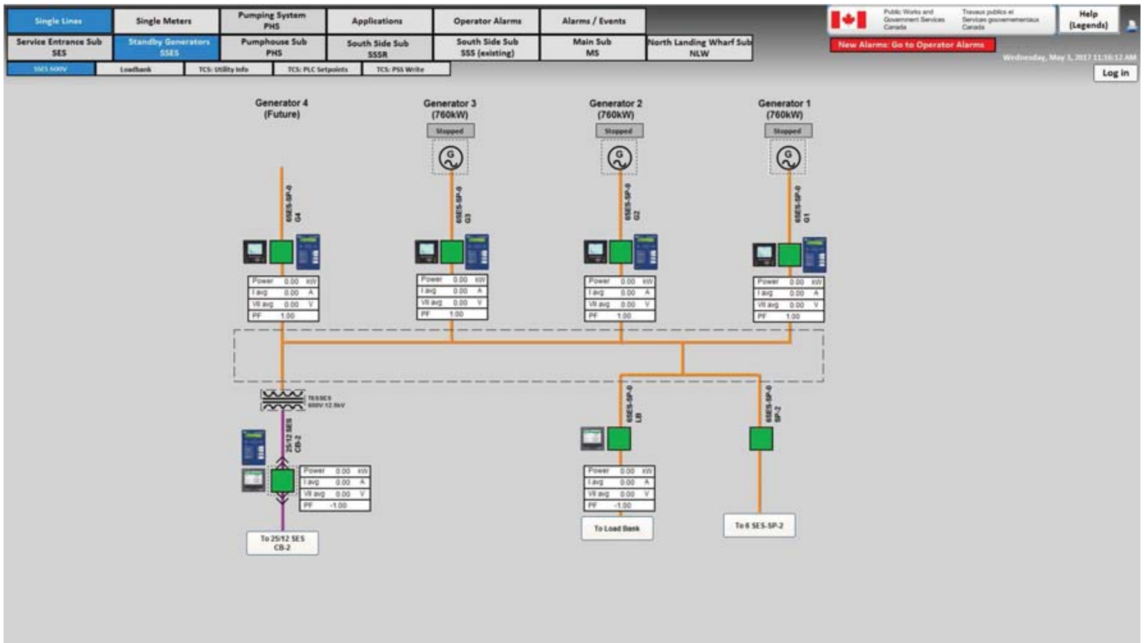
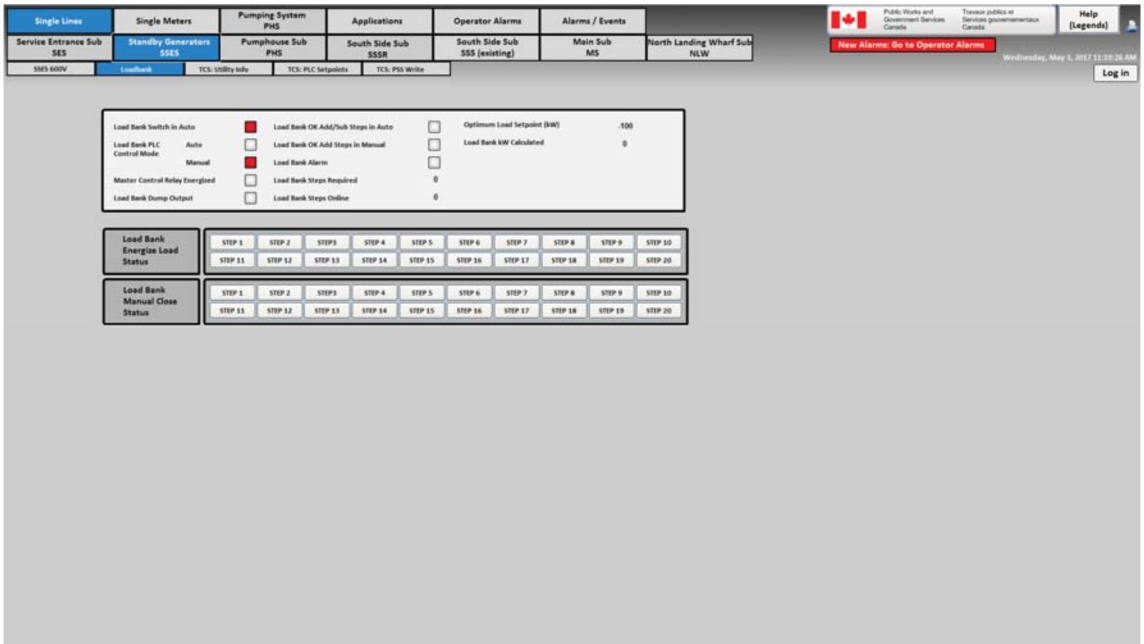


Figure 5: PSS SSES 600V Standby Generation one-line diagram

The load bank HMI screen will give users the ability to remotely monitor the load bank during testing. This is a read-only display that shows users the PLC status for all for the load bank steps. Control function of the load bank is done the load bank panel and TCS HMI touch screen.

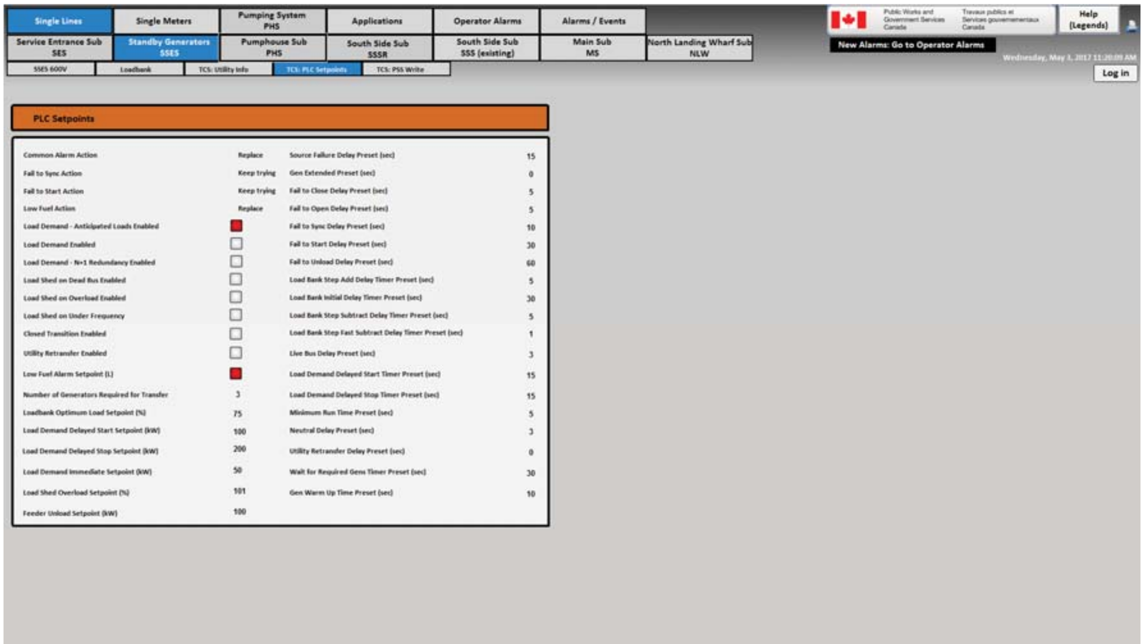
Each load bank step represents a 50kW load. The load bank step indicators will aluminate when the load bank is in either manual or automatic mode. All of the data points read and from the TCS PLC. The calculated load bank kW is also read from the PLC which in turn is monitoring the 4-20mA signal from the PM8240 device.



Load Bank Switch in Auto 🟥
Load Bank PLC Control Mode Auto ☐
Manual 🟥
Master Control Relay Energized ☐
Load Bank Dump Output ☐
Load Bank OK Add/Sub Steps in Auto ☐
Load Bank OK Add Steps in Manual ☐
Load Bank Alarm ☐
Load Bank Steps Required 0
Load Bank Steps Online 0
Optimum Load Setpoint (kW) .100
Load Bank kW Calculated 0

Figure 6: Load Bank diagram

This HMI displays setpoint parameters that are programmed into the PLC and configured from the TCS touch panel display. Values in the screen are ready only.

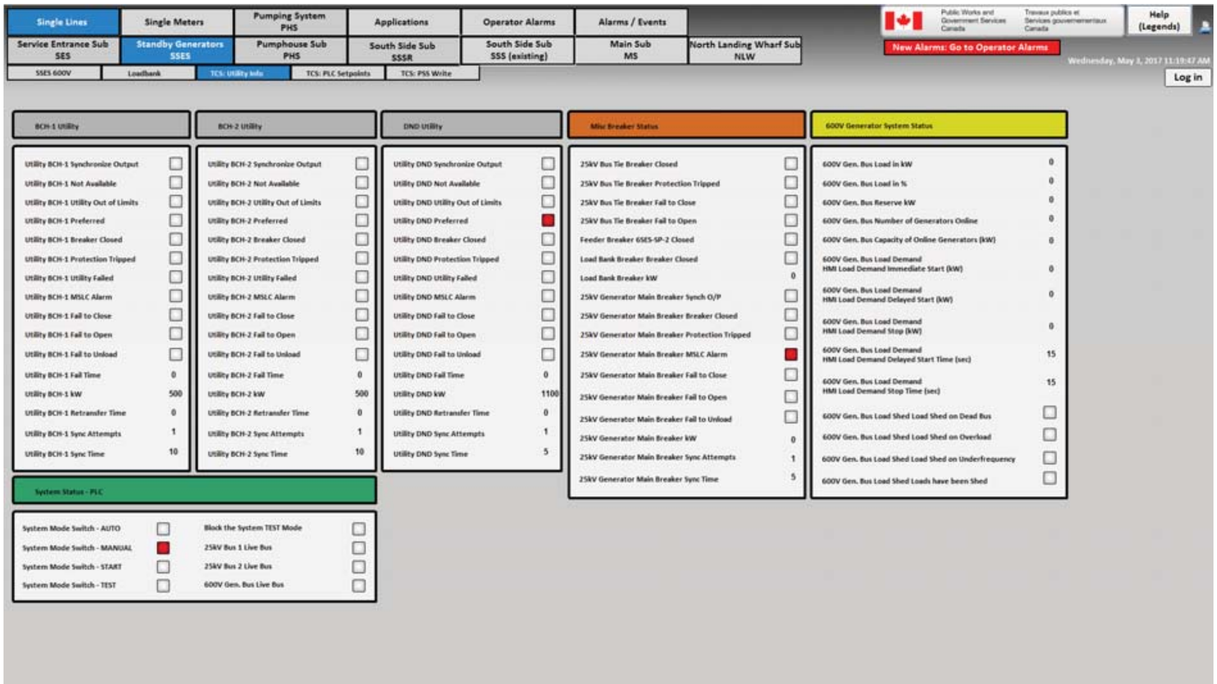


PLC Setpoints

Common Alarm Action	Replace	Source Failure Delay Preset (sec)	15
Fail to Sync Action	Keep trying	Gen Extended Preset (sec)	0
Fail to Start Action	Keep trying	Fail to Close Delay Preset (sec)	5
Low Fuel Action	Replace	Fail to Open Delay Preset (sec)	5
Load Demand - Anticipated Loads Enabled	🟥	Fail to Sync Delay Preset (sec)	10
Load Demand Enabled	☐	Fail to Start Delay Preset (sec)	30
Load Demand - N+1 Redundancy Enabled	☐	Fail to Unload Delay Preset (sec)	60
Load Shed on Dead Bus Enabled	☐	Load Bank Step Add Delay Timer Preset (sec)	5
Load Shed on Overload Enabled	☐	Load Bank Initial Delay Timer Preset (sec)	30
Load Shed on Under Frequency	☐	Load Bank Step Subtract Delay Timer Preset (sec)	5
Closed Transition Enabled	☐	Load Bank Step Fast Subtract Delay Timer Preset (sec)	1
Utility Retransfer Enabled	☐	Live Bus Delay Preset (sec)	3
Low Fuel Alarm Setpoint (L)	🟥	Load Demand Delayed Start Timer Preset (sec)	15
Number of Generators Required for Transfer	3	Load Demand Delayed Stop Timer Preset (sec)	15
Loadbank Optimum Load Setpoint (%)	75	Minimum Run Time Preset (sec)	5
Load Demand Delayed Start Setpoint (kW)	100	Neutral Delay Preset (sec)	3
Load Demand Delayed Stop Setpoint (kW)	200	Utility Retransfer Delay Preset (sec)	0
Load Demand Immediate Setpoint (kW)	50	Wait for Required Gens Timer Preset (sec)	30
Load Shed Overload Setpoint (%)	101	Gen Warm Up Time Preset (sec)	10
Feeder Unload Setpoint (kW)	100		

Figure 7: PLC Setpoint diagram

This HMI summarizes and displays diagnostic & statistical information monitored by the TCS PLC. All data points displayed are read-only registers.



BCH-1 Utility

Utility BCH-1 Synchronize Output	☐
Utility BCH-1 Not Available	☐
Utility BCH-1 Utility Out of Limits	☐
Utility BCH-1 Preferred	☐
Utility BCH-1 Breaker Closed	☐
Utility BCH-1 Protection Tripped	☐
Utility BCH-1 Utility Failed	☐
Utility BCH-1 MSLC Alarm	☐
Utility BCH-1 Fail to Close	☐
Utility BCH-1 Fail to Open	☐
Utility BCH-1 Fail to Unload	☐
Utility BCH-1 Fail Time	0
Utility BCH-1 kW	500
Utility BCH-1 Retransfer Time	0
Utility BCH-1 Sync Attempts	1
Utility BCH-1 Sync Time	10

BCH-2 Utility

Utility BCH-2 Synchronize Output	☐
Utility BCH-2 Not Available	☐
Utility BCH-2 Utility Out of Limits	☐
Utility BCH-2 Preferred	☐
Utility BCH-2 Breaker Closed	☐
Utility BCH-2 Protection Tripped	☐
Utility BCH-2 Utility Failed	☐
Utility BCH-2 MSLC Alarm	☐
Utility BCH-2 Fail to Close	☐
Utility BCH-2 Fail to Open	☐
Utility BCH-2 Fail to Unload	☐
Utility BCH-2 Fail Time	0
Utility BCH-2 kW	500
Utility BCH-2 Retransfer Time	0
Utility BCH-2 Sync Attempts	1
Utility BCH-2 Sync Time	10

DND Utility

Utility DND Synchronize Output	☐
Utility DND Not Available	☐
Utility DND Utility Out of Limits	☐
Utility DND Preferred	🟥
Utility DND Breaker Closed	☐
Utility DND Protection Tripped	☐
Utility DND Utility Failed	☐
Utility DND MSLC Alarm	☐
Utility DND Fail to Close	☐
Utility DND Fail to Open	☐
Utility DND Fail to Unload	☐
Utility DND Fail Time	0
Utility DND kW	1100
Utility DND Retransfer Time	0
Utility DND Sync Attempts	1
Utility DND Sync Time	5

Misc Breaker Status

25kV Bus Tie Breaker Closed	☐
25kV Bus Tie Breaker Protection Tripped	☐
25kV Bus Tie Breaker Fail to Close	☐
25kV Bus Tie Breaker Fail to Open	☐
Feeder Breaker 6SES-SP-2 Closed	☐
Load Bank Breaker Breaker Closed	☐
Load Bank Breaker kW	0
25kV Generator Main Breaker Synch O/P	☐
25kV Generator Main Breaker Breaker Closed	☐
25kV Generator Main Breaker Protection Tripped	☐
25kV Generator Main Breaker MSLC Alarm	🟥
25kV Generator Main Breaker Fail to Close	☐
25kV Generator Main Breaker Fail to Open	☐
25kV Generator Main Breaker Fail to Unload	☐
25kV Generator Main Breaker kW	0
25kV Generator Main Breaker Sync Attempts	1
25kV Generator Main Breaker Sync Time	5

600V Generator System Status

600V Gen. Bus Load in kW	0
600V Gen. Bus Load in %	0
600V Gen. Bus Reserve kW	0
600V Gen. Bus Number of Generators Online	0
600V Gen. Bus Capacity of Online Generators (kW)	0
600V Gen. Bus Load Demand HMI Load Demand Immediate Start (kW)	0
600V Gen. Bus Load Demand HMI Load Demand Delayed Start (kW)	0
600V Gen. Bus Load Demand HMI Load Demand Stop (kW)	0
600V Gen. Bus Load Demand HMI Load Demand Delayed Start Time (sec)	15
600V Gen. Bus Load Demand HMI Load Demand Stop Time (sec)	15
600V Gen. Bus Load Shed Load Shed on Dead Bus	☐
600V Gen. Bus Load Shed Load Shed on Overload	☐
600V Gen. Bus Load Shed Load Shed on Underfrequency	☐
600V Gen. Bus Load Shed Loads have been Shed	☐

System Status - PLC

System Mode Switch - AUTO	☐	Block the System TEST Mode	☐
System Mode Switch - MANUAL	🟥	25kV Bus 1 Live Bus	☐
System Mode Switch - START	☐	25kV Bus 2 Live Bus	☐
System Mode Switch - TEST	☐	600V Gen. Bus Live Bus	☐

Figure 8: TCS Utility Information

4.2 Single meter diagrams

The single meters diagram allows users to access metering specific data from diagrams where all meters are grouped according to their group name/location rather than navigating the single line diagrams. Clicking on the icons will navigate to sub diagrams where individual meter icons are display for the associated grouping.

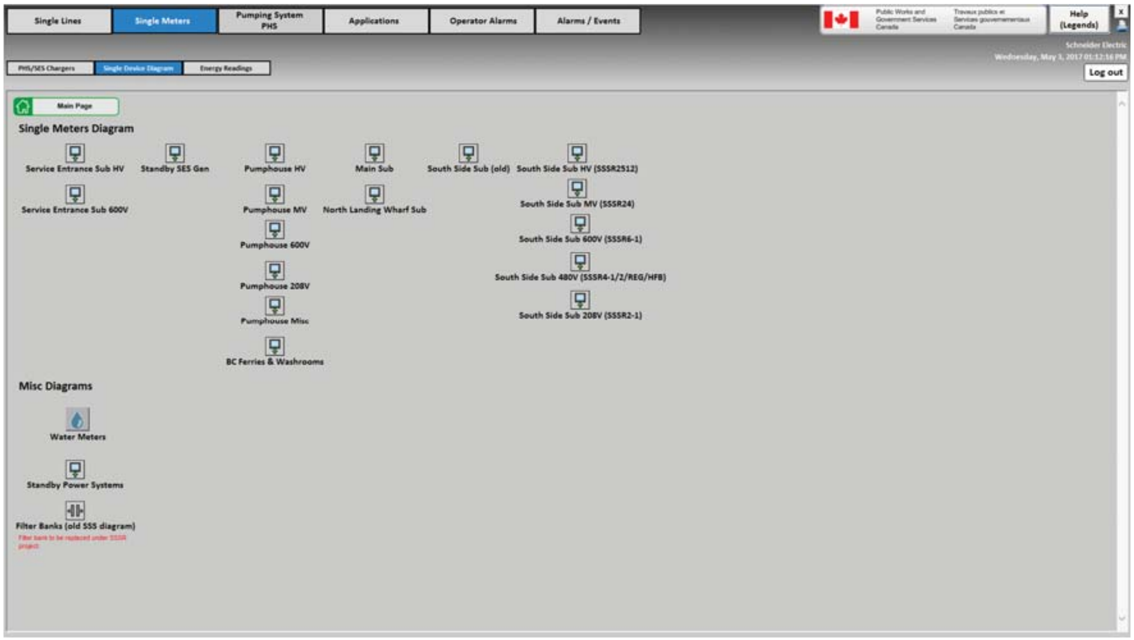


Figure 9: Single meters diagram

Clicking on the meter icons shown below will open the specific device template where users to pull up details metering data.

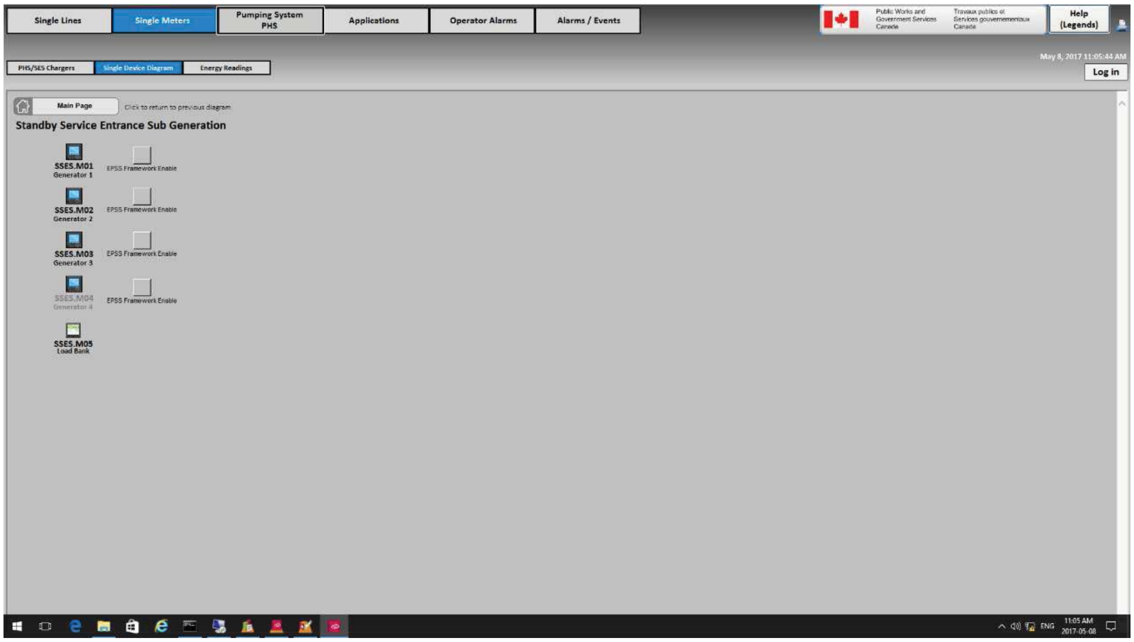
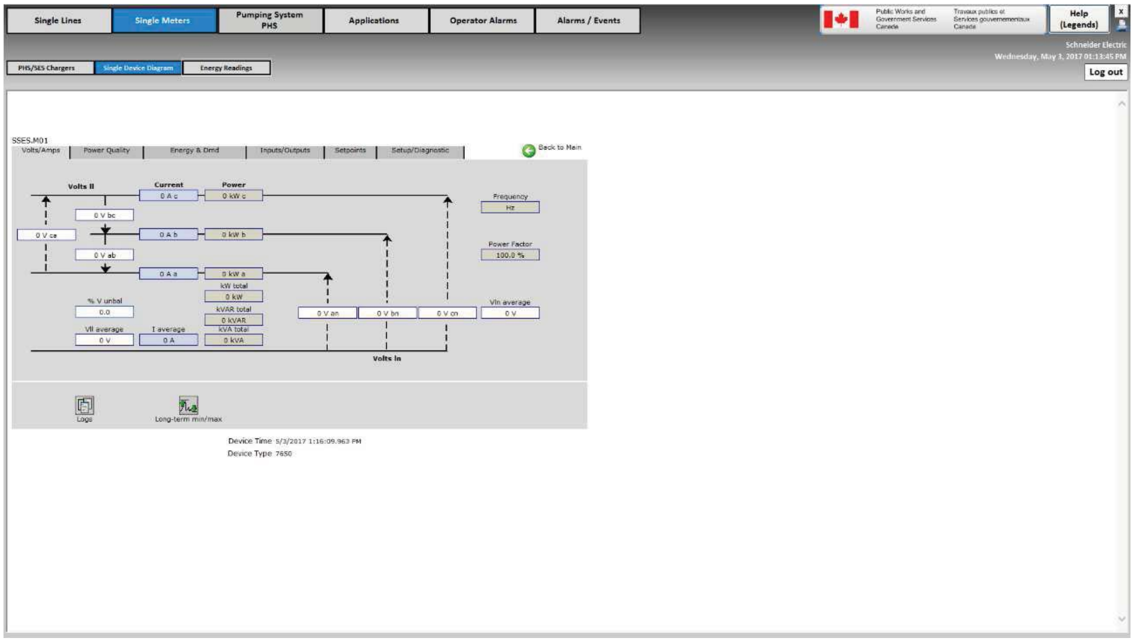


Figure 10: SSES Single meters sub diagram

Meter diagram templates will populate the whole page rather than pop-ups when navigating the single line diagrams. Clicking onm the “back to main” will return users to the previous SES Single meters diagram.



Device Time 5/3/2017 1:16:09.963 PM
Device Type 7650

Figure 11: Device diagram template

4.3 Pop-up screens

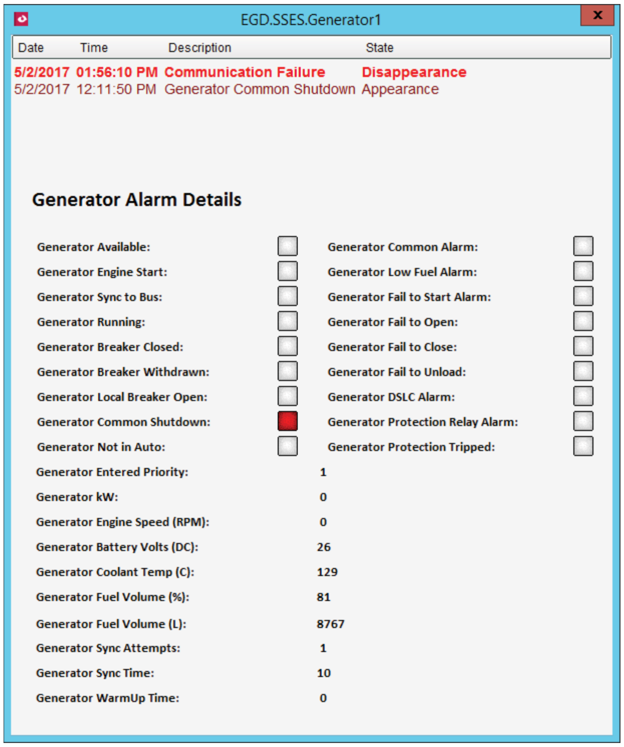
Pop-ups are super imposed diagrams to display alarms / data for equipment when navigating through one-line diagrams

Three pop-up style pages are configured for this project:

- Generator summary pop-up
- SEL 700G generator protection relay pop-up
- PowerLogic meter device pop-up

Clicking on the generator icon will open a window displaying the data points below as well as the last 5 alarms that were triggered from that specific generator and the date & time at which the SCADA system detect the alarm condition. Close the pop-up by clicking on the X in the upper right corner of the window.

The data points below are monitored directly from the TCS PLC and ION7650 devices.



Date	Time	Description	State
5/2/2017	01:56:10 PM	Communication Failure	Disappearance
5/2/2017	12:11:50 PM	Generator Common Shutdown	Appearance

Generator Alarm Details

Generator Available:	☐	Generator Common Alarm:	☐
Generator Engine Start:	☐	Generator Low Fuel Alarm:	☐
Generator Sync to Bus:	☐	Generator Fail to Start Alarm:	☐
Generator Running:	☐	Generator Fail to Open:	☐
Generator Breaker Closed:	☐	Generator Fail to Close:	☐
Generator Breaker Withdrawn:	☐	Generator Fail to Unload:	☐
Generator Local Breaker Open:	☐	Generator DSLC Alarm:	☐
Generator Common Shutdown:	🟥	Generator Protection Relay Alarm:	☐
Generator Not in Auto:	☐	Generator Protection Tripped:	☐

Generator Entered Priority:	1
Generator kW:	0
Generator Engine Speed (RPM):	0
Generator Battery Volts (DC):	26
Generator Coolant Temp (C):	129
Generator Fuel Volume (%):	81
Generator Fuel Volume (L):	8767
Generator Sync Attempts:	1
Generator Sync Time:	10
Generator WarmUp Time:	0

Figure 12: Generator pop-up

Pop-up windows to mimic the front panel display of the SEL 700G protection relays were created. LED's and trip status will displayed will correspond with actual trip alerts and the LED status.

All LED statuses are read directly from the SEL700G Modbus register map.

A breaker trip reset function is accessible for users with an L6 or greater login privilege. Users who are not logged in or are logged in using an account with a level lower than 6 (engineer) will not be able to operate the reset function.

Note the breaker trip reset function will only reset the trip status indicators on the device. The device must still be locally reset by the operator using the reset switch on located on the door of the switch gear.

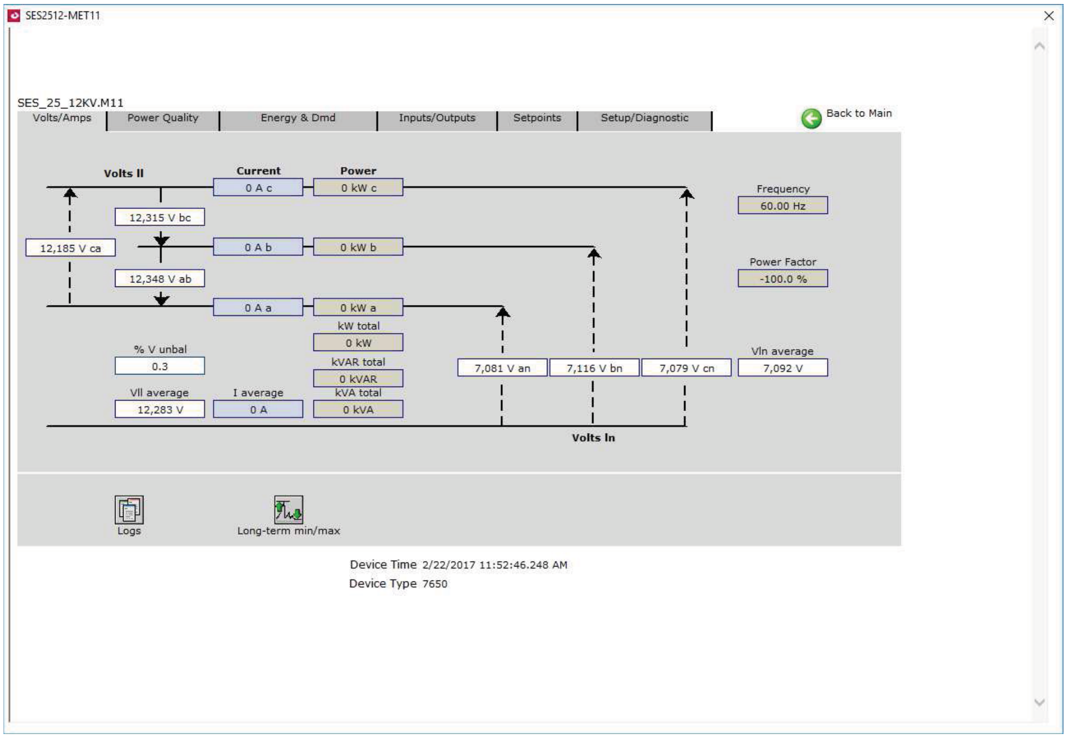
Date	Time	Description	State
5/2/2017	01:56:10 PM	Communication Failure	Disappearance
5/2/2017	12:11:50 PM	Under Voltage Trip	Appearance

CONTROL FUNCTIONS ABOVE RESTRICTED TO PHYSCIAL DEVICE FRONT PANEL

Figure 13: SEL700G generator protection relay pop-up

The metering device template is dynamically populate according the device type and configuration. There are several device types deployed at the EGD site and display formats and available data may vary according to the device. Wye and Delta configured devices will use different templates as well as legacy devices for example.

Note that only 1 metering pop-up may be opened at any moment. In order to open another device, template the initial pop-up must be closed.



Device Time 2/22/2017 11:52:46.248 AM
Device Type 7650

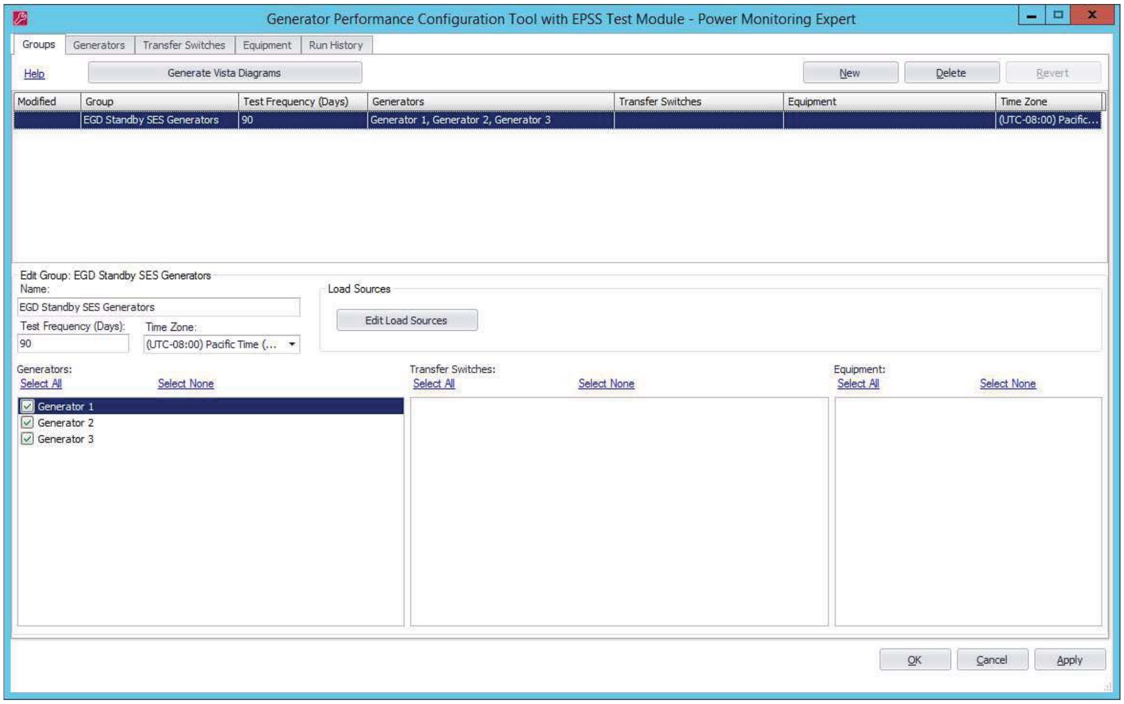
Figure 14: PowerLogic device diagram template pop-up

5 EPSS Reporting Module

The EPSS module is a reporting package integrated into the EGD PSS Advanced Reporting module which serves as an automated analysis and reporting tool for testing and reporting on backup power systems. Its purpose is to increases speed and accuracy of testing, and provides comprehensive reports to validate the results.

The EPSS module requires that metering devices are monitoring the minimum require inputs and have the required EPSS framework programmed. After having loaded the appropriate devices with the required frameworks and the frameworks have been enabled, the “Generator Performance Configuration Tool” can be run to configure the reporting module. Unless additional generators or changes to the measurements are being make, no further updates are required to the configuration.

The screen captures below illustrate the basic configuration of the EPSS reporting module. The initial setup is group the gen sets/site together. For this configuration 3 generators are configured for the “EGD Standby Generators”.



Modified	Group	Test Frequency (Days)	Generators	Transfer Switches	Equipment	Time Zone
	EGD Standby SES Generators	90	Generator 1, Generator 2, Generator 3			(UTC-08:00) Pacific...

Edit Group: EGD Standby SES Generators

Name: EGD Standby SES Generators

Test Frequency (Days): 90

Time Zone: (UTC-08:00) Pacific Time (...

Load Sources

Generators:

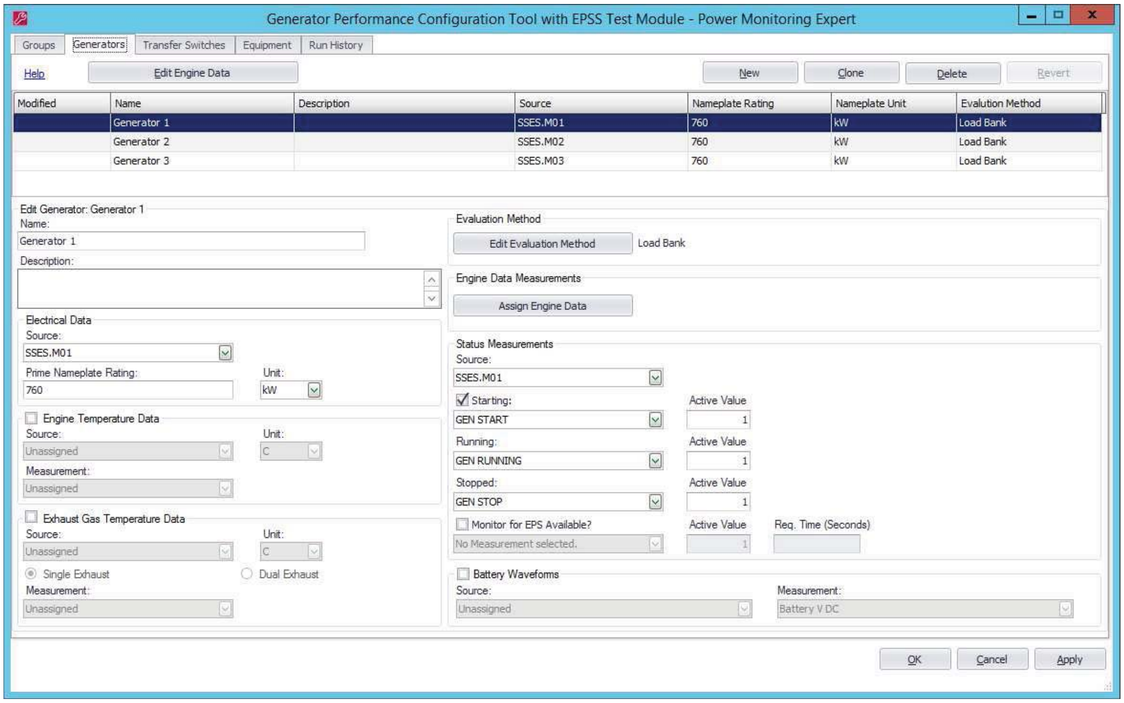
- ☑ Generator 1
- ☑ Generator 2
- ☑ Generator 3

Transfer Switches:

Equipment:

Figure 15: EPSS Group setup

Several miscellaneous measurements may be associated with each generator although they are not required. The only required inputs are the generator start,stop and running inputs as well as the high speed data log for the all the RMS measurements.



Modified	Name	Description	Source	Nameplate Rating	Nameplate Unit	Evalution Method
	Generator 1		SSES.M01	760	kW	Load Bank
	Generator 2		SSES.M02	760	kW	Load Bank
	Generator 3		SSES.M03	760	kW	Load Bank

Edit Generator: Generator 1
Name: Generator 1
Description:

Electrical Data
Source: SSES.M01
Prime Nameplate Rating: 760 Unit: kW

☐ Engine Temperature Data
Source: Unassigned Unit: C
Measurement: Unassigned

☐ Exhaust Gas Temperature Data
Source: Unassigned Unit: C
● Single Exhaust ○ Dual Exhaust
Measurement: Unassigned

Evaluation Method
Load Bank

Engine Data Measurements

Status Measurements
Source: SSES.M01
☑ Starting: GEN START Active Value 1
Running: GEN RUNNING Active Value 1
Stopped: GEN STOP Active Value 1
☐ Monitor for EPS Available? No Measurement selected. Active Value 1 Req. Time (Seconds)

☐ Battery Waveforms
Source: Unassigned
Measurement: Battery V DC

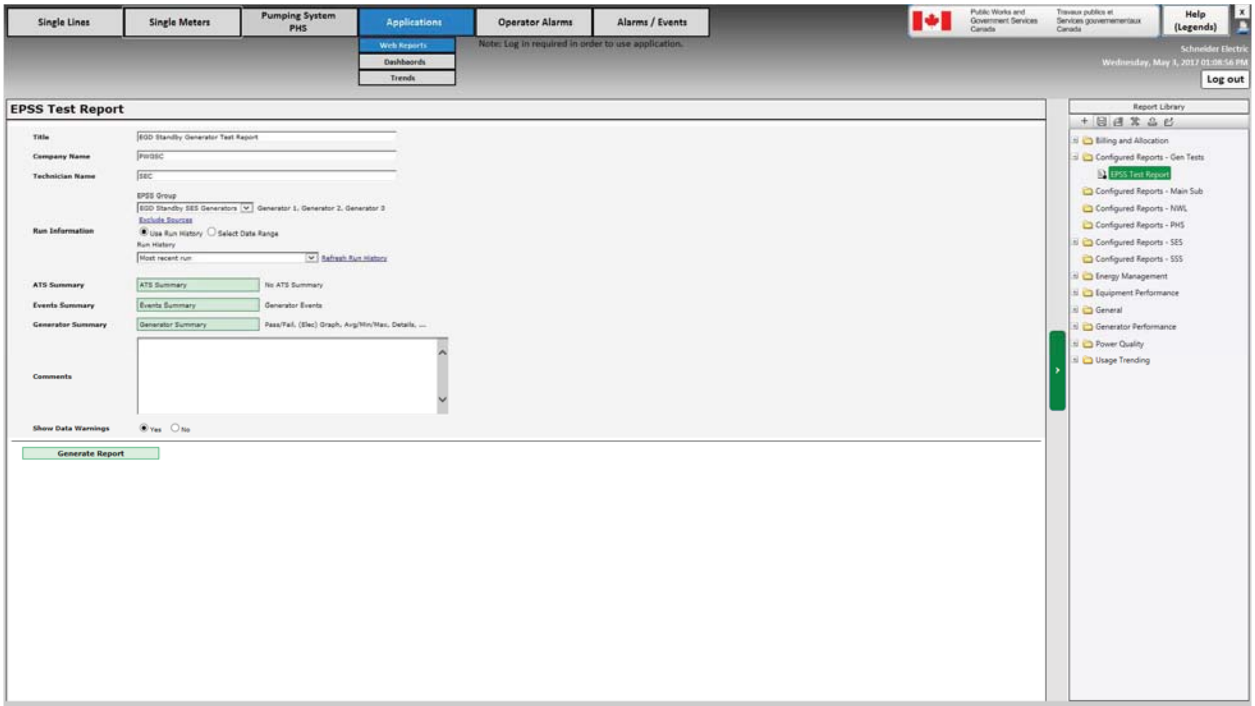
Figure 16: EPSS Generator setup

A saved report template has also been configured. To access the reports, users must be logged in on to the PSS application and that user must have operator (L4) permission or higher.

Navigate to Applicatoins / Web Reports. When the Web Reports page opens (may require 1-2 seconds to populate), go to “EPSS Test Report” under the folder “Configured Reports – Gen Tests”.

The only require input will be the selection of the run history which is a timestamp filter for the report module.

Available selections depend on then the ION7650 devices detected status changes from the generator start and stop triggers which are wired in.

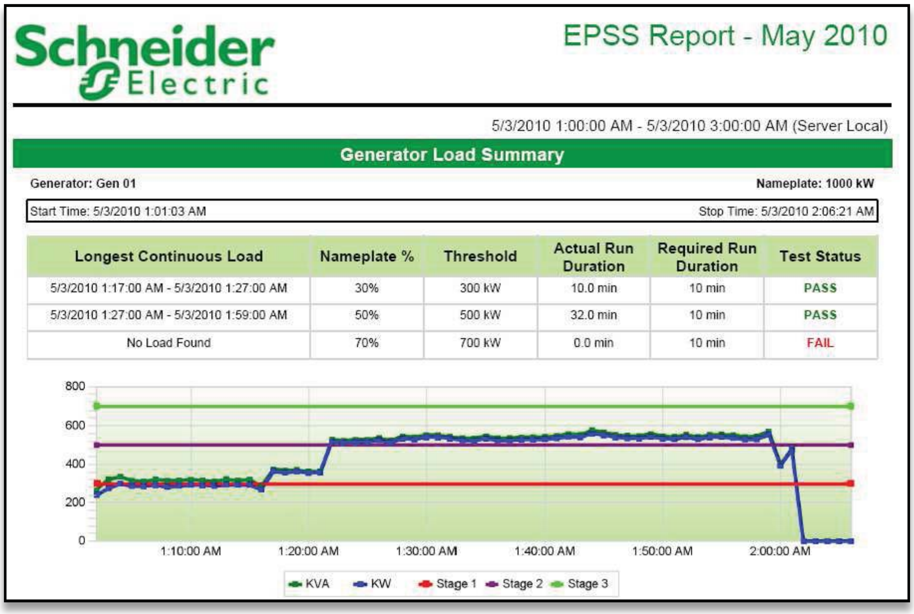


EPSS Test Report

Title: EGD Standby Generator Test Report
Company Name: PWGSC
Technician Name: SEC
Run Information: EPSS Group: EGD Standby SES Generators — Generator 1, Generator 2, Generator 3
Exclude Sources
● Use Run History ○ Select Data Range
Run History: Most recent run — Refresh Run History
ATS Summary: ATS Summary — No ATS Summary
Events Summary: Events Summary — Generator Events
Generator Summary: Generator Summary — Pass/Fail, (Elec) Graph, Avg/Min/Max, Details, ...
Comments:
Show Data Warnings: ● Yes ○ No

Figure 17: Sample EPSS Report

Below is an example for the visualization of the data provided after having configured the EPSS module and generating a report after a load test.



EPSS Report - May 2010

5/3/2010 1:00:00 AM - 5/3/2010 3:00:00 AM (Server Local)

Generator Load Summary

Generator: Gen 01 — Nameplate: 1000 kW

Start Time: 5/3/2010 1:01:03 AM — Stop Time: 5/3/2010 2:06:21 AM

Longest Continuous Load	Nameplate %	Threshold	Actual Run Duration	Required Run Duration	Test Status
5/3/2010 1:17:00 AM - 5/3/2010 1:27:00 AM	30%	300 kW	10.0 min	10 min	PASS
5/3/2010 1:27:00 AM - 5/3/2010 1:59:00 AM	50%	500 kW	32.0 min	10 min	PASS
No Load Found	70%	700 kW	0.0 min	10 min	FAIL

Figure 18: Sample EPSS Report

Appendix

a) Reference documents

- PME 8.1 Help.chm
- PME 8.1 Installation Guide.pdf
- PME 8.1 UserGuide.pdf
- PowerSCADA Expert Design Reference Guide.pdf
- PowerSCADA Installation Guide.pdf
- PM8000 - User’s guide.pdf
- ION7650 – User’s guide.pdf

b) Terminology

The following terminology is used throughout this document.

PME: Power Monitoring Expert

PSE: Power SCADA Expert

PSS: Power SCADA System

TCS: Transfer Control System

ATS: Automatic transfer switch

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT: ☐ MEMORANDUM ☐ INSTRUCTION ☐ FIELD REPORT ☒ SUBMITTAL

FOR: ☒ APPROVAL ☐ YOUR REVIEW ☐ ACTION ☐ YOUR USE ☐ COMMENT ☐ INFORMATION ☐ RECORD ☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Oct 5, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 029

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – 750KW Generator rev 4**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**GD7736 (96pgs)**	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 32 10 item 1.6
Emissions control package to follow

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax ☒ Email

Applied Engineering Solutions Ltd.
3rd Floor, 1815 Blanshard Street
Victoria, BC V8T 5A4

☐ Reviewed
☐ Revise and Resubmit
☒ Reviewed as Modified
☐ Not Reviewed

This review is only for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on shop drawings during this review do not relieve the contractor from compliance with the requirement of the plans and specifications. Review of the specific item shall not include review of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades; and for performing all Work in a safe and satisfactory manner.

Project No.: 16-008
Date: October 20, 2016
By: Iain Barnes

This review is completed with comments and is based on the design presented. It is reviewed with the understanding that follow up will be provided on the items noted, and for complete compliance with the contract documents.
This review does not preclude further commentary on subsequent submissions or correspondance.

1. 1200 amp generator breakers to be LSIG. Breaker has motor operator. Provide complete breaker and accessories information.
2. Confirm color code is RAL 7004.
3. Ensure that breaker lugs have correct size and number of terminals.
4. Full exhaust system to be wrapped with thermal blanket and stainless steel (per emissions vendor)
5. Provide engine barring device and battery tools per specifications.
6. Provide all spare parts and manuals noted in section 1.11.
7. Lighting in generator enclosure to be LED, plus battery power emergency lighting.
8. Confirm location of local load centers in generator enclosures.
9. Show coordinated emissions control panels, tanks, pumps, compressors, piping, wiring, etc.
10. Coordinate with TTI and Schneider to integerate signals, wiring, etc. Provide compelte diagram showing all wiring between systems, protection, etc.
11. Analog fuel level signal is to be be provided to SCADA system. Indicate how this is done; connected to SCADA system?
12. Refer to Section 26 32 10 2.16. Indicate compliance with all tank accessories indicated in specifications, in particular tank overfill protection devices (.12); audible/visual overfill alarm devices (.11); tight fill connections (.8); and all spare/future ports/suction/return connections noted. All features noted must be provided.
13. Seismic information and sign off to be provided.
14. Battery information to be provided.
15. Generator is NOT to shutdown in event of urea fuel depletion.
16. All equipment shall be CSA (or equivalent approval marking) approved.
17. All integration and interconnection systems (cables, hoses, piping ,etc) is the responsibility of this contractor.
18. All hardware and equipment shall be corrosion resistant.
19. Provide supplementary information from generator manufacturer regarding Tier 4F and prohibition of overfuelling/overdutying of diesel. This information to be provided for PWGSC filing purposes.
20. Submit a fully compliant, integrated shop drawing of generator and emissions equipment at the soonest.

Project 1-16-008 Responses, revise and resubmit # 4

AES # 1-Confirm generator breaker has remote trip/close motor operator. Breaker only shows shunt trip which requires manual re-close, this is not acceptable.

FPP# 1-As stated previously" on page # 3 generator index ES description 01, Adder for motor operator LCB" Explanation in further detail

ES= Engineered special, this means this is not a typical standby system design that does not have on unit paralleling controls, once the unit is built and shipped as built drawings will be available to show the details of the EO on the breaker, this should now clear up any confusion.

-AES # 2 Exhaust to be ejected towards dock (south) not straight up. Generator orientation has been revised on our sheets to prevent exhaust from entering air intakes when stack is oriented in this way.

FPP # 2 GA drawing has been added on Page 53 showing the additional components to reduce the emissions from a Tier 2 to a Tier 4, these components are DOC, DPF and SCR.

-AES # 3 Confirm compliance with EEMAC 3 Standards and the door hinges as required in item no. 1; "The roof shall have a minimum 25 mm overhang and provide rain gutters over all doors and openings. All hinges shall be internally mounted and concealed, with grease fittings as required. External hinges will not be accepted. Note that stainless steel enclosures will be considered.)

FPP # 3
The enclosure is EEMAC 3.
The enclosure does not have a rain gutter on the roof, all doors have rain gutters.
~~Hinges are all externally mounted, with tamper proof hardware,~~ grease fitting are not provided or necessary. Hinges will be similar type as sample photo provided by AES
All hinges are composite material

-AES 4 Duty rating: full load continuous plus 10% overload for 1h in every 12h period. (Or explain why not available on standby power units)

FPP# 4 As the request is for an emission compliant generator system, the EPA and CEPA do not allow overfueling of engines any longer. This has been removed from the CSA 282 -00 section 6.1.Emergency electrical power supply for buildings, the last mention of this was in the M89 version item 6.1.2. The CEPA and the EPA approvals are at the engine's stated power rating on the EPA documents. In the case of a generator set, it would be the rating of the set by the genset manufacturer – Kohler

-AES 5 Generator not 4F compliant.

FPP# 5, The generator is not T4 compliant is somewhat correct. As the C/EPA code does not regulate stationary emergency standby generator there is no manufacturer that provides a T 4 compliant emergency genset engines as of yet. However emission vendors can supply reduction systems (DOC,DPF,SCR packages with DEF injection) to reduce the tailpipe emissions down to a Tier 4 level, as the Tier 4 standard is for Non Road, portable generators only we will have to supply an external system. This system is to be attached to the existing genset enclosure structure (see page 53) We have supplied a separate submittal with details of this system as it is a very detailed package and the owner should understand what they will be receiving and ultimately maintaining.

The answer is that we will supply a packaged genset that provides a Tier 4 emission output to the Tier 4 non road standard. This system will be supplied with certificate of compliance from the manufacturer.

AES 6-For next submission please combine generator, fuel tank assembly and exhaust scrubbers into one submission such that we have a single document to discuss.

FPP # 6 Absolutely, we have put the DOC,DPF,SCR details in the emission category.

AES #7-For next submission ensure that generator dimensions/elevations shown all exterior equipment required (IE catalytic scrubbers, urea injectors/storage tanks, mufflers).

FPP # 7- See page 53

-AES #8 If the contractor cannot "factory test" the complete assembly c/w the 4F emissions equiment PWGSC has proposed to following:

1- A complete coordinated shop drawings package (including the Tier 4F solution/stack and full generator enclosure) is submitted for review and approval.

   FPP# 8-1, full emission detail submittal has been provided, we have also included it again in the emission section of the attached submittal

2- Clarify and confirm with the contractor how they will achieve the tests and performance certification for compliance of the system.

   FPP# 8-2 Compliance certificate will be supplied to confirm the system reduction attains the Tier 4 non road emissions as designated.

We hope that this concludes the review and we can begin the manufacturing and engineering process, as we are coming into the winter production season leadtimes will lengthen and production time will shorten due to factory shutdown time.

Frontier
POWER PRODUCTS
7983 Progress Way | Delta, BC V4G 1A3
Phone: 604-946-5531 | Fax: 604-946-8524
www.frontierpower.com

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: Oct 5, 2016
REVIEWED by _GW_
W P

Submittal Package

Job Name: Esquimault Graving S
Quote: 0026255062
Proposal: GD7736

We are pleased to offer the following submittal for your consideration.

Thank you, CRAIG EINARSON, FRONTIER
POWER

KOHLER. Power Systems

TABLE OF CONTENTS

Generator

Kohler Model: 750REOZMD

This diesel generator set equipped with a 5M4278 alternator operating at 347/600 volts is rated for 760 kW/950 kVA. Output amperage: 914.

Qty	Description
	750REOZMD Generator System
3	750REOZMD Generator Set
3	Battery, 2/12V,1150CCA,Wet
3	Battery Rack & Cables
3	Lit Kit, General Maint., 750REOZMD

Include the following:

ES Description 01	Adder for Motor Op. LCB
ES Description 02	Inst Pyrometer and Thermocoup.
Literature Languages	English
Approvals and Listings	Canadian cUL Tank Listing
Approvals and Listings	CSA Listing
Engine	750REOZMD,24V,60Hz
Nameplate Rating	Standby 130C Rise (25C Amb.)
Voltage	60Hz, 347/600V, Wye, 3Ph, 4W
Alternator	5M4278
Cooling System	Unit Mounted Radiator, 50C
Skid and Mounting	Skid
Air Intake	Standard Duty
Controller	DEC550
Controller Accy, Installed	Controller Connection Kit
Enclosure Type	Sound
Enclosure Material	Aluminum
Enclosure Electrical Package	Basic Electrical Pkg, 1 Ph
Enclosure Electrical Acc.	Wire Block Heater

Enclosure Electrical Acc.	Wire Battery Charger
Enclosure Heater	Enclosure Heater, 240VAC
Enclosure DC Lighting	DC Lights
Enclosure Silencer	Internal Silencer
Fuel Tank Type	State
Fuel Runtime (Approx.)	36 Hours
Subbase Fuel Tank Capacity	2859 Gallons
High Fuel Switch	High Fuel Switch
Starting Aids, Installed	9000W,240V,1Ph,w/Valves
Electrical Accy.,Installed	Batt. Chg., Float w/Alarm 10A
Electrical Accy.,Installed	Run Relay
Electrical Accy.,Installed	Failure Relay w/Harness,1Fault
Rating, LCB 1 Right	100% Rated c/w Electric Operator
Amps, LCB 1 Right	1200
Trip Type, LCB 1 Right	Electronic w/ GFI, UL/IEC/CSA
LCB 1 Right Interrupt Rating	35kA at 480V
Fuel Lines, Installed	Flexible Fuel Lines
Exceeds LTL Shipping Height	Add'l Shipping Charge Accepted
Miscellaneous Accy,Installed	Coolant in Genset
Miscellaneous Accy,Installed	Oil in Genset
Warranty	Standard

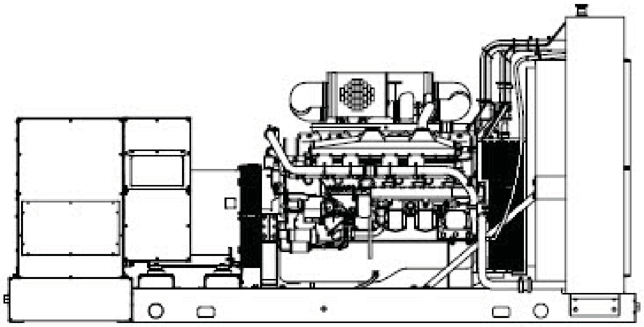
KOHLER. Power Systems

Spec Sheets

KOHLER. Power Systems

750REOZMD
Diesel

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED



Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A one-year limited warranty covers all systems and components.
- Tier 2 EPA-certified for Stationary Emergency Applications
- Seperate Emmisons reduction submittal with SCR/DPF and DOC will follow
-

Alternator Features

- The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
- The brushless, rotating-field alternator has broad range reconnectability.

Other Features

- Controllers are available for all applications. See controller features inside.
- The low coolant level shutdown prevents overheating (standard on radiator models only).Integral vibration isolation eliminates the need for under-unit vibration spring isolators.
- An electronic, isochronous governor delivers precise frequency regulation.
- Multiple circuit breaker configurations.

Generator Set Ratings

				Standby 130C Ratings	
Alternator	Voltage	Ph	Hz	kW/kVA	Amps
5M4278	347/600	3	60	760 / 950	914

RATINGS: All three-phase units are rated at 0.8 power factor.
Standby Ratings: The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating.
Prime Power Ratings: At varying load, the number of generator set operating hours is unlimited.
A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory.
Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates.
The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Model: 750REOZMD, continued

Alternator Specifications

Specifications	Alternator
Alternator manufacturer	Kohler
Type	4-Pole, Rotating-Field
Exciter type	Brushless, Permanent-Magnet Pilot Exciter
Leads, quantity	10, Reconnectable
Voltage regulator	Solid State, Volts/Hz
Insulation	NEMA MG1
Insulation: Material	Class H, Synthetic, Nonhydroscopic
Insulation: Temperature Rise	130°C, 150°C Standby
Bearing: quantity, type	1, Sealed
Coupling	Flexible disc
Amortisseur windings	Full
Rotor balancing	125%
Voltage regulation, no-load to full-load RMS	Controller Dependent
One-Step Load Acceptance	100% of rating
Unbalanced load capability	100% of Rated Standby Current

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling down stream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from a two-thirds pitch stator and skewed rotor.
- Digital solid-state, volts-per-hertz voltage regulator with +/-0.25% no-load to full-load regulation.
- Brushless alternator with brushless pilot exciter for excellent load response.

Engine

Engine Specification

Engine Manufacturer	Mitsubishi
Engine Model	S12A2-Y2PTAW-2
Engine: type	4-Cycle, Turbocharged
Cylinder arrangement	12-V
Displacement, L (cu. in.)	33.93 (2071)
Bore and stroke, mm (in.)	150 x 160 (5.91 x 6.30)
Compression ratio	15.3:1
Piston speed, m/min. (ft./min.)	576 (1890)
Main bearings: quantity, type	7, Precision Half-Shell
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	900 (1207)
Cylinder head material	Cast Iron
Crankshaft material	Forged Steel
Governor: type, make/model	Electronic
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Model: 750REOZMD, continued

Exhaust

Exhaust System

Exhaust Manifold Type	Dry
Exhaust flow at rated kW, kg/hr. (cfm)	208 (7344)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	473 (883)
Maximum allowable back pressure, kPa (in. Hg)	5.9 (1.7)
Exh. outlet size at eng. hookup, mm (in.)	See ADV Drawing

Engine Electrical

Engine Electrical System

Battery charging alternator: Ground (negative/positive)	Negative
Battery charging alternator: Volts (DC)	24
Battery charging alternator: Ampere rating	30
Starter motor rated voltage (DC)	Dual, 24
Battery, recommended cold cranking amps (CCA): Qty., CCA rating each	Two, 1150
Battery voltage (DC)	12

Fuel

Fuel System

Fuel type	Diesel
Fuel supply line, min. ID, mm (in.)	19 (0.75)
Fuel return line, min. ID, mm (in.)	19 (0.75)
Max. lift, engine-driven fuel pump, m (ft.)	1 (3)
Max. fuel flow, Lph (gph)	630 (166)
Max. fuel pump restriction, kPa (in. Hg)	10 (3.0)
Fuel filter: quantity, type	3, Cartridge
Recommended fuel	#2 Diesel

Lubrication

Lubrication System

Type	Full Pressure
Oil pan capacity, L (qt.)	100 (106)
Oil pan capacity with filter, L (qt.)	120 (127)
Oil filter: quantity, type	3, Cartridge
Oil cooler	Water-Cooled

Model: 750REOZMD, continued

Cooling

Radiator System

Ambient temperature, °C (°F)	50 (122)
Engine jacket water capacity, L (gal.)	100 (26.4)
Radiator system capacity, including engine, L (gal.)	303 (80)
Engine jacket water flow, Lpm (gpm)	1100 (291)
Charge cooler water flow, Lpm (gpm)	470 (124)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	321 (18253)
Heat rejected to charge cooling water at rated kW, dry exhaust, Kw Btu/ min.	252 (14341)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	1524 (60)
Fan, kWm (HP)	40 (54)
Max. restriction of cooling air, intake and discharge side of radiator, kPA (in. H20)	0.125 (0.5)

* Enclosure with internal silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System

Exhaust manifold type	Dry
Jacket water engine inlet, mm (in.)	95 (3.75)
Jacket water engine outlet, mm (in.)	95 (3.75)
Intercooler water engine inlet, mm (in.)	67 (2.63)
Intercooler water engine outlet, mm (in.)	95 (3.75)
Static head allowable above engine, kPa (ft. H2O)	98 (32.8)
Note:	Contact your local distributor for cooling system options and specifications based on your specific requirements.

Operation Requirements

Air Requirements

Radiator-cooled cooling air, m3/min. (scfm) *	1161 (41000)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m3/min. rise and ambient temp. of 29°C (85°F) m3/min. (cfm)	416 (14700)
Combustion air, m3/min. (cfm)	78 (2763)
Heat rejected to ambient air: Engine, kW (Btu/min.)	69 (3912)
Heat rejected to ambient air: Alternator, kW (Btu/min.)	47 (2673)
Radiator-cooled cooling air, m3/min. (scfm) *	1456 (51425)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m3/min. rise and ambient temp. of 29°C (85°F) m3/min. (cfm)	416 (14700)
Combustion air, m3/min. (cfm)	78 (2763)
Heat rejected to ambient air: Engine, kW (Btu/min.)	69 (3912)
Heat rejected to ambient air: Alternator, kW (Btu/min.)	47 (2673)

*Air density = 1.20 kg/m3 (0.075 lbm/ft3)

Fuel Consumption

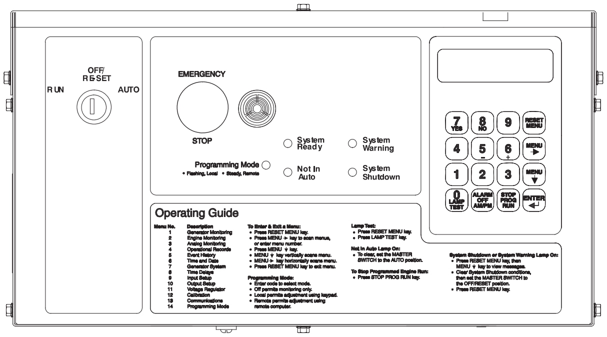
Diesel, Lph (gph), at % load	Rating
Standby Fuel Consumption at 100% load	232.3 Lph (61.4 gph)
Standby Fuel Consumption at 75% load	164.0 Lph (43.3 gph)
Standby Fuel Consumption at 50% load	108.2 Lph (28.6 gph)
Standby Fuel Consumption at 25% load	65.0 Lph (17.2 gph)
Prime Fuel Consumption at 100% load	207.1 Lph (54.7 gph)

Industrial Generator Set Accessories

KOHLER. Power Systems

Generator Set Controller

ISO 9001
KOHLER
POWER SYSTEMS
NATIONALLY REGISTERED



Operating Guide

Menu No.	Description
1	Generator Monitoring
2	Engine Monitoring
3	Analog Monitoring
4	Operational Records
5	Event History
6	Time and Date
7	Generator System
8	Time Delays
9	Input Setup
10	Output Setup
11	Voltage Regulator
12	Calibration
13	Communications
14	Programming Mode

To Enter & Exit a Menu:
- Press RESET MENU key.
- Press MENU → key to scan menus, or enter menu number.
- Press MENU ↓ key.
- MENU ↓ key vertically scans menu.
- MENU → key horizontally scans menu.
- Press RESET MENU key to exit menu.

Programming Mode:
- Enter code to select mode.
- Off permits monitoring only.
- Local permits adjustment using keypad.
- Remote permits adjustment using remote computer.

Lamp Test:
- Press RESET MENU key.
- Press LAMP TEST key.

Not In Auto Lamp On:
- To clear, set the MASTER SWITCH to the AUTO position.

To Stop Programmed Engine Run:
- Press STOP PROG RUN key.

System Shutdown or System Warning Lamp On:
- Press RESET MENU key, then MENU ↓ key to view messages.
- Clear System Shutdown conditions, then set the MASTER SWITCH to the OFF/RESET position.
- Press RESET MENU key.

Decision-Maker® 550

Kohler® Decision-Maker® 550 Controller

General Description and Function

The Decision-Maker® 550 generator set controller provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility with selected engine Electronic Control Modules (ECM).

ECM models only: The Decision-Maker® 550 controller directly communicates with the ECM to monitor engine parameters and diagnose engine problems (see Controller Diagnostics for details).

Standard Features

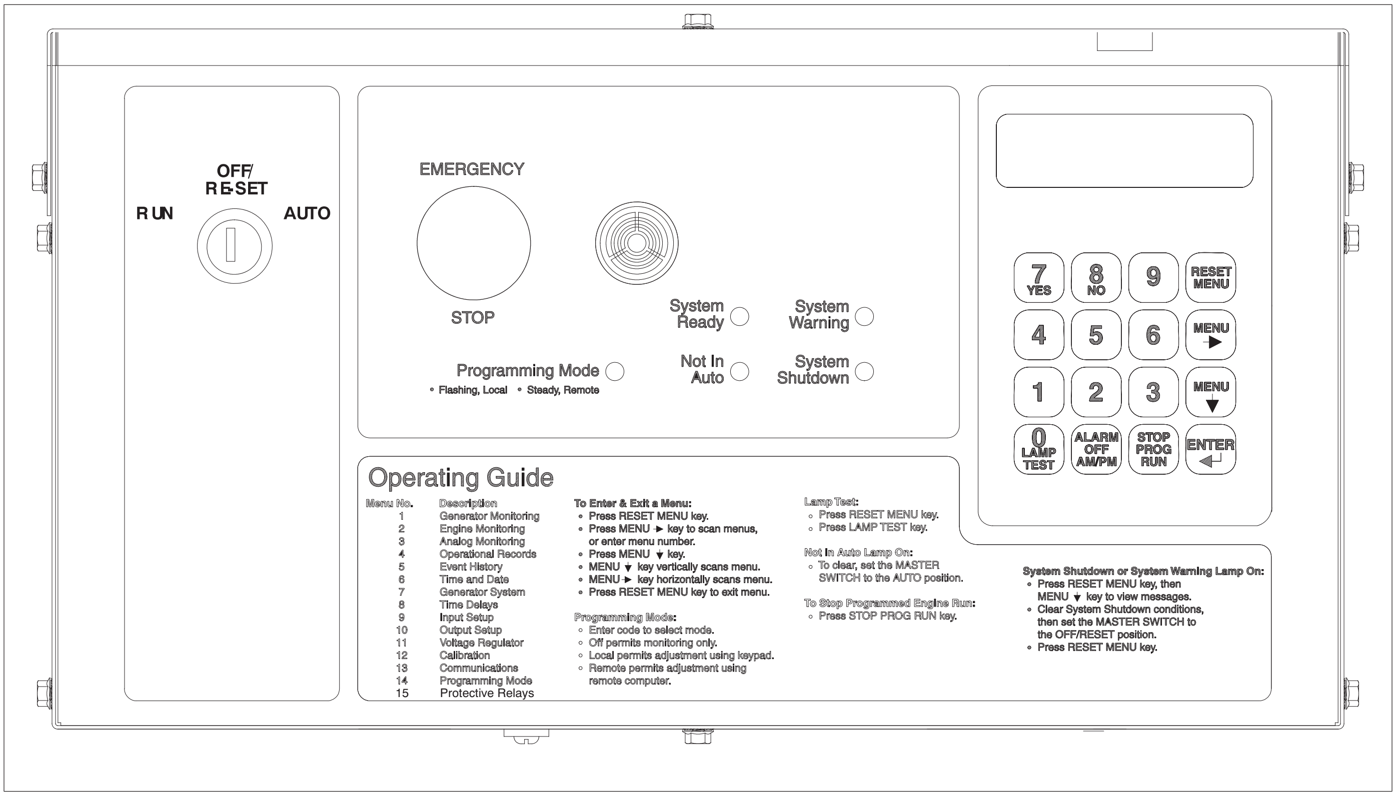
- A digital display and keypad provide access to data. The display provides complete and understandable information, and the keypad allows easy local access.
- Measurements selectable in metric or English units.
- The controller can communicate directly with a personal computer via a network or via a modem configuration.
- The controller supports Modbus® protocol. Use with serial bus or Ethernet networks. (Ethernet requires an external Modbus®/Ethernet converter module.)
- Integrated voltage regulator providing ±0.25% regulation.
- Built-in alternator thermal overload protection.
- A lockout keyswitch meets appropriate local code requirements.

Optional Features

- Monitor III, an optional menu-driven Windows®-based PC software, monitors engine and alternator parameters and also provides control capability. See G6-76 spec sheet for more information.
- Menu 15 (Protective Relays) is required for optional protective functions and is only available with the Kohler PD-Series switchgear.

Modbus® is a registered trademark of Schneider Electric.

Windows® is a registered trademark of Microsoft Corporation.



Decision-Maker® 550 Controller

Controller Features

Decision-Maker® 550—Software Version 2.70 or higher

Specifications

- Power source with circuit protection: 12- or 24-volt DC
- Power drain: 700 milliamps (or 400 milliamps without panel lamps)
- Humidity range: 5% to 95% noncondensing
- Operating temperature range: -40°C to +70°C (-40°F to +158°F)
- Storage temperature range: -40°C to +85°C (-40°F to +185°F)
- Standards:
  - NFPA 99
  - NFPA 110, Level 1
  - CSA 282-09
  - UL 508

Hardware Features

- Vacuum fluorescent display
- Environmentally sealed 16-button membrane keypad
- LED status indicating lights
- Three-position (run, off/reset, auto) keyswitch
- Latch-type emergency stop switch with International Electromechanical Commission (IEC) yellow ring identification
- Alarm horn
- Fuse-protected battery circuits
- Controller mounts locally or remotely up to a distance of 12 m (40 ft.) and viewed from one of four positions
- Dimensions—W x H x D,
  460 x 275 x 291 mm (18.15 x 10.8 x 11.47 in.)

NFPA Requirements

In order to meet NFPA 110, Level 1 requirements, the generator set controller monitors the engine/generator functions and faults shown below.

NFPA 110 Common Alarm

- Engine functions:
  - Overcrank
  - Low coolant temperature warning
  - High coolant temperature warning
  - High coolant temperature shutdown
  - Low oil pressure shutdown
  - Low oil pressure warning
  - Overspeed
  - Low fuel (level or pressure) *
  - Low coolant level
  - EPS supplying load
  - High battery voltage *
  - Low battery voltage *
  - Air damper indicator
- General functions:
  - Master switch not in auto
  - Battery charger fault *
  - Lamp test
  - Contacts for local and remote common alarm
  - Audible alarm silence switch
  - Remote emergency stop

* Function requires optional input sensors or kits and is engine dependent, see Controller Displays as Provided by the Engine ECM.

Controller Functions

The control functions apply to both the ECM and non-ECM equipped models unless noted otherwise.

- **AC Output Voltage Adjustment**
  The voltage adjustment provides keypad adjustment in 0.1 volt increments of the average line-to-line AC output voltage with a maximum adjustment of ±10% of the system voltage.

- **Alternator Protection**
  The controller firmware provides generator set overload and short circuit protection matched to each alternator for the particular voltage/phase configuration.

- **Automatic Restart**
  The controller automatic restart feature initiates the start routine and recrank when the generator set slows to less than 390 rpm after a failed start attempt.

- **Battleswitch (Fault Shutdown Override Switch)**
  The *battleswitch* input provides the ability to override the fault shutdowns except emergency stop and overspeed shutdown in emergency situations and during generator set troubleshooting.

- **Clock and Calendar**
  Real-time clock and calendar functions time stamp shutdowns for local display and remote monitor. Also use these functions to determine the generator set start date and days of operation.

- **Cooldown Temperature Override**
  This feature provides the ability to bypass (override) the cooldown temperature shutdown and force the generator set to run for the full engine cooldown time delay. Also see Time Delay Engine Cooldown (TDEC).

- **Cyclic Cranking**
  The controller has programmable cyclic cranking. The customer selects the number of crank cycles (1-6) and the crank time from 10 to 30 seconds. The crank disconnect depends upon the speed sensor input information or the generator frequency information. The default cyclic crank setting is 15 seconds on, 15 seconds off for three cycles.

- **Digital Voltage Regulator**
  The digital voltage regulator provides ±0.25% no-load to full-load regulation.

- **Display Power Shutdown**
  To conserve battery power, the display turns off after 5 minutes of inactivity. Pressing any keypad button activates the display.

- **ECM Communication**
  The controller monitors ECM communication links and provides fault detection for oil pressure signal loss, coolant temperature signal loss, and ECM communication loss. Each of these faults provides local display, alarm horn ON, and relay driver output (RDO) on ECM models only. See Controller Diagnostics following for additional information.

- **Idle Speed Function**
  Idle speed function provides the ability to start and run the engine at idle speed for a selectable time period. The engine will go to normal speed should the temperature reach warm-up before the time delay is complete.

- **Lamp Test**
  Keypad switch verifies functionality of the indicator LEDs, alarm horn, and digital display.

- **Load Shed**
  The load shed function provides a load control output (RDO) with user-selectable load shed level.

- **Master Switch Fault**
  The generator set master switch has fault detection at four levels: 1) master switch to off, 2) master switch open, 3) master switch error, and 4) master switch not in auto. Each of these faults/warnings provides local display, alarm horn on, and activates a relay driver output (RDO). By placing the master switch to the off/reset position, all generator set faults can be reset.

- **Modbus® Interface**
  The Modbus® interface provides industry standard open protocol for communication between the generator set controller and other devices or for network communications.

- **Number of Starts**
  Total number of generator set successful starts is recorded and displayed on the local display and remote PC monitor. This information is a resettable and total record.

- **Programming Access**
  The setup access and programming information is password protected. When locally accessing programming information, the PM (programming mode) LED flashes. When remotely accessing programming information, the PM LED is steady.

- **Programmed Run**
  The programmed run function provides user-selectable time for a one-time exercising of the generator set. The controller does not provide weekly scheduled exercise periods.

- **Remote Reset**
  The remote reset function resets faults and allows restarting of the generator set without going to the master switch off/reset position. The remote reset function is initiated via the remote reset digital input.

- **Running Time Hourmeter**
  The running time hourmeter function is available on the local display and remote monitor. The information displayed uses real time loaded and unloaded run time as an actual and resettable record.

- **Self-Test**
  The controller has memory protection and a microprocessor self-test.

- **Starting Aid**
  The starting aid feature provides control for an ether injection system. This setup has adjustable *on* time before engine crank from 0 to 10 seconds. This feature is also part of the remote communication option.

- **Time Delay Engine Cooldown (TDEC)**
  The TDEC provides a user-selectable time delay before the generator set shuts down. If the engine is *above* the preset temperature and unit is signalled to shut down, unit will continue to run for the duration of the TDEC. If the engine is *at or below* the preset temperature and unit is signalled to shut down or the TDEC is running, unit will shut down without waiting for the time delay to expire. Also see Cooldown Temperature Override.

- **Time Delay Engine Start (TDES)**
  The TDES provides a user-selectable time delay before the generator set starts.

Modbus® is a registered trademark of Schneider Electric.

Controller Diagnostics

The controller features warnings and shutdowns as text messages on the vacuum fluorescent display. See the table below.

Warnings show yellow LED and signal an impending problem.
Shutdowns show red LED and stop the generator set.

Note: Menu 15 features are available by purchasing the paralleling switchgear option.

Note: The available user inputs are dependent on factory reserved inputs for specific engine types, engine controls, and paralleling applications.

User-Defined Common Fault and Status. The user customizes outputs through a menu of warnings, shutdowns, and status conditions. User defines up to 31 relay driver outputs **(RDOs)** (relays not included).

	Warning Function	Shutdown Function	User-Defined	User RDOs
Engine Protection				
Air damper control, if equipped			X	X
Air damper indicator, if equipped		X	X	X
Coolant temp. signal loss		X	X	X
High battery voltage	X		X	X
High coolant temperature	X	X	X	X
High oil temp. shutdown		X	X	X
Low battery voltage	X		X	X
Low coolant level		X	X	X
Low coolant temperature	X		X	X
Low fuel level (diesel) *	X		X	X
Low fuel pressure (gas) *	X		X	X
Low oil pressure	X	X	X	X
Oil pressure signal loss		X	X	X
Overcrank		X	X	X
Overspeed		X	X	X
Speed sensor fault	X		X	X
Starting aid			X	X
Weak battery	X		X	X
General Protection				
Auxiliary inputs 0-5 VDC— up to 7 analog	X	X	X	X
Auxiliary inputs— up to 21 digital	X	X	X	X
Battery charger fault *	X		X	X
Defined common fault †			X	X
EEPROM write failure		X	X	X
Emergency stop		X	X	X
Engine cooldown delay			X	X
Engine start delay			X	X
EPS supplying load	X		X	X
Internal fault		X	X	X
Load shed kW overload	X		X	X

	Warning Function	Shutdown Function	User-Defined	User RDOs
Load shed underfrequency	X		X	X
Master switch error		X	X	X
Master switch not in auto	X		X	X
Master switch open		X	X	X
Master switch to off		X	X	X
NFPA 110 common alarm			X	X
SCRDO's 1-4 (software controlled RDOs)			X	X
System ready (status)			X	X
Alternator Protection				
AC sensing loss	X	X	X	X
Critical overvoltage		X	X	X
Generator running			X	X
Ground fault *	X		X	X
Locked rotor		X	X	X
AC Protection (includes Menu 15 Enabled Enhancements)				
Alternator protection (short circuit and overload)		X	X	X
Breaker trip			‡	X
Common protective relay output			X	X
In synchronization			‡	X
Loss of field (reverse VAR)		X	X	X
Overcurrent	X	X	X	X
Overfrequency		X	X	X
Overpower		X	X	X
Overvoltage		X	X	X
Reverse power		X	X	X
Underfrequency		X	X	X
Undervoltage		X	X	X

* Function requires optional input sensors or kits and is engine dependent, see Controller Displays as Provided by the Engine ECM.
† Factory default settings for the defined common fault are emergency stop, high coolant temperature shutdown, low oil pressure shutdown, overcrank, and overspeed.
‡ Factory set inputs that are fixed and not user changeable.

Controller Displays as Provided by the Engine ECM (availability subject to change by the engine manufacturer)

Display	GM/PSI	Doosan	John Deere (JDEC)	Volvo (EMS II)	Volvo (EDC III)	DD/MTU (ADEC)
Ambient temperature		X				
Charge air pressure	X	X		X	X	X
Charge air temperature	X	X	X	X	X	
Coolant level				X	X	X
Coolant pressure				X	X	
Coolant temperature	X	X	X	X	X	X
Crankcase pressure				X	X	
ECM battery voltage	X	X				X
ECM fault codes	X	X	X	X	X	X
ECM serial number						X
Engine model number			X			X
Engine serial number			X			X
Engine speed	X	X	X	X	X	X
Fuel pressure				X	X	
Fuel rate	X	X	X	X	X	X
Fuel temperature			X	X	X	X
Oil level					X	
Oil pressure	X	X	X	X	X	X
Oil temperature				X	X	X
Trip fuel				X	X	X

NOTE: 40-60REOZK (Kohler KDI engines) do not include an ECM as standard equipment. REOZMD/ROZMC (Mitsubishi engines) have an ECM but do not send signals to the generator set controller.

Controller Monitoring

Standard Equipment and Features

- Alarm horn
- Indicators:
  - Not in auto (yellow)
  - Program mode (yellow)
  - System ready (green)
  - System shutdown (red)
  - System warning (yellow)
- Switches and standard features:
  - Keypad, 16-button multi-function sealed membrane
  - Lamp test
  - Keyswitch, auto, off/reset, run (engine start)
  - Switch, emergency stop (normally closed contacts)
- Vacuum fluorescent display with two lines of 20 characters

Displays

Some engine displays are dependent upon enhanced electronic engine control availability.

- Engine monitoring data (metric or English units):
  - Battery voltage
  - Engine model number †
  - Engine serial number †
  - Engine speed
  - Engine start countdown
  - ECM—battery voltage †
  - ECM—fault codes
  - ECM—serial number †
  - Fuel rate
  - Level—coolant †
  - Level—oil †
  - Pressure—crankcase †
  - Pressure—charge air †
  - Pressure—coolant †
  - Pressure—fuel
  - Pressure—oil
  - Rpm
  - Temperature—ambient †
  - Temperature—charge air †
  - Temperature—coolant
  - Temperature—fuel †
  - Temperature—oil †
  - Trip fuel †
- Engine setpoints
  - Coolant—high temperature shutdown and warning setpoints
  - Oil—low pressure shutdown and warning setpoints
  - Temperature—engine cooled down setpoint
  - Temperature—engine warmed up setpoint
- Generator monitoring data:
  - Current (L1, L2, L3), ±0.25% accuracy
  - Frequency, ±0.5% accuracy
  - Kilowatts, total per phase (L1, L2, L3), ±0.5% accuracy
  - KVA, total per phase (L1, L2, L3), ±0.5% accuracy
  - KVAR, total absorbing/generating per phase (L1, L2, L3), ±0.5% accuracy
  - Percent alternator duty level (actual load kW/standby kW rating)
  - Power factor per phase, leading/lagging
  - Voltage (line-to-line, line-to-neutral for all phases), ±0.25% accuracy
- Operational records:
  - Event history (stores up to 100 system events)
  - Last start date
  - Number of starts
  - Number of starts since last maintenance
  - Operating days since last maintenance
  - Operating mode—standby or prime power
  - Run time (total, loaded and unloaded hours, and total kW hours)
  - Run time since maintenance (total, loaded, and unloaded hours and total kW hours)
  - System shutdowns
  - System warnings
  - Time, date, and day of week
- Time delays—general:
  - Crank cycles for on/pause
  - Crank cycles for overcrank shutdown
  - Engine cooldown
  - Engine start
  - Load shed
  - Voltage, over- and under-
  - Starting aid
- Time delays—paralleling relays (PR) for optional switchgear applications:
  - Current—over (PR)
  - Current—over shutdown
  - Frequency—over- and under- (PR and shutdown)
  - Loss of field (PR and shutdown)
  - Loss of field shutdown (PR)
  - Power—over (PR)
  - Power—over shutdown
  - Reverse power (PR)
  - Reverse power shutdown
  - Synch matching—frequency, phase, voltage
  - Voltage—over- and under- (PR and shutdown)
- System parameters:
  - Alternator number
  - Current, rated (based on kW, voltage, connection settings)
  - Frequency
  - Generator set model number
  - Generator set serial number
  - Generator set spec number
  - Rating, kW
  - Phase, single and three (wye or delta)
  - Voltage, AC
  - Voltage configuration, wye or delta

Inputs

- Customer and remote inputs:
  - Analog inputs 0-5 VDC (up to 7 user-defined analog inputs with multiple shutdown and warning levels)
  - Digital contact inputs (up to 21 user-defined digital inputs with shutdown or warning levels)
  - Ground fault detector *
  - Remote emergency stop
  - Remote reset
  - Remote 2-wire start
- Digital inputs (standard):
  - Air damper fault, if equipped
  - Battery charger fault *
  - Battleswitch
  - Emergency stop
  - Field overvoltage (350 kW and higher)
  - High oil temperature
  - Idle mode active (ECM models only) *
  - Low coolant level
  - Low coolant temperature
  - Low fuel warning *
  - Low fuel shutdown *
- Switchgear inputs in Menu 15 (to interface with switchgear system):
  - Circuit breaker closed
  - Enable synch
  - Lockout shutdown
  - Remote reset
  - Remote shutdown
  - VAR/PF mode selection
  - Voltage—raise/lower (or VAR/PF raise/lower in VAR/PF mode)

Outputs

See the Fault Diagnostics section for a breakdown of the available shutdown and warning functions.

- Thirty-one user-defined relay driver outputs (relays not included)
  - Fifteen NFPA 110 faults
  - Defined common faults

Communication

- RS-485 connector for Modbus® RTU communication port
- RS-232 connector for a PC or modem (optional software required)
- SAE J1939 connector for the engine ECM (engine control module)

* Function requires optional input sensors or kits and is engine dependent; see Controller Displays as Provided by the Engine ECM on page 4.

† See Controller Displays as Provided by the Engine ECM on page 4 for display availability.

Modbus® is a registered trademark of Schneider Electric.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the
US and Canada, phone 1-800-544-2444
KOHLERPower.com

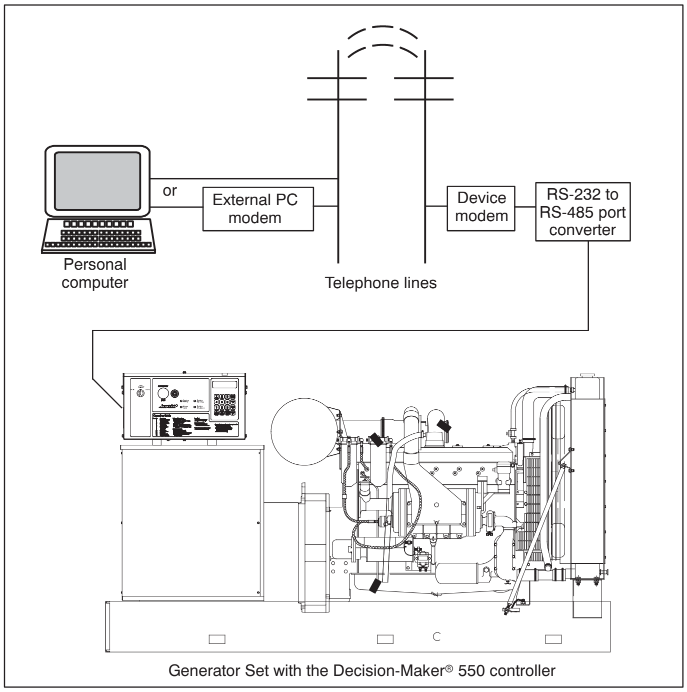
Kohler Power Systems
Asia Pacific Headquarters
7 Jurong Pier Road
Singapore 619159
Phone (65) 6264-6422, Fax (65) 6264-6455

Decision-Maker® 550 Controller Available Options

Communication and PC Software Available Options

Refer to spec sheet G6-76, Monitor III Software for additional communication and PC software information including Modbus® communication.

- ☐ **Local Single Connection.** A PC is connected directly to the device communication module with an RS-232 cable for applications where the PC is within 15 m (50 ft.) of the device or RS-485 cable for applications where the PC is up to 1220 m (4000 ft.) from the device.
- ☐ **Local Area Network (LAN).** A PC is connected directly to the device's local area network. A LAN is a system of connecting more than one device to a single PC.
- ☐ **Remote Network (Ethernet):** A PC with a NIC card uses an Ethernet connection to access a remotely located converter (Modbus®/Ethernet) serving a controller. Refer to G6-79 for system details.
- ☐ **Remote Network (Modem):** A PC uses a modem to connect to a remotely located device modem serving a controller. Monitoring software (Monitor III) runs on the PC to view system operation.
- ☐ **Monitor III Software for Monitoring and Control (Windows®-based user interface)**
- ☐ **Converter, Modbus®/Ethernet.** Supports a power system using a controller accessed via the Ethernet. Converter is supplied with an IP address by the site administrator. Refer to G6-79 for converter details.
- ☐ **RS-232 to RS-485 Port Converters**



Generator Set with the Decision-Maker® 550 controller

Availability is subject to change without notice. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler® generator set distributor for availability.

Other Available Options

- ☐ **Common Failure Relay** remotely signals auxiliary fault, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10-amp contacts at 120 VAC or 28 VDC maximum.
- ☐ **Run Relay** provides a three-pole, double-throw relay with 10-amp contacts at 120 VAC or 28 VDC maximum for indicating that the generator set is running.
- ☐ **Controller Cable** enables remote mounting of the controller with distances of up to 12 m (40 ft.) from the generator set.
- ☐ **Controller Connection Kit** provides a cable connecting the controller output terminals to a terminal strip in the junction box.
- ☐ **Dry Contact Kit** interfaces between the controller signals and customer-supplied accessories providing contact closure to activate warning devices such as lamps or horns. Kits are available with either one or ten single-pole, double-throw (form-C) relays with 10-amp contacts at 120 VAC or 28 VDC maximum.
- ☐ **Float/Equalize Battery Charger with Alarm Feature** signals controller of battery charger fault.
- ☐ **Prealarm Kit for NFPA 110 (gas fuel models only)** warns the operator of low fuel pressure. Select the kit based on LP vapor or natural gas, combination dual fuel, or LP liquid withdrawal.
- ☐ **Prime Power Switch** prevents battery drain during generator set non-operation periods and when the generator set battery cannot be maintained by an AC battery charger.
- ☐ **Remote Audiovisual Alarm Panel** warns the operator of fault shutdowns and warning conditions. Kit includes common fault lamp and horn with silence switch.
- ☐ **Remote Emergency Stop Panel** immediately shuts the generator set down from a remote station.
- ☐ **Remote Serial Annunciator (RSA) Panel** enables the operator to monitor the status of the generator set from a remote location, which may be required for NFPA 99 and NFPA 110 installations. Uses Modbus® protocol, an industry standard.

Modbus® is a registered trademark of Schneider Electric.

Windows® is a registered trademark of Microsoft Corporation.

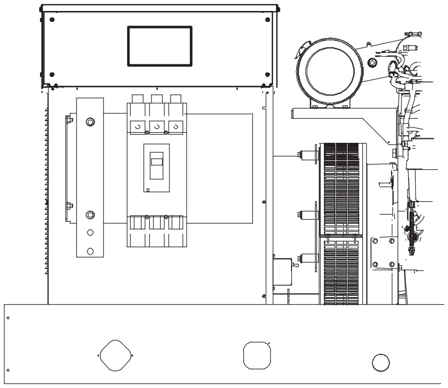
DISTRIBUTED BY:

© 2003, 2005, 2006, 2007, 2008, 2011, 2012, 2013, 2015 by Kohler Co., All rights reserved.

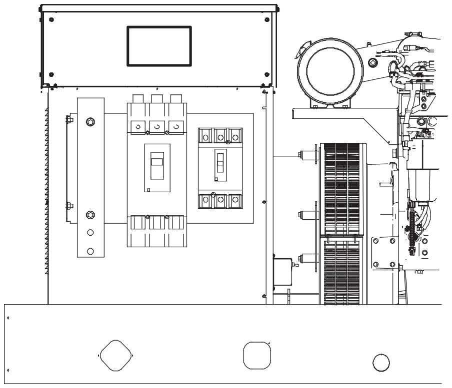
KOHLER. Power Systems

Line Circuit Breakers 15-2250 kW

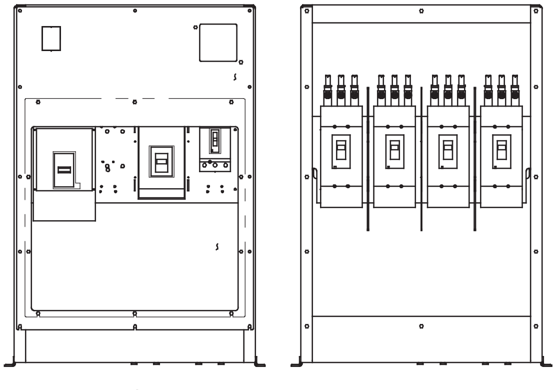
ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED



Single Circuit Breaker Kit with Neutral Bus Bar 15-300 kW Model Shown



Dual Circuit Breaker Kit with Neutral Bus Bar 15-300 kW Model Shown



Multiple Circuit Breaker Kits with Neutral Bus Bar 350-2250 kW Model Shown (also applies to some 300 kW models)

Standard Features

- The line circuit breaker interrupts the generator set output during a short circuit and protects the wiring when an overload occurs. Use the circuit breaker to manually disconnect the generator set from the load during generator set service.
- Circuit breaker kits are mounted to the generator set and are provided with load-side lugs and neutral bus bar.
- Kohler Co. offers a wide selection of molded-case line circuit breaker kits including single, dual, and multiple configurations for each generator set.
- Four types of line circuit breakers are available: (see page 2 for definitions and pages 3 and 4 for application details)
  - Magnetic trip
  - Thermal magnetic trip
  - Electronic trip
  - Electronic with ground fault (LSIG) trip
- In addition, line circuit breakers are offered with 80% and 100% ratings.
- Single line circuit breaker kits allow circuit protection of the entire electrical system load.
- Dual line circuit breaker kits allow circuit protection of selected priority loads from the remaining electrical system load.
- Multiple line circuit breaker kits with field connection barrier allow circuit protection for special applications (350-2250 kW).
- Line circuit breakers comply with the following codes and standards unless otherwise stated.
  - UL 489 Molded Case Circuit Breakers
  - UL 1077 Supplementary Protectors
  - UL 2200 Stationary Engine Generator Assemblies

Line Circuit Breaker Types

Magnetic Trip

The magnetic trip features an electromagnet in series with the load contacts and a moveable armature to activate the trip mechanism. When a sudden and excessive current such as a short circuit occurs, the electromagnet attracts the armature resulting in an instantaneous trip (UL 1077 circuit breakers).

Thermal Magnetic Trip

Thermal magnetic trip contains a thermal portion with a bimetallic strip that reacts to the heat produced from the load current. Excessive current causes it to bend sufficiently to trip the mechanism. The trip delay is dependant on the duration and excess of the overload current. Elements are factory-calibrated. A combination of both thermal and magnetic features allows a delayed trip on an overload and an instantaneous trip on a short circuit condition.

Electronic Trip

These line circuit breakers use electronic controls and miniature current transformers to monitor electrical currents and trip when preset limits are exceeded.

LI breakers are a combination of adjustable trip functions including long-time ampere rating, long-time delay, and instantaneous pickup. LSI breakers have all of the LI breaker features plus short-time pickup, short-time delay, and defeatable instantaneous pickup. LSIG breakers have all of the LSI breaker features plus ground-fault pickup and delay.

Electronic with Ground Fault Trip

The ground fault trip feature is referred to as LSIG in this document. Models with LSIG compare current flow in phase and neutral lines, and trip when current unbalance exists.

Ground fault trip units are an integral part of the circuit breaker and are not available as field-installable kits. The ground fault pickup switch sets the current level at which the circuit breaker will trip after the ground fault delay. Ground fault pickup values are based on circuit breaker sensor plug only and not on the rating plug multiplier. Changing the rating plug multiplier has no effect on the ground fault pickup values.

80% Rated Circuit Breaker

Most molded-case circuit breakers are 80% rated devices. An 80% rated circuit breaker can only be applied at 80% of its rating for continuous loads as defined by NFPA 70. Circuit conductors used with 80% rated circuit breakers are required to be rated for 100% of the circuit breaker's rating.

The 80% rated circuit breakers are typically at a lower cost than the 100% rated circuit breaker but load growth is limited.

100% Rated Circuit Breaker

Applications where all UL and NEC restrictions are met can use 100% rated circuit breakers where 100% rated circuits can carry 100% of the circuit breaker and conductor current rating.

The 100% rated circuit breakers are typically at a higher cost than the 80% rated circuit breaker but have load growth possibilities.

When applying 100% rated circuit breakers, comply with the various restrictions including UL Standard 489 and NEC Section 210. If any of the 100% rated circuit breaker restrictions are not met, the circuit breaker becomes an 80% rated circuit breaker.

Line Circuit Breaker Options

☐ Alarm Switch

The alarm switch indicates that the circuit breaker is in a tripped position caused by an overload, short circuit, ground fault, the operation of the shunt trip, an undervoltage trip, or the push-to-trip pushbutton. The alarm resets when the circuit breaker is reset.

☐ Auxiliary Contacts

These switches send a signal indicating whether the main circuit breaker contacts are in the open or closed position.

☐ Breaker Separators (350-2250 kW)

Provides adequate clearance between breaker circuits.

☐ Bus Bars

Bus bar kits offer a convenient way to connect load leads to the generator set when a circuit breaker is not present.

15-300 kW. Bus bar kits are available on alternators with leads for connection to the generator set when circuit breakers are not ordered.

350-2250 kW. A bus bar kit is provided on the right side of the unit when no circuit breaker is ordered. Bus bars are also available in combination with circuit breakers or other bus bars on the opposite side of the junction box. On medium voltage (3.3 kV and above) units, a bus bar kit is standard.

☐ Field Connection Barrier

Provides installer wiring isolation from factory connections.

☐ Ground Fault Annunciation

A relay contact for customer connection indicates a ground fault condition and is part of a ground fault alarm.

☐ Lockout Device (padlock attachment)

This field-installable handle padlock attachment is available for manually operated circuit breakers. The attachment can accommodate three padlocks and will lock the circuit breaker in the OFF position only.

☐ Neutral Lugs

Various neutral lug sizes are available to accommodate multiple cable sizes for connection to the bus bar only.

☐ Overcurrent Trip Switch

The overcurrent trip switch indicates that the circuit breaker has tripped due to overload, ground fault, or short circuit and returns to the deenergized state when the circuit breaker is reset.

☐ Shunt Trip, 12 VDC or 24 VDC

A shunt trip option provides a solenoid within the circuit breaker case that, when momentarily energized from a remote source, activates the trip mechanism. This feature allows the circuit breaker to be tripped by customer-selected faults such as alternator overload or overspeed. The circuit breaker must be reset locally after being tripped. Tripping has priority over manual or motor operator closing.

☐ Shunt Trip Wiring

Connects the shunt trip to the generator set controller.

☐ Undervoltage Trip, 12 VDC or 24 VDC

The undervoltage trips the circuit breaker when the control voltage drops below the preset threshold of 35%-70% of the rated voltage.

350-2250 kW Line Circuit Breaker Specifications

80% Rating Circuit Breaker

Gen. Set kW	Alt. Model	Ampere Range	Trip Type	C. B. Frame Size
350-2250 kW (also available on some 300 kW)	4M/ 5M/ 7M	15-150	Thermal Magnetic	HD
		60-150	Electronic LI	
		60-150	Electronic LSIG	
		175-250	Thermal Magnetic	JD
		250	Electronic LI	
			Electronic LSIG	
		60-150	Electronic LI	HG
		60-150	Electronic LSIG	
		250	Electronic LI	JG
			Electronic LSIG	
		30	9-325 A. Mag. Trip	HJ
		50	84-546 A. Mag. Trip	
		100	180-1040 A. Mag. Trip	
		150	348-1690 A. Mag. Trip	
		250	684-2500 A. Mag. Trip	JJ
		300-400	Thermal Magnetic	LA
		400	500-1000 A. Mag. Trip	
			750-1600 A. Mag. Trip	
			1000-2000 A. Mag. Trip	
			1125-2250 A. Mag. Trip	
			1250-2500 A. Mag. Trip	
			1500-3000 A. Mag. Trip	
			1750-3500 A. Mag. Trip	
			2000-4000 A. Mag. Trip	
		400-600	Electronic LI	LG
		400-600	Electronic LSIG	
		700-800	Thermal Magnetic	MG
		1000-1200	Thermal Magnetic	PG
		800-1200	Electronic LSI	
		800-1200	Electronic LSIG	
		1200	Thermal Magnetic	PJ
		1200	Electronic LSI	
		1200	Electronic LSIG	
		1600-2500	Thermal Magnetic	RJ
		1600-2500	Electronic LSI	
		1600-2500	Electronic LSIG	

Interrupting Ratings

Circuit Breaker Frame Size	240 Volt, kA	480 Volt, kA	600 Volt, kA
HD	25	18	14
HG	65	35	18
HJ	100	65	25
JD	25	18	14
JG	65	35	18
JJ	100	65	25
LA	42	30	22
LG	65	35	18
MG			
PG			
PJ	100	65	25
RJ			
NW	100	100	85

100% Rating Circuit Breaker

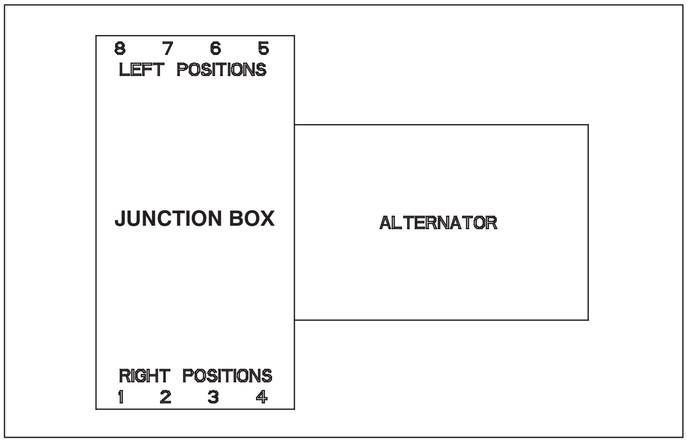
Gen. Set kW	Alt. Model	Ampere Range	Trip Type	C. B. Frame Size
350-2250 kW (also available on some 300 kW)	4M/ 5M/ 7M	15-150	Thermal Magnetic	HD
		60-150	Electronic LI	
		60-150	Electronic LSIG	
		175-250	Thermal Magnetic	JD
		250	Electronic LI	
			Electronic LSIG	
		60-150	Electronic LI	HG
		60-150	Electronic LSIG	
		250	Electronic LI	JG
			Electronic LSIG	
		400	Electronic LI	LG
			Electronic LSIG	
		600-1200	Electronic LSI	PG
		600-1200	Electronic LSIG	
		1200	Electronic LSI	PJ
		1200	Electronic LSIG	
		1600-2500	Electronic LSI	RJ
		1600-2500	Electronic LSIG	
		3000	Electronic LSI	NW
		3000	Electronic LSIG	

Circuit Breaker Lugs Per Phase (Al/Cu)

Frame Size	Ampere Range	Wire Range
HD (80%)	15-150	One #14 to 3/0
HD (100%)	15-150	One #14 to 2/0 Cu only
HG	60-150	One #14 to 3/0
HJ	30-150	One #14 to 3/0
JD (80%)	175	One 1/0 to 4/0
JD (80%)	200-250	One 3/0 to 350 kcmil
JD (100%)	175-250	One 3/0 to 300 kcmil Cu only
JG (80%)	250	One 3/0 to 350 kcmil
JG (100%)	250	One 3/0 to 300 kcmil Cu only
JJ	250	One 3/0 to 350 kcmil
LA	300-400	One #1 to 600 kcmil or Two #1 to 250 kcmil
LG	400-600	Two 2/0 to 500 kcmil
MG	700-800	Three 3/0 to 500 kcmil
PG	600-800	Three 3/0 to 500 kcmil
	1000-1200	Four 3/0 to 500 kcmil
PJ	1200	Four 3/0 to 500 kcmil
RJ	1600-2500	Eight 1/0 to 750 kcmil or (16) 1/0 to 300 kcmil
NW	3000	Eight 1/0 to 750 kcmil or (16) 1/0 to 300 kcmil

350-2250 kW Line Circuit Breaker Specifications

Breaker Positions



NOTE: Breaker and load bus phasing on right positions is A-B-C and on left positions is C-B-A.

NOTE: HD, HG, JD, JG, and LG-frames when selected with LSIG trip require two mounting spaces (one space for the breaker and one space for the LSIG neutral). These combinations are not reflected in the Multiple Circuit Breaker Combinations table on this page.

NOTE: H/J in the tables on this page refer to frame sizes HD, HG, HJ, JD, JG, and JJ.

Circuit Breaker Lugs Per Phase (Al/Cu)

Frame Size	Ampere Range	Wire Range
HD (80%)	15-150	One #14 to 3/0
HD (100%)	15-150	One #14 to 2/0 Cu only
HG	60-150	One #14 to 3/0
HJ	30-150	One #14 to 3/0
JD (80%)	175	One 1/0 to 4/0
JD (80%)	200-250	One 3/0 to 350 kcmil
JD (100%)	175-250	One 3/0 to 300 kcmil Cu only
JG (80%)	250	One 3/0 to 350 kcmil
JG (100%)	250	One 3/0 to 300 kcmil Cu only
JJ	250	One 3/0 to 350 kcmil
LA	300-400	One #1 to 600 kcmil or Two #1 to 250 kcmil
LG	400-600	Two 2/0 to 500 kcmil
MG	700-800	Three 3/0 to 500 kcmil
PG	600-800	Three 3/0 to 500 kcmil
	1000-1200	Four 3/0 to 500 kcmil
PJ	1200	Four 3/0 to 500 kcmil
RJ	1600-2500	Eight 1/0 to 750 kcmil or (16) 1/0 to 300 kcmil
NW	3000	Eight 1/0 to 750 kcmil or (16) 1/0 to 300 kcmil

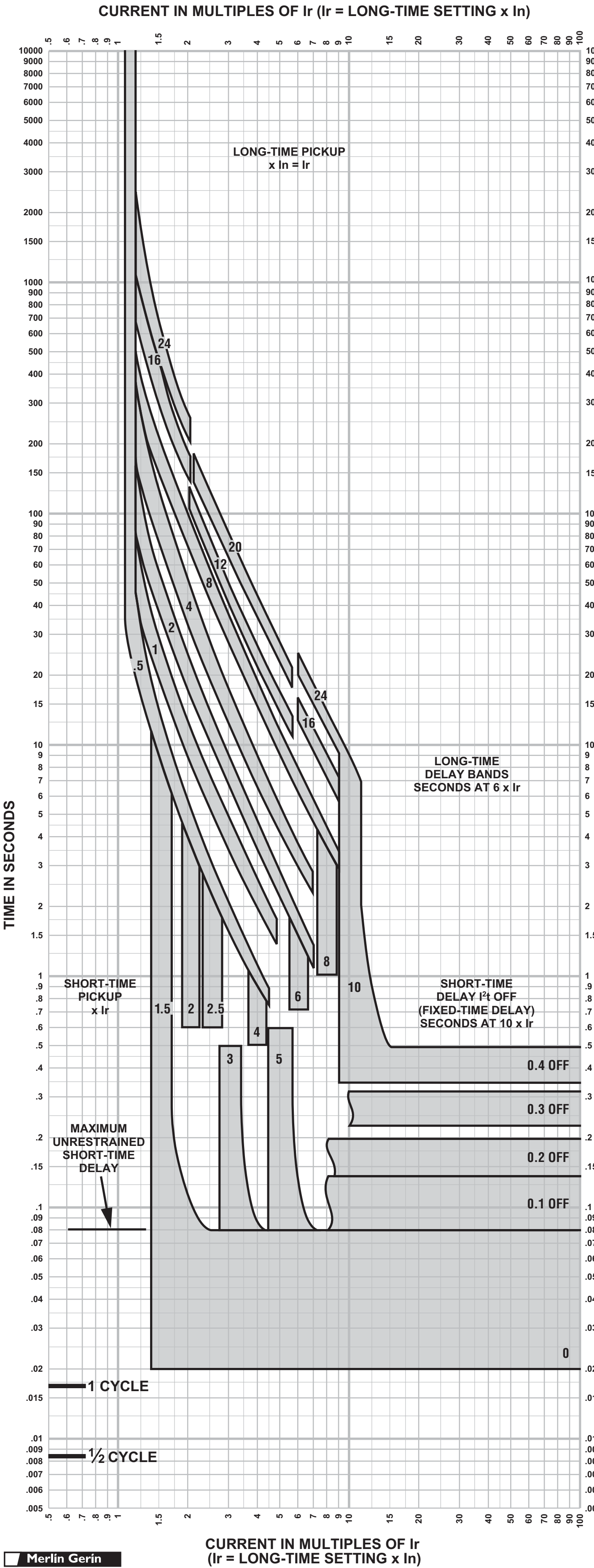
Multiple Circuit Breaker Combinations

Alternator Model	Positions			
	1 or 5	2 or 6	3 or 7	4 or 8
4M/ 5M/ 7M	H/J			
	H/J	H/J		
	H/J	H/J	H/J	
	H/J	H/J	H/J	H/J
	LA			
	LA	H/J		
	LA	LA		
	LA	H/J	H/J	
	LA	LA	H/J	
	LA	LA	LA	
	LA	H/J	H/J	H/J
	LA	LA	H/J	H/J
	LA	LA	LA	H/J
	LA	LA	LA	LA
	LG			
	LG	H/J		
	LG	LA		
	LG	LG		
	LG	H/J	H/J	
	LG	LA	H/J	
	LG	LA	LA	
	LG	LG	H/J	
	LG	LG	LA	
	LG	LG	LG	
	LG	H/J	H/J	H/J
	LG	LA	H/J	H/J
	LG	LA	LA	H/J
	LG	LA	LA	LA
	LG	LG	H/J	H/J
	LG	LG	LA	H/J
	LG	LG	LA	LA
	LG	LG	LG	H/J
	LG	LG	LG	LA
	LG	LG	LG	LG †
	MG/PG/PJ			
	MG/PG/PJ		H/J	
	MG/PG/PJ		LA	
	MG/PG/PJ		LG	
	MG/PG/PJ		MG/PG/PJ ‡	
	MG/PG/PJ		H/J	H/J
	MG/PG/PJ		LA	H/J
	MG/PG/PJ		LA	LA
	MG/PG/PJ		LG	H/J
	MG/PG/PJ		LG	LA
	MG/PG/PJ		LG	LG †
	RJ			
	NW *			
	NONE OR LOAD BUS KIT			

* Frame size NW is not available with 1219 mm (48 in.) junction box.

† Frame size LG is not available in position 4 with 1219 mm (48 in.) junction box.

‡ Frame sizes MG/PG/PJ are not available in position 3 or 4 with 1219 mm (48 in.) junction box.



MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT CHARACTERISTIC TRIP CURVE NO. 613-4

Long-time Pickup and Delay
Short-time Pickup and I²t OFF Delay

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C ambient temperature.

Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
6. Overload indicator illuminates at 100%.

Merlin Gerin
Modicon
Square D
Telemecanique
Federal Pioneer
Federal Pacific
Schneider Electric Brands

Schneider Electric

© 2000 Schneider Electric all rights reserved

Curve No. 0613TC0004
December 2000
Drawing No. B48095-613-04

POWERPACT® P- and R-Frame Molded Case Circuit Breakers (Standard or 100% rated up to 2500 A)

The most compact and innovative molded case circuit breakers

P-Frame 1200 A

R-Frame

POWERPACT Molded Case Circuit Breakers lead the industry with proven, reliable protection and innovative design. Providing unparalleled performance and control, this generation of P- and R-frame circuit breakers features exclusive MICROLOGIC® Trip Units, which allow for a range of sophisticated applications for metering and monitoring. In addition, units can be interchanged to allow for maximum flexibility and are field-installable for easy upgrades as needed.

The compact P- and R-frame circuit breakers permit smaller footprint and higher density installations using I-LINE® Panelboards and Switchboards. These circuit breakers are available in 100% rated construction up to 2500 A to meet a broad range of commercial and industrial application needs.

Full-Featured Performance

- P-frame – 1200 A available in both standard and 100% ratings with sensor sizes 250–1200 A. Interrupting ratings (AIR) G-35kAIR, J-65kAIR and L-100kAIR at 480 VAC
- R-frame – 2500 A available in both standard and 100% ratings with sensor sizes 600–2500 A. Interrupting ratings (AIR) G-35kAIR, J-65kAIR and L-100kAIR at 480 VAC
- Compact breaker size allows for smaller footprint installations using I-LINE Panelboards and Switchboards. 9" width on P-frame designs and 15" width on R-frame designs provide increased density installations
- Most field-installable accessories are common to all frame sizes for easier stocking and installation
- Selection of four interchangeable MICROLOGIC Trip Units with POWERLOGIC® power metering and monitoring capabilities available in advanced trip units
- Compatible with POWERLOGIC® systems and high amperage power circuit breakers
- Built-in MODBUS® protocol provides an open communications platform and eliminates the need to purchase additional, proprietary network solutions
- Connection options include bus, cable or I-Line for installation flexibility
- Additional options are available for 5-cycle closing, stored energy mechanisms and draw-out mounting of 1200 A breakers

POWERPACT® P- and R-Frame Molded Case Circuit Breakers
(Standard or 100% rated up to 2500 A)

Onboard Intelligence

For "smarter breakers," a range of MICROLOGIC® Trip Units provides advanced functionality, such as a communications interface, and power metering and monitoring capabilities. With the appropriate MICROLOGIC Trip Unit, you can communicate with breakers, gather power information, monitor events and remotely control breakers based on predetermined conditions, leading to substantial savings in electrical system operating costs.

These interchangeable, microprocessor-controlled, plug-in devices provide the next generation of protection, measurement and control functions, delivering not only greater electrical system safety but also improved system integration and coordination.

MICROLOGIC® Trip Units

Choose the Model that Meets Your Needs

MICROLOGIC 3.0 and 5.0

- Basic circuit protection including long-time, instantaneous and optional short-time adjustments

MICROLOGIC 3.0A, 5.0A and 6.0A

- Long-time, instantaneous and optional short-time adjustments
- Integrated ammeter and phase loading bar graph
- LED trip indicator
- Zone selective interlocking with downstream and upstream breakers
- Optional ground-fault protection
- Optional MODBUS® communications interface

MICROLOGIC 5.0P and 6.0P

- Long-time, instantaneous and optional short-time adjustments
- Advanced relay protection (current imbalance, under/over voltage, etc.)
- Inverse Definite Minimum Time Lag (IdmtL) long-time delay curve shaping for improved coordination
- Basic power metering and monitoring functions
- Standard MODBUS communications interface compatibility with POWERLOGIC® installations
- Standard GF alarm on 5.0P. 6.0P has equipment ground-fault tripping protection

MICROLOGIC 5.0H and 6.0H

- All 5.0P and 6.0P functions
- Enhanced POWERLOGIC power metering and monitoring capabilities
- Basic power quality (harmonic) measurement
- Waveform capture

Contact your Square D sales representative for additional information. Or, visit www.SquareD.com.

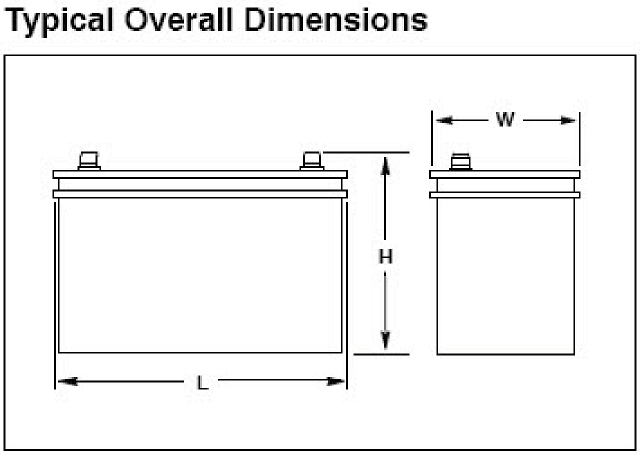
© 2002 Schneider Electric All rights reserved
Order Number 0612HO0201

SQUARE D
Schneider Electric

Industrial Generator Set Accessories

System Batteries

Typical Overall Dimensions

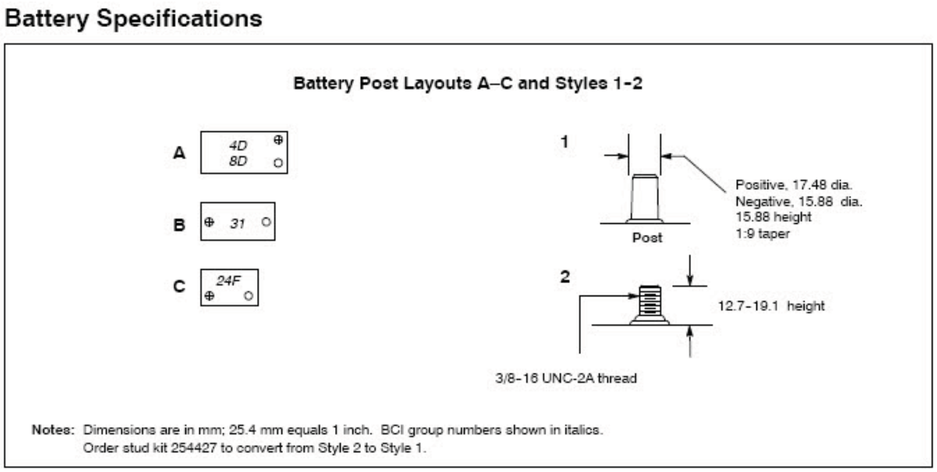


Standard Features

- Kohler Co. selects batteries to meet the engine manufacturer's specifications and to comply with NFPA requirements for engine-cranking cycles.
- Heavy-duty starting batteries are the most cost-effective means of engine cranking and provide excellent reliability in generator set applications.
- Batteries are rated according to SAE standard J-537. All batteries are 12-volt and have lead-calcium or lead-antimony plates with sulfuric acid electrolyte.
- Most generator set battery kits offer dry-charged or wet-charged batteries.
- Tough polypropylene cases protect against life-shortening vibration and impact damage.
- Removable cell covers allow checking of electrolyte specific gravity.

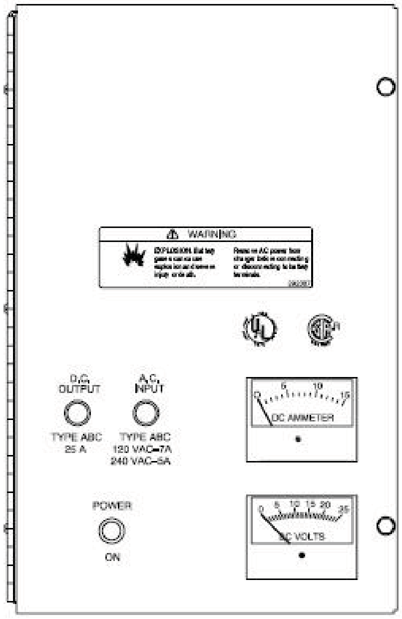
				Battery SAE Dimension, mm (in.)					
Charge Type*	Battery Part Number	Battery Qty. per Size	BCI Group Size	L	W	H	Cold Cranking Amps at 18ºC (0ºF) Min.	Reserve Capacity Minutes at 27º (80ºF) Min.	Battery Post Layout and Style
Wet	GM34399	2	8D	527.1 (20.8)	282.4 (11.1)	276.4 (10.9)	1150	400	A/1

Battery Specifications



Notes: Dimensions are in mm; 25.4 mm equals 1 inch. BCI group numbers shown in italics.
Order stud kit 254427 to convert from Style 2 to Style 1.

Float/Equalize Battery Charger



Standard Features

- Kohler automatic battery chargers feature two charging modes to keep lead-acid and nickel-cadmium batteries fully charged without overcharging.
- The battery charger automatic float-to-equalize operation maintains battery voltage with no manual intervention.
- Temperature compensation feature prevents overcharging or undercharging battery at high/low ambient temperatures.
- Current-limiting circuitry prevents battery charger from overload at low battery voltage and during a short circuit.
- The ten amp DC current limit allows the battery charger to remain connected to the battery during engine cranking.
- Battery charger complies with NFPA 110 code requirements when equipped with optional alarm circuit board.
- Alarm board features low battery voltage, high battery voltage, and battery charger malfunction alarm contacts.

NFPA 110 Alarm Outputs	Output		Number of Cells	
	Voltage	Amps	Lead Acid	Ni Cd
Yes	24	10	12	18
AC Input Voltage, Frequency	120/240 VAC			
DC Voltage Regulation	±1%			
Weight (battery charger without mounting brackets)	11.8 kg (26 lb.)			
Dimensions, L x D x H (battery charger without mounting brackets)	271 x 143 x 422 mm (10.67 x 5.63 x 16.63 in.)			

Automatic Float to Equalize

When the battery loses its charge, the battery charger operates in the High Rate Constant Current Mode until the battery voltage rises to the preset equalize level.

At the preset equalize level, the battery charger switches to the constant voltage Equalize Mode until the current required to maintain this voltage drops to 50% of the battery charger's high rate current.

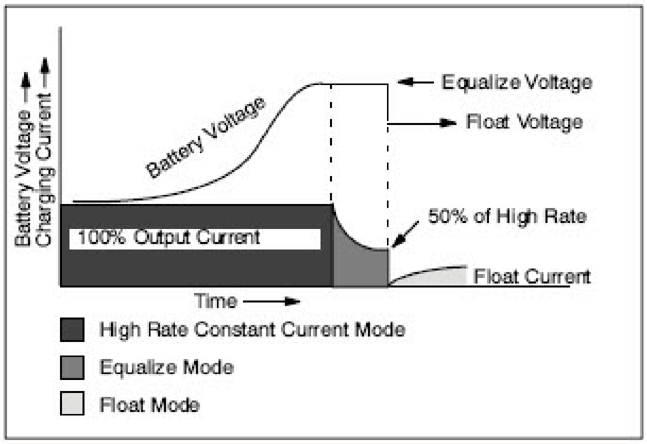


Figure 1

The battery charger then switches to the lower constant voltage Float Mode when the battery nears full charge. The battery charger continues to operate in this mode until AC input power disconnects or the current required to maintain the battery at the float voltage setting exceeds 6 amps.

Temperature Compensation

The battery charger compensates for battery temperature using a negative temperature coefficient. The battery charger provides temperature compensation of -2mv/°C per cell over the ambient temperature range of -40°C up to 60°C. The temperature compensation automatically adjusts the float and equalize voltage settings to prevent the battery from overcharging at high ambient temperatures and undercharging at low ambient temperatures.

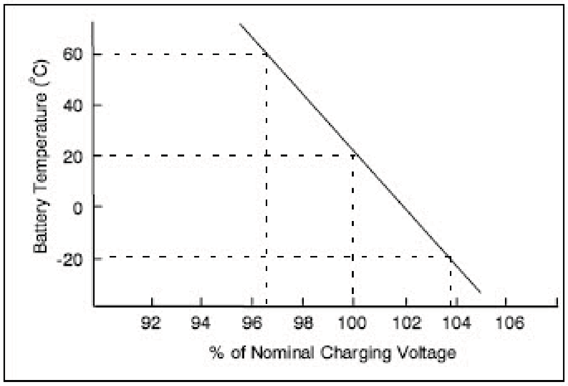


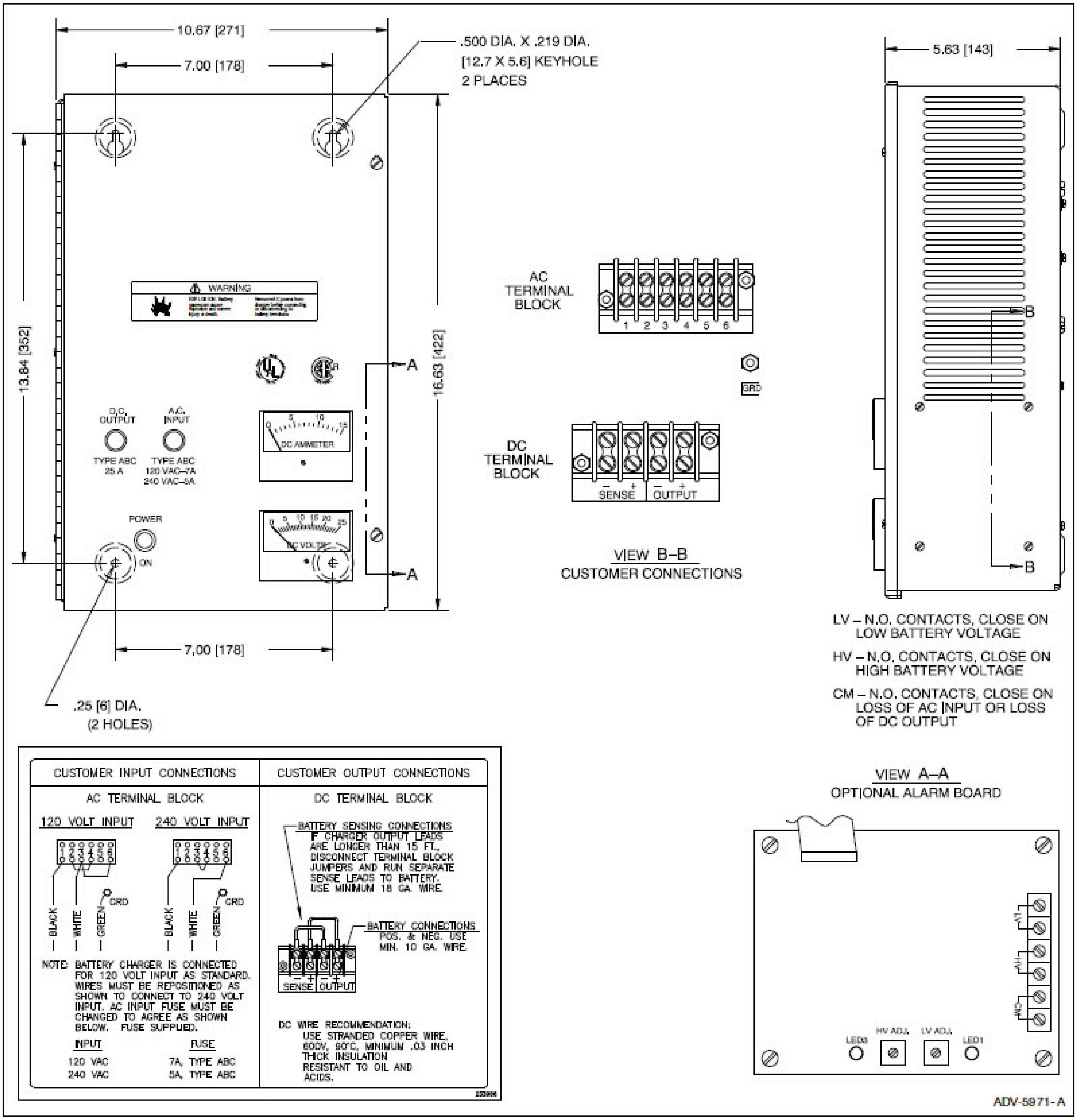
Figure 2

Standard Features

- Ammeter and voltmeter indicate battery charging rate with 5% full-scale accuracy. POWER ON lamp indicates battery charger is operating.
- AC input and DC output fuses prevent battery charger damage from abnormal overlaod and short-circuit conditions.
- Operational temperature range is from 40°C (-40°F) to 60°C (140°F). Battery charger float equalize voltage automatically adjust throughout the temperature range.
- Reverse polarity protection circuitry prevents battery charger from energizing if improperly connected.
- Internal terminal blocks for AC input and DC output/ sensing lead connections.
- DC voltage regulation of ±1% from no load to full load and AC input line voltage variations of ±10%.
- UL-1012 listed/CSA certified.
- Wall-mount, slotted enclosure with knockouts for customer conduit installation.
- Reconnection blocks allow operation at 120 or 240 volts AC, single phase, 50 or 60 hertz.
- Battery charger circuitry protected from AC line and DC load voltage spikes and transients.
- Terminal block for remote battery sensing leads.
- Automatic float-to-equalize operation with individual potentiometer adjustments. Charge up to 12 lead-acid or 18 nickel-cadmium battery cells.
- No adjustments are necessary for lead-acid or nickel-cadmium batteries.
- Oversized transformer and SCR heatsink allow constant current charging at 10 amps up to the equalize voltage setting for fastest battery charging.

Note: The battery charger will discharge the engine starting battery(ies) when the battery charger is connected to the battery(ies) and is not connected to an AC power supply. To prevent engine starting battery(ies) discharge, install battery charger relay kit GM39659.

Float/Equalize Battery Charger, continued



LV – N.O. CONTACTS, CLOSE ON LOW BATTERY VOLTAGE

HV – N.O. CONTACTS, CLOSE ON HIGH BATTERY VOLTAGE

CM – N.O. CONTACTS, CLOSE ON LOSS OF AC INPUT OR LOSS OF DC OUTPUT

NOTE: BATTERY CHARGER IS CONNECTED FOR 120 VOLT INPUT AS STANDARD. WIRES MUST BE REPOSITIONED AS SHOWN TO CONNECT TO 240 VOLT INPUT. AC INPUT FUSE MUST BE CHANGED TO AGREE AS SHOWN BELOW. FUSE SUPPLIED.

INPUT	FUSE
120 VAC	7A, TYPE ABC
240 VAC	5A, TYPE ABC

BATTERY SENSING CONNECTIONS
IF CHARGER OUTPUT LEADS ARE LONGER THAN 15 FT., DISCONNECT TERMINAL BLOCK JUMPERS AND RUN SEPARATE SENSE LEADS TO BATTERY. USE MINIMUM 18 GA. WIRE.

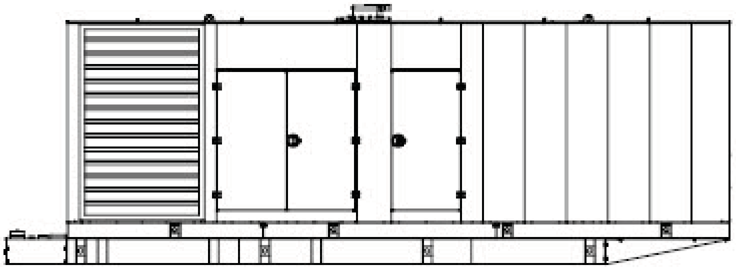
BATTERY CONNECTIONS
POS. & NEG. USE MIN. 10 GA. WIRE.

DC WIRE RECOMMENDATION:
USE STRANDED COPPER WIRE, 600V, 90°C, MINIMUM .03 INCH THICK INSULATION RESISTANT TO OIL AND ACIDS.

KOHLER. Power Systems

Sound Enclosure with Subbase Fuel Tank Package

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED



Sound Enclosure

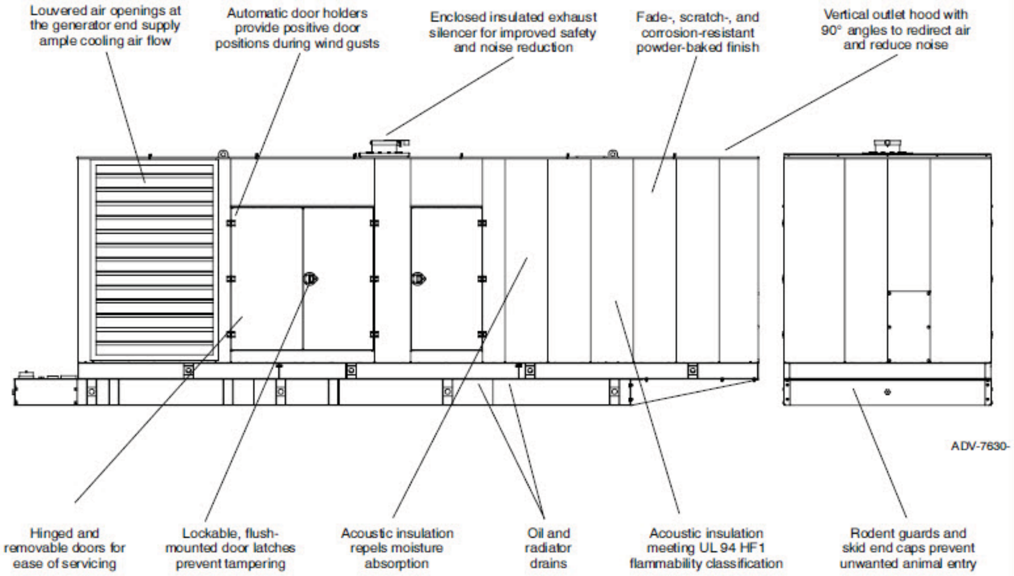
Sound Enclosure Standard Features

- Internal-mounted, critical exhaust silencer with rain cap.
- Lift base or tank-mounted, steel or aluminum construction with hinged and removable doors. Aluminum enclosures recommended for high humidity and/or high salt/coastal regions.
- Fade-, scratch-, and corrosion-resistant Kohler® cream beige powder-baked finish.
- Lockable, flush-mounted door latches.
- Air inlet louvers reduce rain and snow entry.
- Acoustic insulation that meets UL 94 HF1 flammability classification.
- Sound attenuated enclosure that offers an average of 67 dB(A) sound level at 7 m (23 ft.) using acoustic insulation, acoustic-lined air inlets and an acoustic-lined air discharge.

Subbase Fuel Tank Features

- The above-ground rectangular secondary containment tank mounts directly to the generator set, below the generator set skid (subbase).
- Both the inner and outer UL-listed tanks have emergency relief vents.
- Flexible fuel lines are provided with subbase fuel tank selection.
- The containment tank's construction protects against fuel leaks or ruptures. The inner (primary) tank is sealed inside the outer (secondary) tank. The outer tank contains the fuel if the inner tank leaks or ruptures.
- The above ground secondary containment subbase fuel tank meets UL 142 requirements.

Sound Enclosure



Enclosure ships assembled on subbase fuel tank or lifting base.

Sound Enclosure Features

- Available in steel (14 gauge) or aluminum (3mm [0.125 in.]) formed panel, solid construction. Preassembled package offering corrosion resistant (aluminum), dent resilient structure mounting directly to the lift base or fuel tank.
- Powder-baked paint. Superior finish, durability, and appearance.
- Interchangeable modular panel construction. Allows complete serviceability or replacement without compromising enclosure design.
- Internal critical exhaust silencer. Offers maximum component life, operator safety, and includes rain shield and cap.
- Note: Installing an additional length of exhaust tail pipe may increase backpressure levels. Please refer to the generator set spec sheet for the maximum backpressure value.
- Attenuated design. Acoustic insulation UL 94 HF1 listed for flame resistance; 75 dB(A) design offering mechanically restrained acoustic insulation in enclosure only.
- Service access. Multi-personnel doors for easy access to generator set control and servicing of the fuel fill, fuel gauge, oil fill, and battery.
- Cooling/Combustion Air Intake. Attenuated models offering fixed air inlet louvers. The 75 dB(A) models include acoustic insulation lining with urethane film.

- Extended operation. Usable tank capacities offers full load standby operation of up to 72 hours.
- Power Armor Plus textured epoxy-based rubberized coating that creates an ultra-thick barrier between the tank and harsh environmental conditions like humidity, saltwater, and extreme temperatures, and provides advanced corrosion and abrasion protection
- UL listed. Secondary containment generator set base tank meeting UL 142 tank requirements.
- NFPA compliant. Designed to comply with the installation standards of NFPA 30 and NFPA 37.
- Integral external lift lugs. Enables crane with spreader-bar lifting of the complete package (empty tank, mounted generator set, and enclosure) to ensure safety.
- Emergency pressure relief vents. Meets UL requirements; ensures adequate venting of inner and outer tank under extreme pressure and/or emergency conditions.
- Normal vent with cap. Vent is raised above lockable fuel fill.
- Fuel level sender with fuel level and low and high fuel warning annunciated through the generator set controller.
- Leak detection switch. Annunciates a contained primary tank fuel leak condition at generator set control.
- Electrical stub-up.
- State tank designed to comply with with Forida Dept. of Environmental Protection (FDEP) File No. EQ-634 installation standards.

Fuel Tank Capacity, L (gal.)	Est. Fuel Supply Hours at 60 Hz with Full Load	Enclosure and Fuel Tank Length, mm (in.)	Enclosure and Fuel Tank Width, mm (in.)	Enclosure and Fuel Tank Weight, kg (lb.)	Enclosure and Fuel Tank Height, mm (in.)	Fuel Tank Height (H), mm (in.)	Sound Pressure Level, dB(A)
Lift base	0	8826 (347)	2645 (104)	10142 (22360)	3253 (128)	254 (10)	67
10824 (2859)	36	9594 (378)	2645 (104)	13708 (30220)	3913 (154)	914 (36)	67

Note: Data in table is for reference only, refer to the respective ADV drawings for details.
Note: Refer to TIB-114 for generator set sound data.
* Max weight includes the generator set (wet) with the largest alternator option, enclosure, silencer, and tank (no fuel).

Accessories

Basic Electrical Package (BEP)

Distribution panel/load center. Prewired AC power distribution of all factory-installed features including block heater, two GFCI-protected internal 120-volt service receptacles, internal lighting, and commercial grade wall switch.The load center powered by building source power and protected by a main circuit breaker, rated for 100 amps with capacity and circuit positions for future expansion.AC power distribution installed in accordance with NEC and all wiring within EMT thin wall conduit. Four incandescent or fluorescent lights located within UL-listed fixtures designed for wet locations.

Enclosure Heater

Heater, 5 kW Ceiling Mounted. Electrical utility heater prewired to load center internal to enclosure. Rated at 17100 Btu includes adjustable louvers offering down flow and horizontal air tuning, built-in thermostat with automatic fan delay controls.

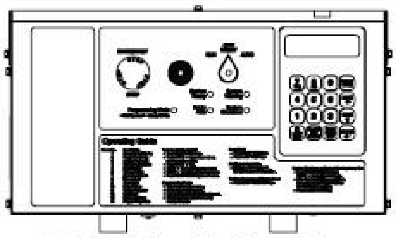
DC Light Package

Prewired DC light package offering an economical alternative light source within the enclosure, as a complement to the BEP or a source of light when AC power is not available.Battery drain limited with fuse protection and controlled through a 0-60 minute, spring-wound, no-hold timer.

Battery Charger, Mounted.
Mounting, prewiring of DC output and AC input when optional BEP is selected. Battery charger located inside the enclosure and accessible through an access door.

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

Integral Voltage Regulator with Kohler® Decision-Maker® 550 and Menu-Driven Selections (20-3250 kW Generator Set Models)



550 Controller with Menu-Driven Integral Voltage Regulator

The voltage regulator is integral to the controller and uses microprocessor logic providing ±0.25% no-load to full-load regulation using root-mean-square (RMS) voltage sensing. The voltage regulator features three-phase sensing and is available for 12- or 24-volt engine electrical systems.

Voltage Regulators

The following information provides general features, specifications, and functions of available voltage regulators.

This information generally applies to a single generator set and multiple generator sets with paralleling applications. Refer to the respective generator set specification sheet and see your authorized distributor for information regarding specific voltage regulator applications and availability.

Integral Voltage Regulators with Decision-Maker® 550 Controllers

Calibration	Digital Display	Range Settings	Default Selection
Voltage Adjustment	Volt Adj	±20% of System Voltage	System Voltage
Controller Gain	Regulator Gain	1-1000	100
Underfrequency Unload or Frequency Setpoint	Frequency Setpoint	40 to 70 Hz	1 Hz Below System Frequency (ECM) 2 Hz Below System Frequency (non-ECM)
Underfrequency Unload Scope	Slope	0-10% of Rated Voltage (Volts per Cycle)	15 volts per Cycle at 480 Volts (3.1%)
Reactive Droop	Voltage Droop	0-10% of System Voltage	4% of System Voltage
VAR Control	kVAR Adj	-35% to 110%	0 kVAR
PF Adjust Control	PF Adj	0.70 to 1.0 to 0.60	0.8 Lagging
VAR/PF Gain Adjustment	VAR/PF Gain	1-10000	100

Specification/Feature	Integral with Decision-Maker® 550
Generator Set Availability	350-2250 kW
Type	Microprocessor Based
Status and Shutdown Indicators	LEDs and Text Vacuum Fluorescent Display (VFD) Display
Operating Temperature	-40°C to 70°C (-40°F to 158°F)
Storage Temperature	-40°C to 85°C (-40°F to 185°F)
Humidity	5-95% Non-Condensing
Circuit Protection	Solid-State, Redundant Software and Fuses
Sensing, Nominal	100-240 Volts (L-L), 50-60 Hz
Sensing Mode	RMS, Single- or 3-Phase
Input Requirements	8-36 VDC
Continuous Output	12 VDC @ 100mA max. 5.0 ADC with GM88453 Activator Board
Maximum Output	12 VDC @ 100mA max. 7.8 ADC with GM88453 Activator Board
Transition Frequency	50-70 Hz
Exciter Field Resistance	4-30 Ohms with GM88453 Activator Board
No-Load to Full-Load Voltage Regulation	±0.25%
Thermal Drift	<0.5% (-40°C to 70°C) [-40°F to 158°F] Range
Response Time	Less than 5µS
System Voltage Adjust.	±10%
Voltage Adjustment	Controller Keypad
Remote Voltage Adjustment	Digital Input Standard/ Analog 0-5 VDC (±10%) Input Optional
Paralleling Capability	Reactive Droop Standard
VAR/PF Control Input	Standard

Integral Voltage Regulator with Decision-Maker® 550 Controller

- A digital display and keypad provide access to data. A two-line vacuum fluorescent display provides complete and concise information.
- The controller provides an interface between the generator set and switchgear for paralleling applications incorporating multiple generator set and/or utility feeds.
- The controller can communicate with a personal computer directly or on a network. See spec sheets G6-76, Monitor III Software for more information.
- Using optional menu-driven, Windows®-based PC software, an operator can monitor engine and alternator parameters and also provide control capability.
- The controller supports Modbus® RTU (Remote Terminal Unit), an industry standard open communication protocol.
- These controllers can control Fast Response^{TM} II, Fast Response^{TM} X, and wound field alternators using the GM88453 activator board.

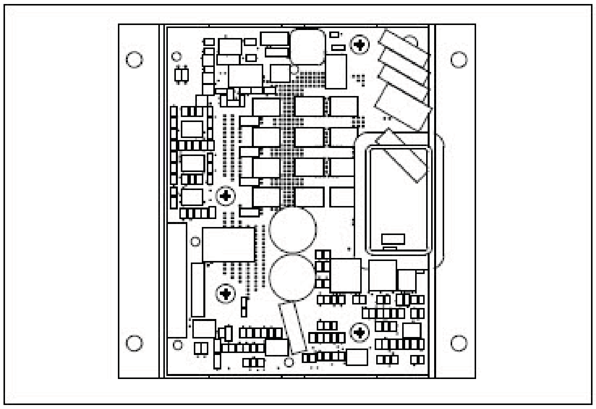
Voltage Regulator Menu 11 Displays

- Voltage Adjust
  - Three-phase voltage display
  - Numeric entry of voltage adjust
- Under frequency unload (V/Hz) settingts
  - Enable/disable
  - Cut-in frequency
  - Numeric entry of V/Hz slope
- Reactive Droop settings
  - Enable/disable
  - Numeric entry of droop settings
- VAR control enabled, yes/no
  - Total kVAR (running), kVAR adjustment
  - Generating/absorbing yes/no
- Power factor control enabled yes/no, droop at rated load 0.8 PF
  - Average power factor (running), PF adjustment
  - Lagging/leading, yes/no
- Voltage regulator gain
- Analog voltage regulator adjust enable

Modbus® is a registered trademark of Schneider Electric.

Windows® is a registered trademark of Microsoft Corporation.

Activator Board GM88453



- Interfaces between the controller and alternator assembly using rotor field leads, auxiliary power windings, and optic board leads.
- Allows the Decision-Maker® controllers the ability to control a wound-field alternator using the same control signal as Fast Response^{TM} alternator.
- Permits the generator set controller to control the current to the exciter field of a wound-field excited alternator.
- Contains two isolated relay driver outputs (RDO) rated at 250 mA. Provides RDO outputs indicating a field over-excitation condition and that the alternator is supplying voltage to the activator.

Modbus® is a registered trademark of Schneider Electric.

Alternator Data

KOHLER
Power Systems

TECHNICAL INFORMATION BULLETIN

Alternator Data Sheet

Alternator Model: 5M4278 (6-6-13)

Kilowatt ratings at	1800 RPM			60 Hertz		4 LEADS	Dedicated voltage 3 phase		
kW (kVA)	3 Phase			0.8 Power Factor			Dripproof or Open Enclosure		
	Class B	Class F					Class H		
Voltage*	80° C ① Continuous	90° C ① Lloyds	95° C ① ABS	105° C ② British Standard	105° C ① Continuous	130° C ① Standby	125° C ② British Standard	125° C ① Continuous	150° C ① Standby
600	700 (875)	725 (906)	750 (938)	820 (1025)	825 (1031)	875 (1094)	820 (1025)	875 (1094)	900 (1125)

① *Rise by resistance method, Mil-Std-705, Method 680.1b.*

② *British Standard Rating per BS 5000*

Submittal Data: 600 Volts*, 875 kW, 1093 kVA, 0.8 P.F., 1800 RPM, 60 Hz, 3 Phase **STD. CONNECTION**

Mil-Std-705B

Method	Description	Value
301.1b	Insulation Resistance	>1.5 Meg
302.1a	High Potential Test	
	Main Stator	2200 Volts
	Main Rotor	1500 Volts
	Exciter Stator	1500 Volts
	Exciter Rotor	1500 Volts
	PMG Stator	1500 Volts
401.1a	Stator Resistance, Line to Line	
	High Wye Connection	0.0069 Ohms
	Rotor Resistance	0.584 Ohms
	Exciter Stator	23 Ohms
	Exciter Rotor	0.045 Ohms
	PMG Stator	2.1 Ohms
410.1a	No Load Exciter Field Amps at 600 Volts Line to Line	0.81 A DC
420.1a	Short Circuit Ratio	0.773
421.1a	Xd Synchronous Reactance	2.27 pu
		0.748 ohms
422.1a	X2 Negative Sequence React.	0.177 pu
		0.058 ohms
423.1a	X0 Zero Sequence Reactance	0.052 pu
		0.017 ohms
425.1a	X'd Transient Reactance	0.119 pu
		0.039 ohms
426.1a	X"d Subtransient Reactance	0.108 pu
		0.036 ohms
--	Xq Quadrature Synchronous	0.972 pu
		0.32 ohms
427.1a	T'd Transient Short Circuit Time Constant	0.127 sec.
428.1a	T"d Subtransient Short Circuit Time Constant	0.014 sec.
430.1a	T'do Transient Open Circuit Time Constant	2.33 sec.
432.1a	Ta Short Circuit Time Constant of Armature Winding	0.02 sec.

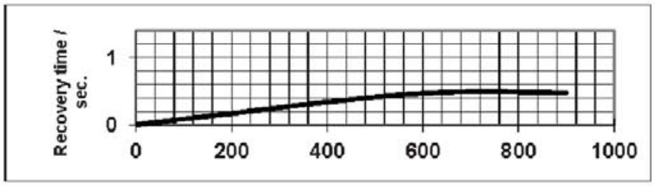
Mil-Std-705B

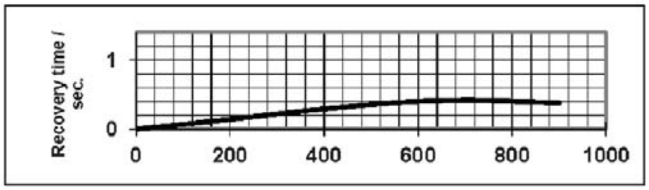
Method	Description	Value
505.3b	Overspeed	2250 RPM
507.1c	Phase Sequence CCW-ODE	ABC
508.1c	Voltage Balance, L-L or L-N	0.20%
601.4a	L-L Harmonic Maximum - Total (Distortion Factor)	5.0%
601.4a	L-L Harmonic Maximum - Single	3.0%
601.1c	Deviation Factor	5.0%
---	TIF (1960 Weightings)	< 50
---	THF (IEC, BS & NEMA Weightings)	< 2 %
652.1a	Shaft Current	< 0.1 ma
---	Main Stator Capacitance to ground	0.037 mfd
	Additional Prototype Mil-Std Methods are Available on Request.	
--	Generator Frame	574
--	Type	MAGNAMAXDVR
--	Insulation	Class H
--	Coupling - Single Bearing	Flexible
--	Amortisseur Windings	Full
--	Excitation	Ext. Voltage Regulated, Brushless
--	Cooling Air Volume	1220 CFM
--	Heat rejection rate	2804 Btu's/min
--	Full load current	1052 amps
--	Minimum Input hp required	1239.0
	Efficiency at rated load :	94.7%
--	Full load torque	3614 Lb-ft

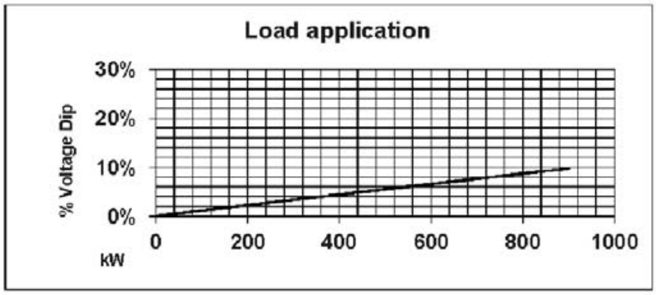
* Voltage refers to wye (star) connection, unless otherwise specified.

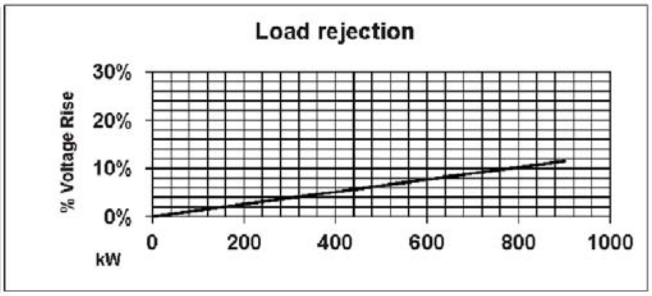
TYPICAL DYNAMIC CHARACTERISTICS

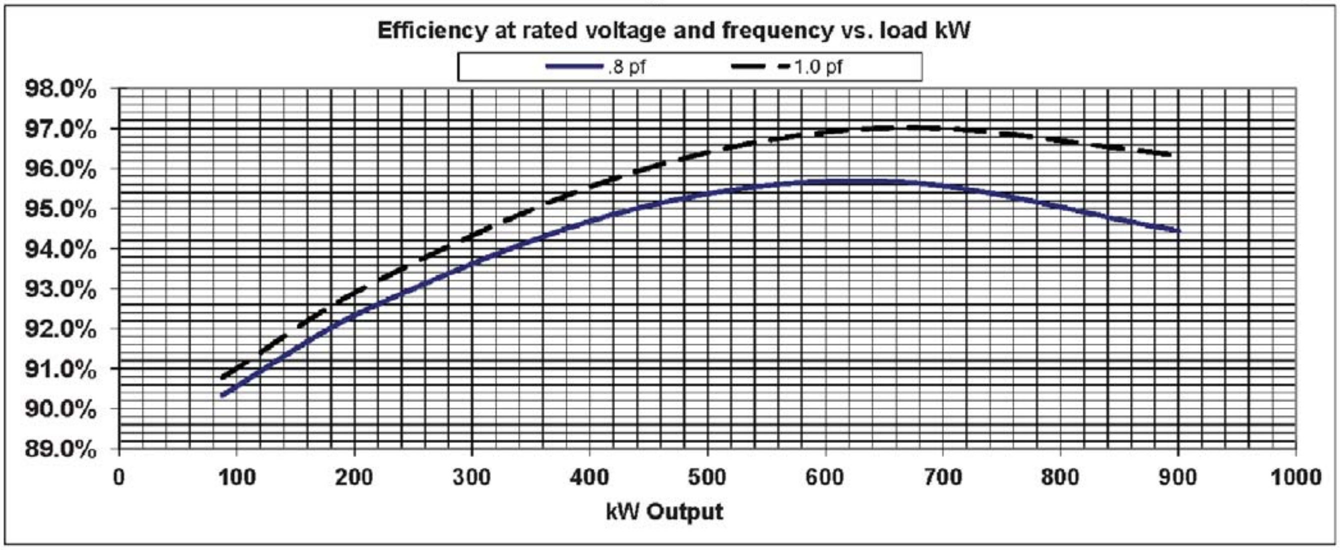
Alternator Model: 5M4278

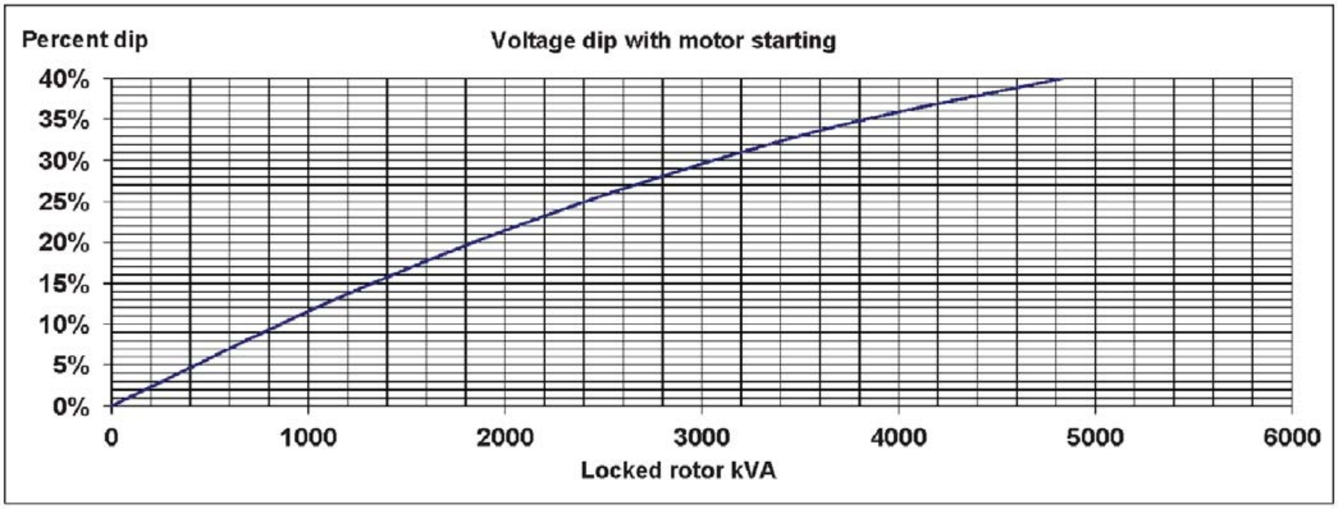








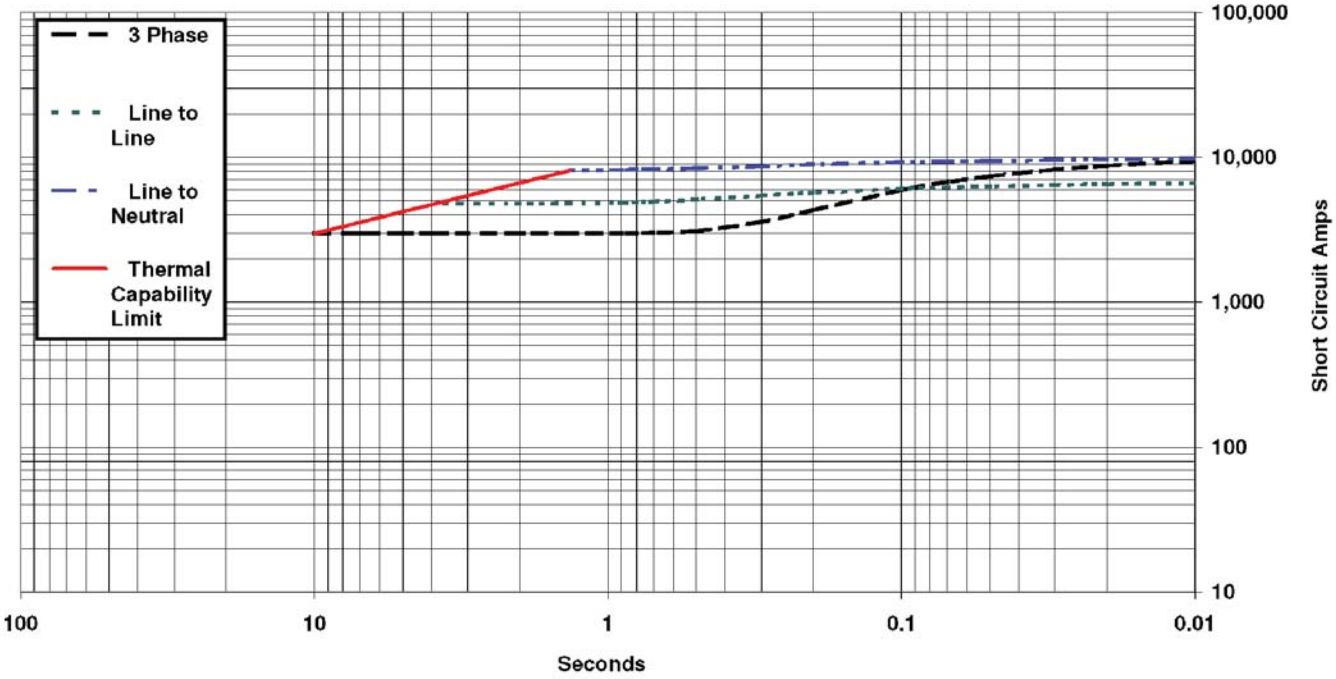




Voltage refers to wye (star) connection, unless otherwise specified.

5M4278, 60 Hz, 600 V Connection
SHORT CIRCUIT DECREMENT CURVE

Full Load Current: 992 Amps **Steady State S.C. Current:** 2976 Amps **Max. 3 ph. Symm. S.C. Current:** 9725 Amps



NOTE: Symmetrical component values are shown, maximum asymmetrical values are 1.732 times the symmetrical values.

The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. © 2015 by Kohler Co. All rights reserved.

KOHLER. POWER SYSTEMS

Emissions Data

KOHLER
Power Systems

750REOZMD

60 HZ. DIESEL INDUSTRIAL GENERATOR SET
EMISSION DATA SHEET

ENGINE INFORMATION

Model:	Mitsubishi, S12A2-Y2PTAW-2	Bore:	150mm (5.91 in.)
Nameplate BPH @ 1800 RPM:	1207	Stroke:	160mm (6.30 in.)
Type:	4-Cycle, 12 V Cylinder	Displacement:	33.93 L (2071 cu. in.)
Aspiration:	Turbocharged	EPA Family:	GMVXL33.9BBA
Compression Ratio	15.3:1	EPA Certificate	GMVXL33.9BBA-010
Emission Control Device	Turbocharged and after cooled		

Table 1

PERFORMANCE DATA:	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby
Engine bkW @ Stated Load	225.00	450.00	675.00	900.00
Fuel Consumption (g/kWh)	251.00	223.00	218.00	240.00
Exhaust Gas Flow (m^3/s)				232.00
Exhaust Temperature (°C)				473.00

EXHAUST EMISSION DATA:	Table 2 EPA CERTIFICATE DATA
HC (Total Unburned Hydrocarbons)	0.56
NOx (Oxides of Nitrogen as NO2)	5.36
CO (Carbon Monoxide)	0.60
PM (Particular Matter)	0.17

Values are in g/kWh

TEST METHODS AND CONDITIONS

Data was recorded during steady-state rated engine speed (± 25 RPM) with full load (± 2%). Pressures,

temperatures, and emission rates were stabilized

Fuel Spec	Type 2-D and ASTM D975 No.2D
Fuel Temperature	37 ± 10 ° C
Intake Temperature	25 ° C
Baro`metic Pressure	100 kPa (29.6 In Hg)
Relative Humidity	30 %
Standard	ISO 8178

The emission data here were taken from a single engine under the test condition shown above.
These data are subjected to instrumentation and engine to engine variabilty.

Data and specifications subject to change without notice
For further information, please contact MENA, 630-268-0750

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2016 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION
AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Mitsubishi Heavy Industries, Ltd.**
(U.S. Manufacturer or Importer)

Certificate Number: GMVXL33.9BBA-010

Effective Date:
11/03/2015

Expiration Date:
12/31/2016

Byron J. Bunker, Division Director
Compliance Division

Issue Date:
11/03/2015

Revision Date:
N/A

Model Year: 2016
Manufacturer Type: Original Engine Manufacturer
Engine Family: GMVXL33.9BBA

Mobile/Stationary Indicator: Stationary
Emissions Power Category: 560<kW<=2237
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Engine Design Modification

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

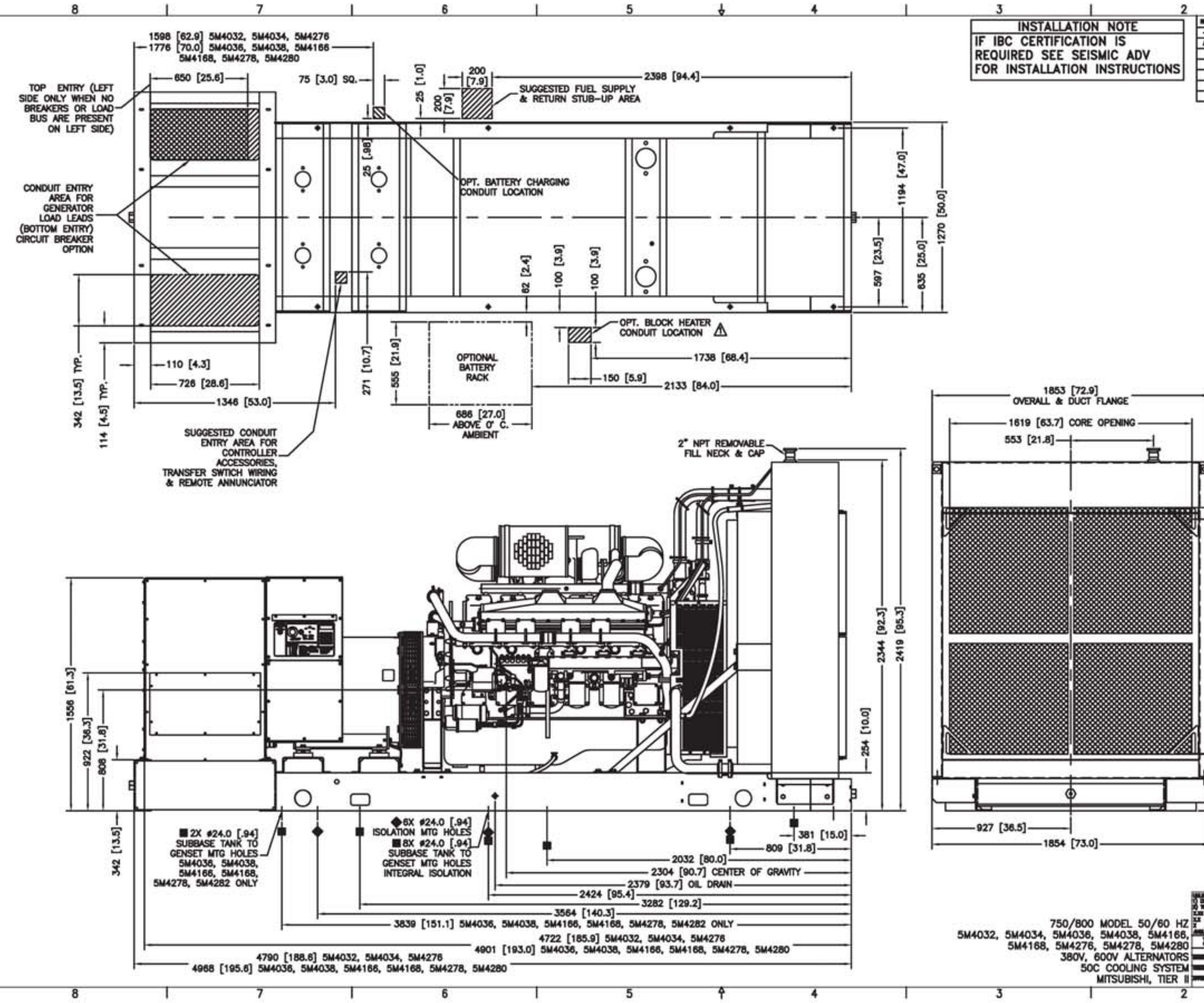
This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

KOHLER. POWER SYSTEMS

Dimensional Drawings



REV	DATE	REVISION	BY
–	5-2-11	NEW DRAWING [90464-6]	DJV
A	6-24-11	(A-4-7) 2X ⌀24.0 [.94] ADDED, 381 [15.0], 2032 [80.0], 2424 [95.4],	
		3839 [151.1] ADDED; NUMBER OF DECIMAL PLACES CORRECTED ON	
		ALL DIMENSIONS [91901]	KJB

INSTALLATION NOTE

IF IBC CERTIFICATION IS REQUIRED SEE SEISMIC ADV FOR INSTALLATION INSTRUCTIONS

MODEL	ALT. FRAME	CONNECTION
750 60HZ	5M4032	10 LEAD
750/800 60HZ	5M4034	10 LEAD
750/800 60HZ	5M4036	10 LEAD
800 60HZ	5M4038	4 LEAD
750/800 60HZ	5M4166	4 LEAD
800 60HZ	5M4168	4 LEAD
750 60HZ	5M4276	4 LEAD
750/800 60HZ	5M4278	4 LEAD
800 60HZ	5M4280	4 LEAD

ALL LEAD CONNECTIONS USE ⌀10 [.38] HARDWARE

INSTALLATION NOTE

IF SUBBASE FUEL TANK AND/OR SOUND HOUSING IS USED, REFER TO SUBBASE FUEL TANK ADV TO DETERMINE MOUNTING LOCATIONS.

GENSET WET WEIGHT (Kg [lbs]):
(LESS ACCESSORIES)
RAD. MOUNTED MAX. (WET) 6577 [14,500]

⚠ WHEN SUBBASE TANK IS USED, CONDUIT LOCATION SHOULD BE ALTERED ACCORDINGLY, OR IN STUB-UP AREA FOR SUBBASE TANK. REFER TO SUBBASE ADV.

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENTS.

750/800 MODEL 50/60 HZ
5M4032, 5M4034, 5M4036, 5M4038, 5M4166,
5M4168, 5M4276, 5M4278, 5M4280
380V, 600V ALTERNATORS
50C COOLING SYSTEM
MITSUBISHI, TIER II

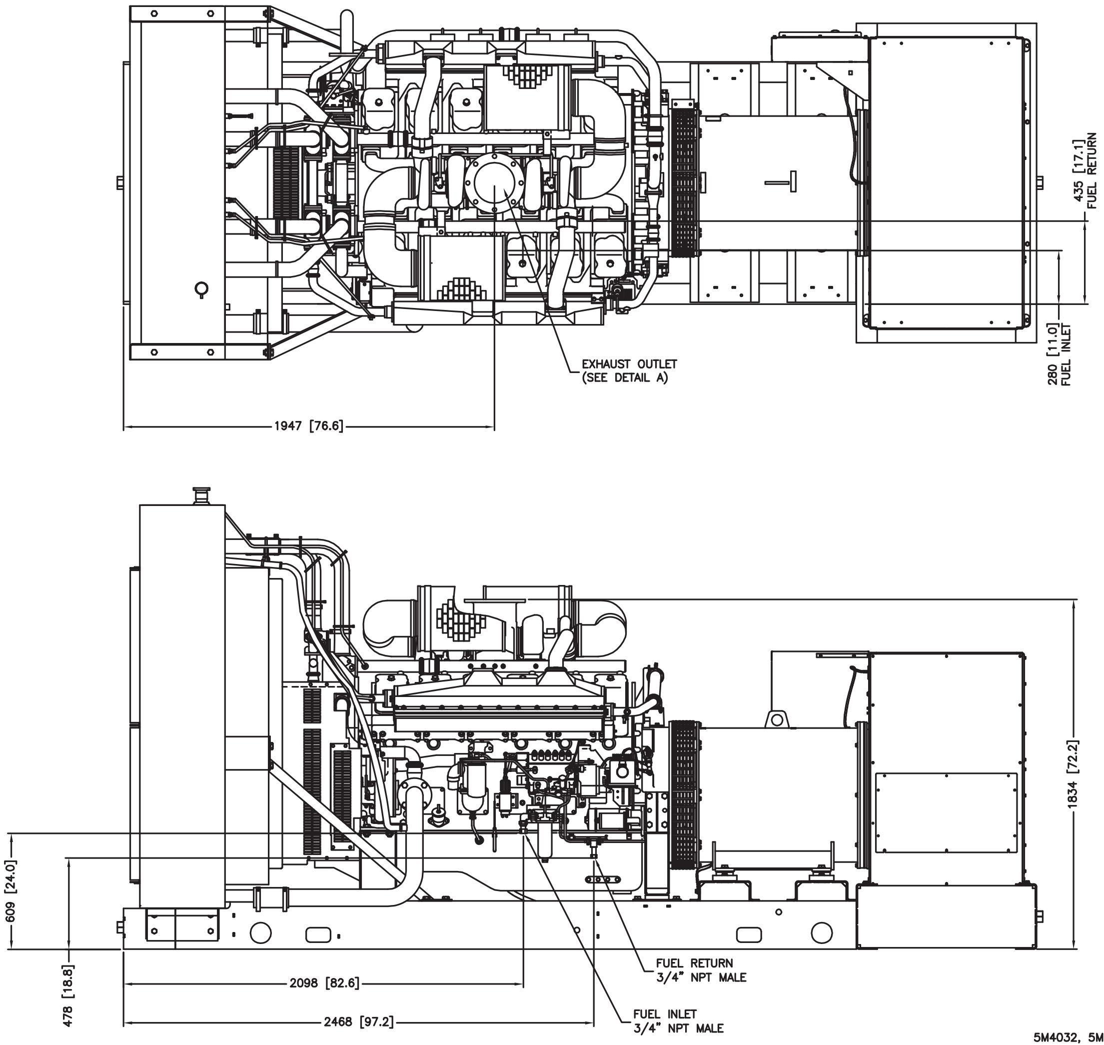
KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

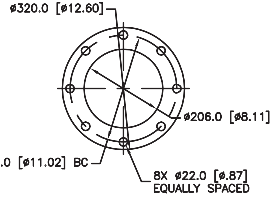
DIMENSION PRINT
750/850REOZMD

APPROVALS		DATE
	DJV	5-2-11
	DJV	5-2-11
	WRD	5-2-11

.1X
1-6
ADV-8207
D

REV	DATE	REVISION	BY
–	5-2-11	NEW DRAWING [90464-8]	DJV
A	6-24-11	NUMBER OF DECIMAL PLACES CORRECTED FOR ALL DIMENSIONS [91901]	KJB





DETAIL A
.2 SCALE

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENTS.

750/800 MODEL 50/60 HZ
5M4032, 5M4034, 5M4036, 5M4038, 5M4166,
5M4168, 5M4276, 5M4278, 5M4280
380V, 600V ALTERNATORS
50C COOLING SYSTEM
MITSUBISHI, TIER II

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ±
X.X ±
X ±
ANGLES ±

SURFACE FINISH
MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DJV	5-2-11
CHECKED	DJV	5-2-11
APPROVED	WRD	5-2-11

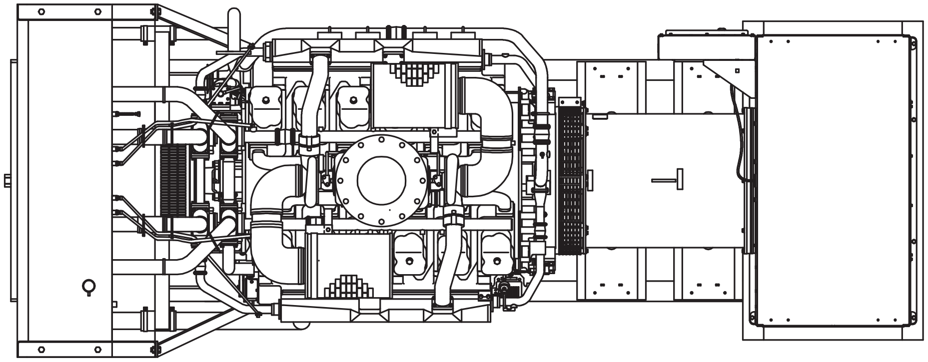
KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

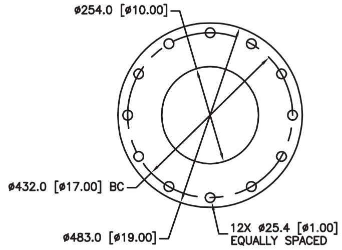
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT
750/850REOZMD

SCALE .1X
CAD NO.
SHEET 2-8
DWG. NO. ADV-8207 D
PLOTTED DATE

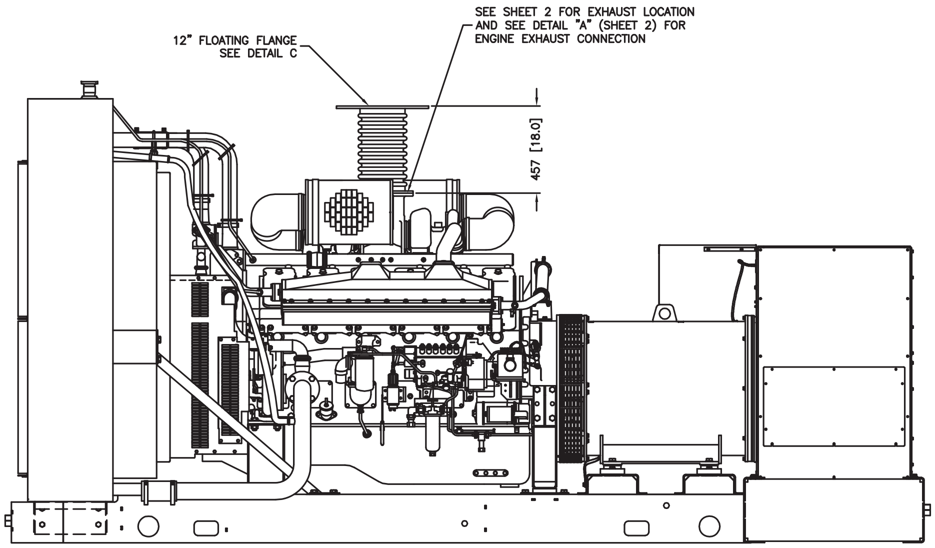
REV	DATE	REVISION	BY
–	5-2-11	NEW DRAWING [90464-8]	DJV
A	6-24-11	NUMBER OF DECIMAL PLACES CORRECTED FOR ALL DIMENSIONS [91901]	KJB





DETAIL C

12" ANSI B16.5 CLASS 150
.2 SCALE



FLEXIBLE EXHAUST

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENTS.

750/800 MODEL 50/60 HZ
5M4032, 5M4034, 5M4036, 5M4038, 5M4166,
5M4168, 5M4276, 5M4278, 5M4280
380V, 600V ALTERNATORS
50C COOLING SYSTEM
MITSUBISHI, TIER II

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ±
X.X ±
X ±
ANGLES ±
SURFACE FINISH
MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DJV	5-2-11
CHECKED	DJV	5-2-11
APPROVED	WRD	5-2-11

KOHLER CO.

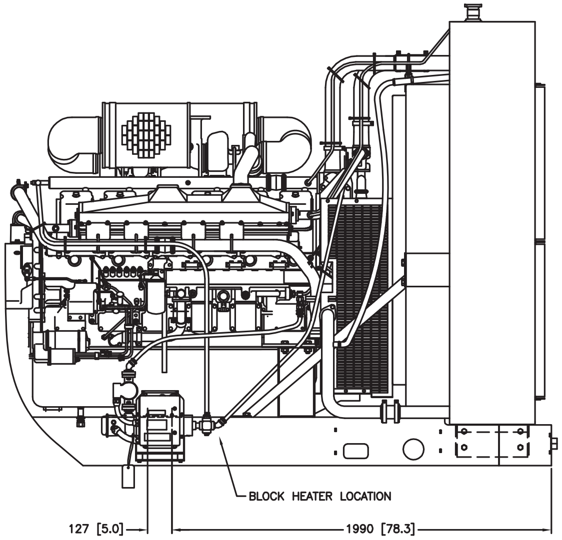
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

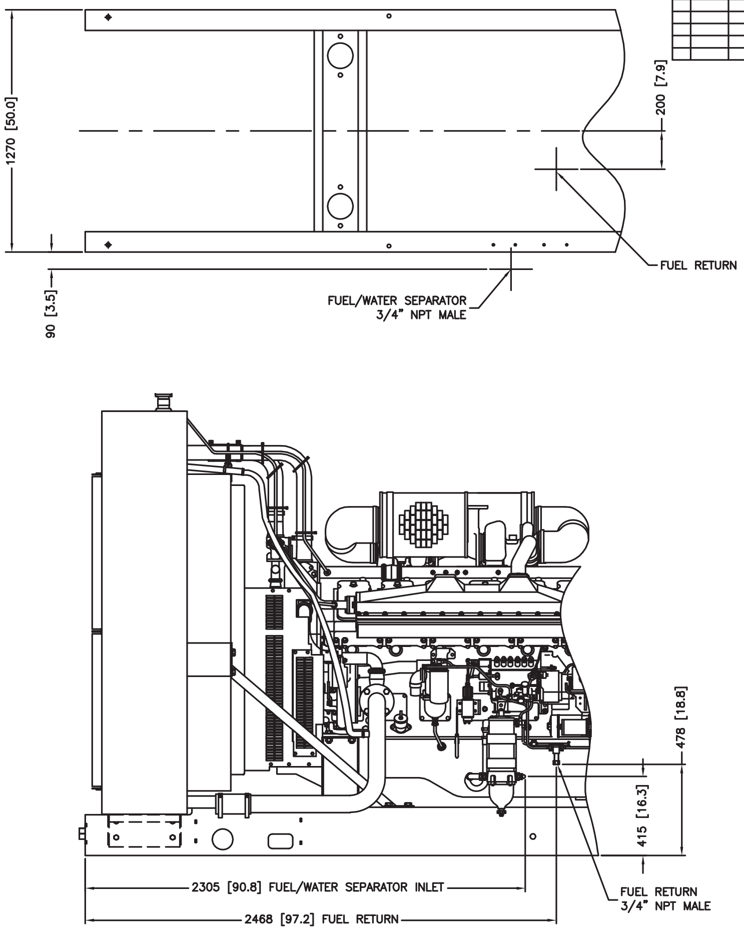
TITLE
DIMENSION PRINT
750/850REOZMD

SCALE .1X
CAD NO.
SHEET 4-6
DWG. NO. ADV-8207 D
PLOTTED DATE

REV	DATE	REVISION	BY
–	5-2-11	NEW DRAWING [90464-8]	DJV
A	6-24-11	NUMBER OF DECIMAL PLACES CORRECTED FOR ALL DIMENSIONS [91901]	KJB



BLOCK HEATER



FUEL/WATER SEPARATOR

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENTS.

750/800 MODEL 50/60 HZ
5M4032, 5M4034, 5M4036, 5M4038, 5M4166,
5M4168, 5M4276, 5M4278, 5M4280
380V, 600V ALTERNATORS
50C COOLING SYSTEM
MITSUBISHI, TIER II

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ±
X.X ±
X ±
ANGLES ±

SURFACE FINISH ✓ MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DJV	5-2-11
CHECKED	DJV	5-2-11
APPROVED	WRD	5-2-11

KOHLER CO.

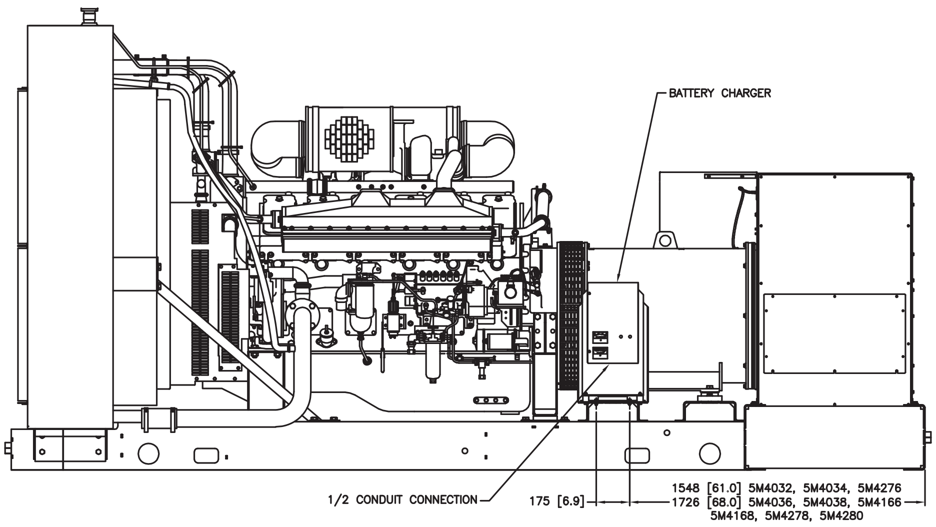
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

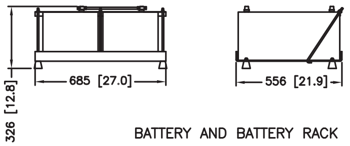
TITLE
DIMENSION PRINT
750/850REOZMD

SCALE .1X
CAD NO.
SHEET 5-6
DWG. NO. ADV-8207
D
PLOTTED DATE

REV	DATE	REVISION	BY
–	5-2-11	NEW DRAWING [90464-8]	DJV
A	6-24-11	NUMBER OF DECIMAL PLACES CORRECTED FOR ALL DIMENSIONS [91901]	KJB



BATTERY CHARGER



BATTERY AND BATTERY RACK

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENTS.

750/800 MODEL 50/60 HZ
5M4032, 5M4034, 5M4036, 5M4038, 5M4166,
5M4168, 5M4276, 5M4278, 5M4280
380V, 600V ALTERNATORS
50C COOLING SYSTEM
MITSUBISHI, TIER II

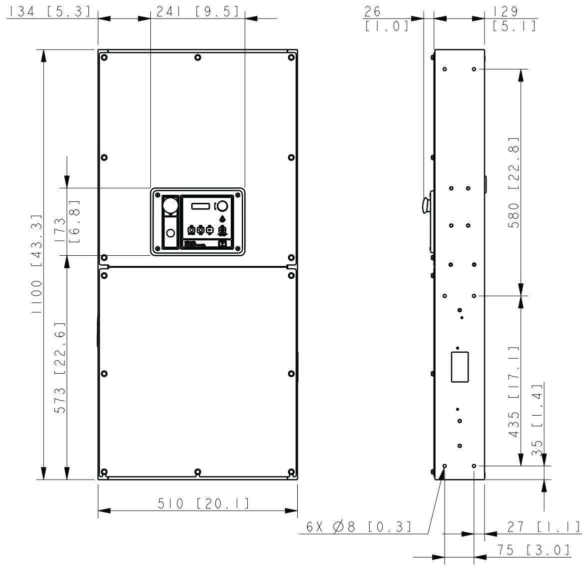
UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ±
X.X ±
X ±
ANGLES ±
SURFACE FINISH
√ MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DJV	5-2-11
CHECKED	DJV	5-2-11
APPROVED	WRD	5-2-11

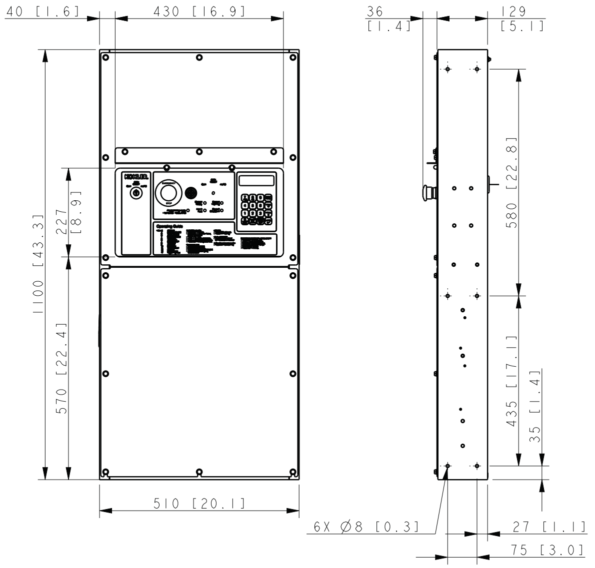
KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT
750/850REOZMD

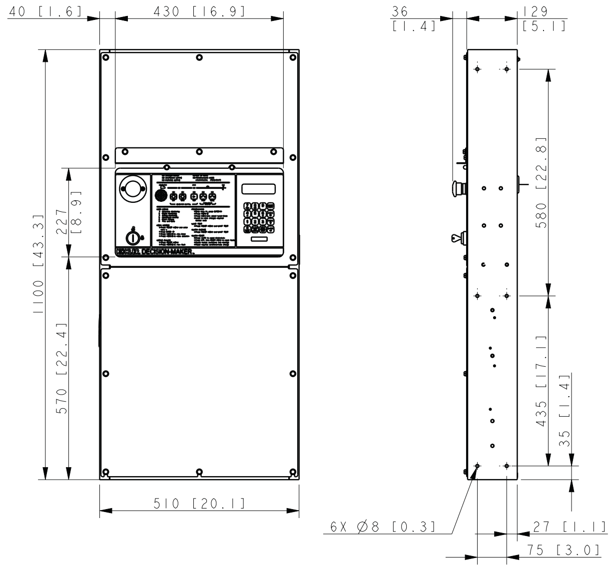
SCALE .1X
CAD NO.
SHEET 6-6
DWG. NO. ADV-8207 D
PLOTTED DATE



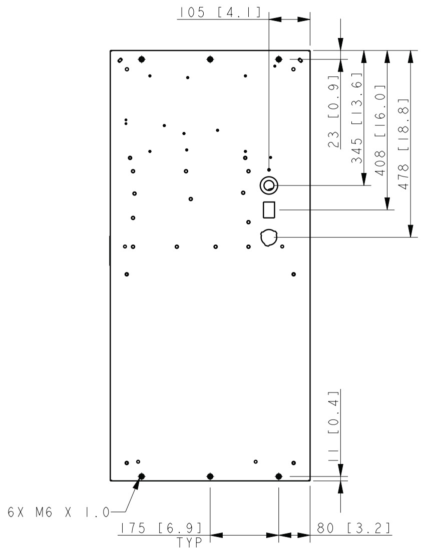
DEC 3000



DEC 550



DEC 6000



REAR VIEW OF CONTROLLER
(DEC 3000, DEC 550 & DEC 6000)

300-2250KW
CONTROLLER

DIMENSIONS IN [] ARE ENGLISH EQUIVALENTS

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	1-26-11	NEW DRAWING [90647-3]	DJV
A	2-22-12	(D-2/3) 430 [1.6] WAS 445 [17.5], 40 [1.6]	
		WAS 33 [1.3] (D-5/6) 430 [16.9] WAS 400	
		[15.7], 40 [1.6] WAS 55 [2.2] (CT07212)	KJB

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ±
X.X ±
X ±
ANGLES ±

SURFACE FINISH
MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DJV	1-26-11
CHECKED	DJV	1-26-11
APPROVED	JDZ	1-26-11

KOHLER CO. METRIC PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

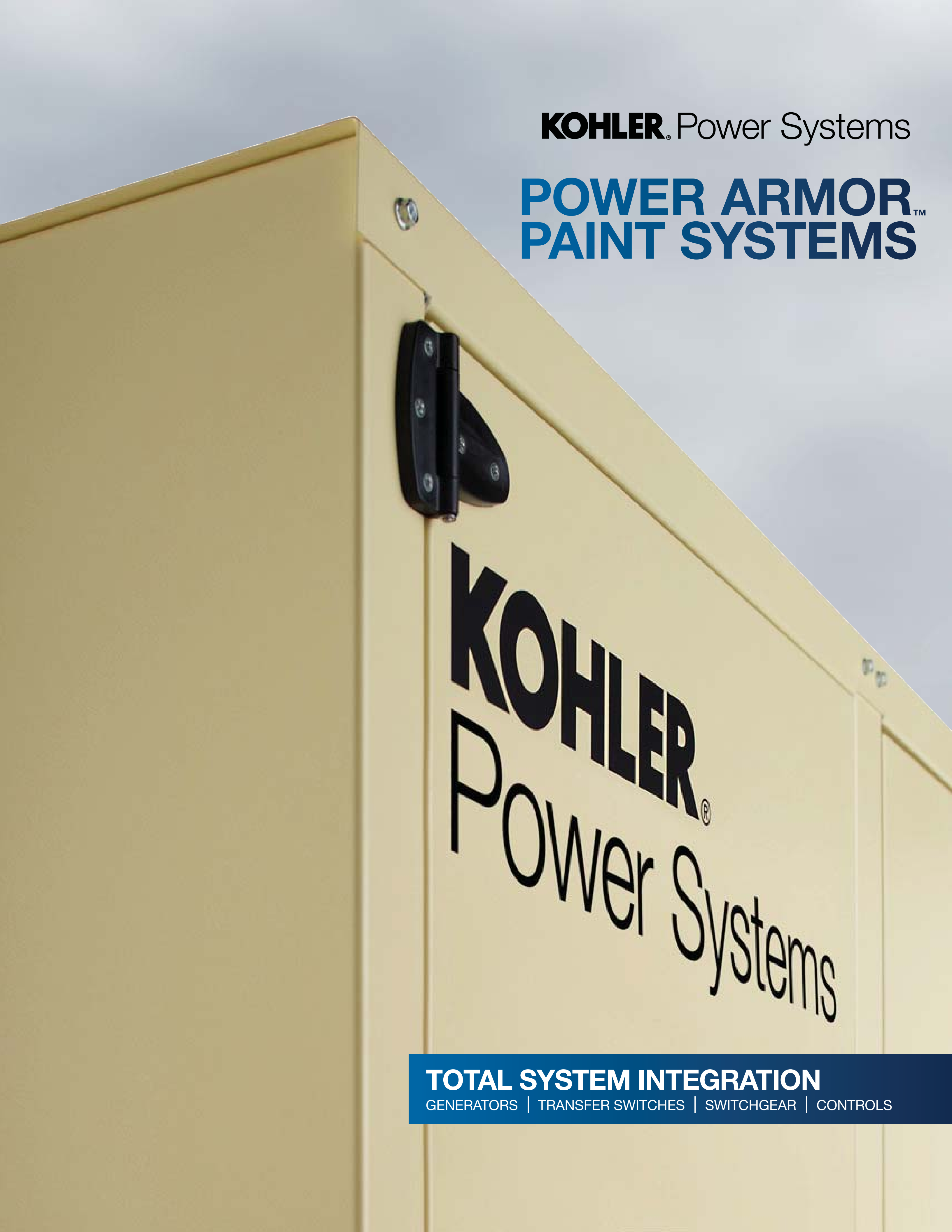
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT, CONTROLLER

SCALE 0.16
CAD NO.
SHEET 1 of 1
DWG NO. **ADV-7985** **D**

KOHLER. Power Systems

POWER ARMOR™ PAINT SYSTEMS



TOTAL SYSTEM INTEGRATION

GENERATORS | TRANSFER SWITCHES | SWITCHGEAR | CONTROLS

KOHLER. Power Systems

A WORD TO SALT SPRAY AND ANGRY WEATHER. WE'RE READY FOR YOU.

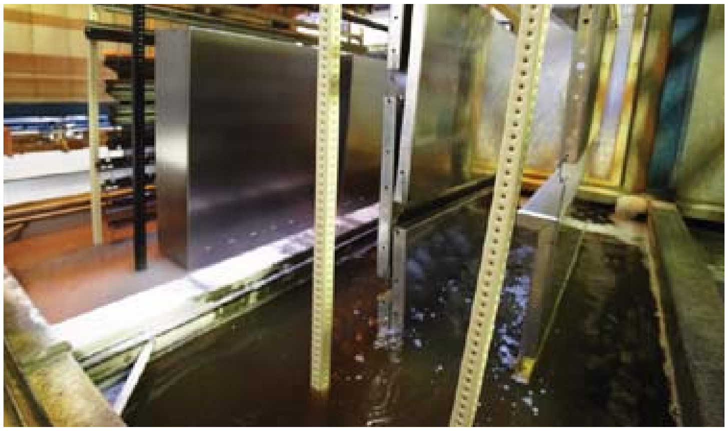
We took a good hard look at today's generator tanks and enclosures. You know what we found? An opportunity to improve. We all know the weather can be unforgiving to your equipment, causing excessive paint damage, rampant rust and unsightly exteriors.

Rather than accept the status quo, we did something about it. We installed a state-of-the-art coating system that defeats Mother Nature without harming her. One that provides extreme corrosion resistance while protecting the environment. Some call it impossible.

We call it POWER ARMOR™

OUR POWER ARMOR™ PROCESS

INTRODUCING THE ULTIMATE PAINT SYSTEM



KOHLER® enclosures, skids and internal components endure one of the industry's toughest paint processes. We invested millions in this system to make your generators look better, longer. Here's how:

TWO-STAGE ALKALINE CLEANER

Our ultra-strong cleaners remove grease, grit and grime from parts.

ZIRCONIUM-BASED CONVERSION COATING

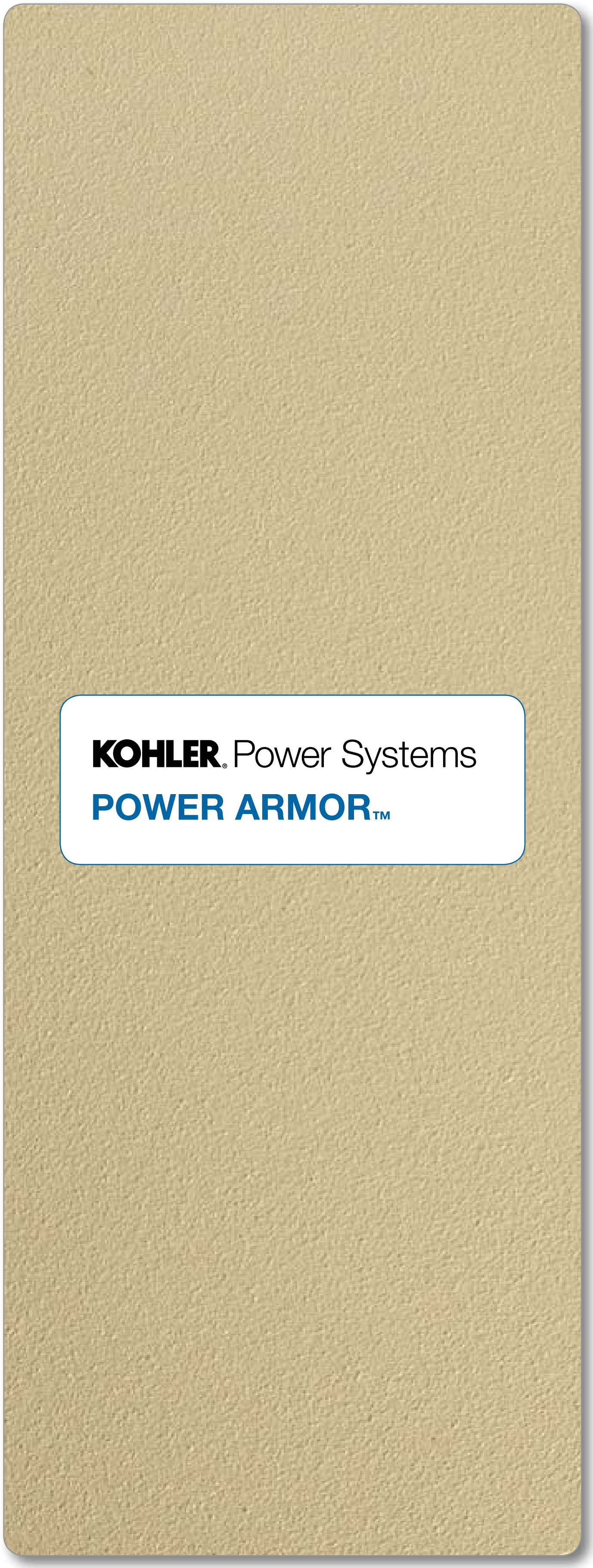
This automotive-grade process prepares metal for e-coat (electrocoat) adhesion.

E-COAT APPLICATION

All parts receive 100% epoxy e-coat coverage, with the added benefit of high-edge protection.

POWDER COAT

Following the e-coat process, our parts are powder coated in an automated booth, which recycles excess powder to reduce waste.



KOHLER. Power Systems

POWER ARMOR™ PAINT SYSTEM

For Enclosures, Skids and Components

POWER ARMOR is a textured industrial finish that provides heavy-duty durability in harsh conditions.

CORROSION RESISTANCE

POWER ARMOR surpasses 3,000-hour salt spray corrosion tests per ASTM B-1117.

HEAVY-DUTY DURABILITY

POWER ARMOR combines high-edge, E-coat epoxy primer with TGIC (triglycidyl isocyanurate) powder coat topcoat for advanced corrosion resistance and abrasion protection, as well as enhanced edge coverage and color retention.

ECO DESIGN

Our 10-stage, automotive grade e-coat paint system is heavy-metal free and reduces sludge by at least 80% compared to zinc-phosphate-based products.

KOHLER. Power Systems


KOHLER. Power Systems

POWER ARMOR PLUS™

POWER ARMOR PLUS™ PAINT SYSTEM

For Sub-Base Fuel Tanks

POWER ARMOR PLUS is a textured epoxy-based, rubberized coating that's built to take a beating.

NEXT-LEVEL TOUGHNESS

KOHLER sub-base fuel tanks are armored with a polyurea-textured coating, the same coating found on truck beds.

EXTREME DURABILITY

POWER ARMOR PLUS creates an ultra-thick barrier between your equipment and harsh environmental conditions.

SIGNIFICANT COST SAVINGS

With POWER ARMOR PLUS, there's no need for expensive secondary epoxy treatments on tanks.

CLEAN, INDUSTRIAL LOOK

The textured finish provides the ultimate industrial surface with better grip for generator servicing.

SPEC YOUR JOB AT

KOHLERPOWER.COM/INDUSTRIAL

For more information, call **800.544.2444**
or visit **KohlerPower.com/Industrial**

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

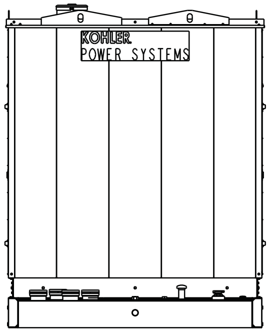
KOHLER Power Systems

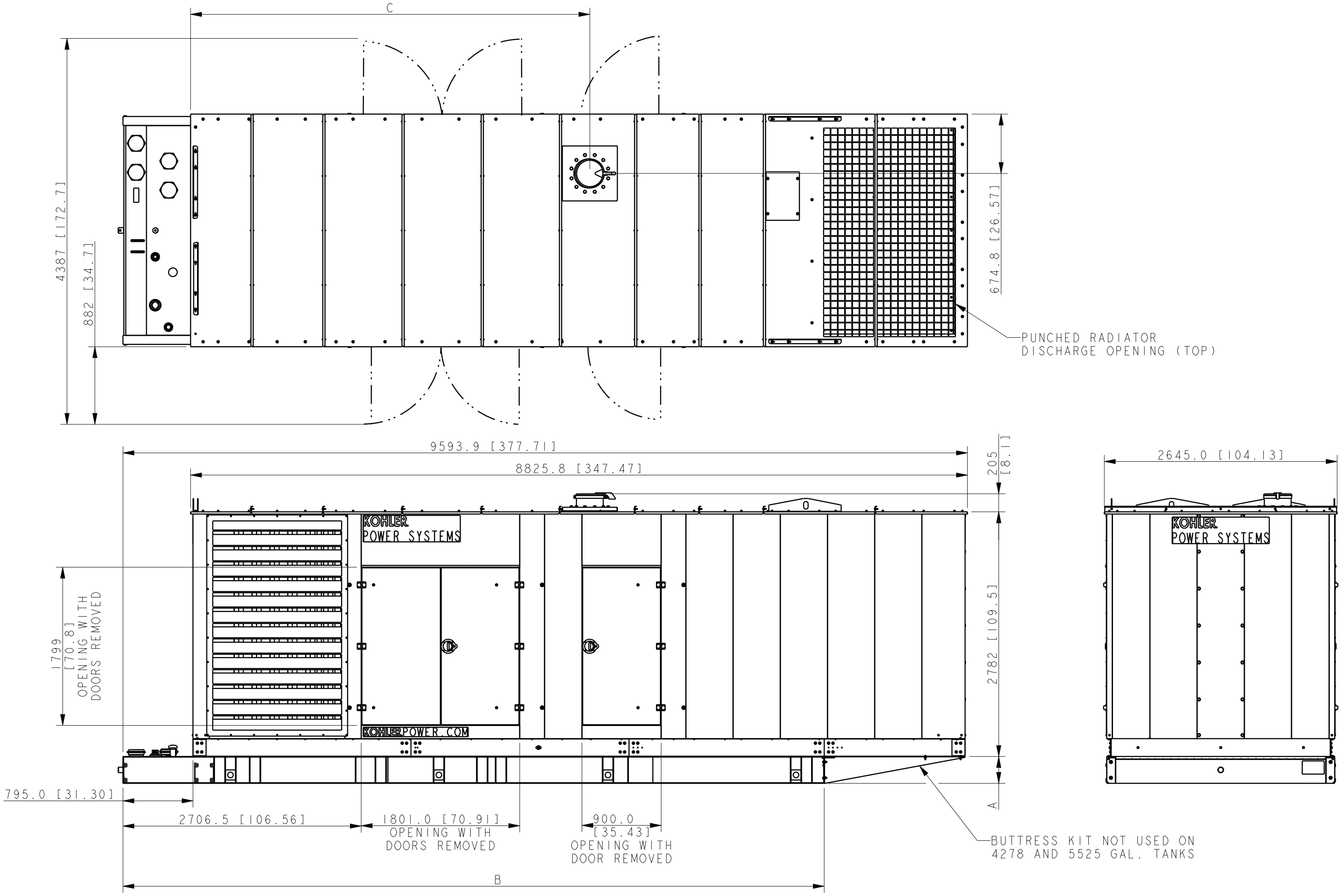
Printed in U.S.A.
G12-395 2/13

© 2013 by Kohler Co.

KOHLER® is a registered trademark of Kohler Co.
Use of this material for reproduction on the Internet and World Wide Web
is strictly prohibited without written permission from Kohler Co.

MODEL	DIM C MM [INCH]
700/800 REOZDE	4724.2 [186.0]
750/800 REOZMD	4574.5 [180.1]
900/1000 REOZDE /MD	4536.4 [178.6]





*WEIGHT INCLUDES GENERATOR (WET), ENCLOSURE & SILENCER.

NOTE: DIMENSIONS IN [ ] ARE ENGLISH EQUIVALENTS.

	700/800 REOZDE	900/1000 REOZDE	750/800 REOZMD	900/1000 REOZMD
STEEL SOUND ENCLOSURE WEIGHT KG [LBS]	8981 [19800]	10523 [23200]	9435 [20800]	12655 [27900]
ALUM. SOUND ENCLOSURE WEIGHT KG [LBS]	8754 [19300]	10297 [22700]	9208 [20300]	12428 [27400]

TANK INFORMATION

LITERS [GALLONS] MIN HOURS	GENSETS	DIM A MM [INCH]	DIM B MM [INCH]	TANK WEIGHT KG [LBS] (NO FUEL)
LIFT BASE ONLY	700-1000REOZDE / MD	254 [10.0]	8773 [345.4]	934 [2060]
3682 [973] 12 HOURS	700-1000REOZDE / MD	304.8 [12.0]	7967 [313.6]	3512 [7743]
6679 [1791] 24 HOURS	700-1000REOZDE / 750-800REOZMD	508.0 [20.0]	7967 [313.6]	3938 [8681]
8215 [2170] 24 HOURS	900-1000REOZMD	609.6 [24.0]	7967 [313.6]	4139 [9125]
8215 [2170] 36 HOURS	700-800REOZDE	609.6 [24.0]	7967 [313.6]	4139 [9125]
10824 [2859] 36 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4500 [9920]
10824 [2859] 48 HOURS	700-800REOZDE	914.4 [36.0]	7967 [313.6]	4500 [9920]
13970 [3690] 48 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4832 [10653]
16193 [4278] 72 HOURS	700-800REOZDE	914.4 [36.0]	9567 [376.6]	5498 [12120]
20914 [5525] 72 HOURS	900-1000REOZDE / 750-1000REOZMD	914.6 [36.0]	11430 [450.0]	6322 [13938]

TANK/LIFT BASE WEIGHT
+ENCLOSURE WEIGHT
=TOTAL WEIGHT

700-1000 KW SOUND ENCLOSURE
WITH SUB BASE TANK
OR LIFTING BASE OPTION

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
E	03-19-14	SEE SHEET 4 [CT75098]	SSH
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT85282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 1 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 3 OF 6. (D-6) VIEW OF E-VENTS UPDATED. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30´
SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

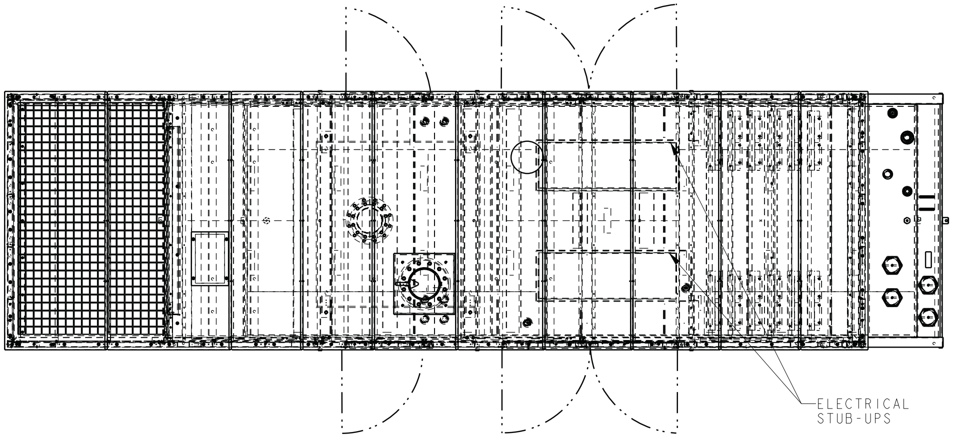
KOHLER CO. METRIC PRO-E

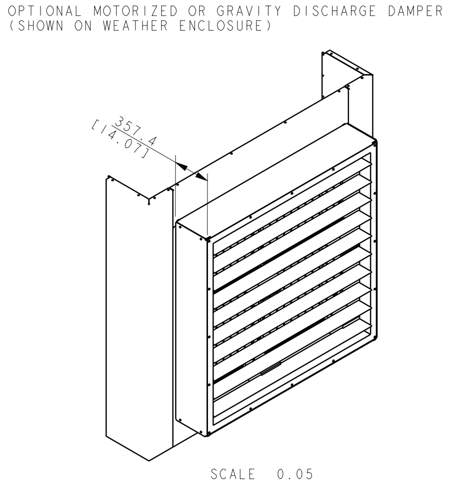
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

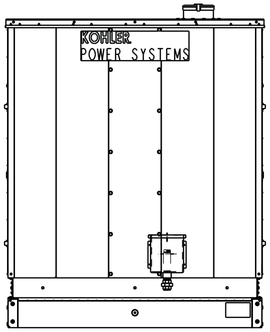
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

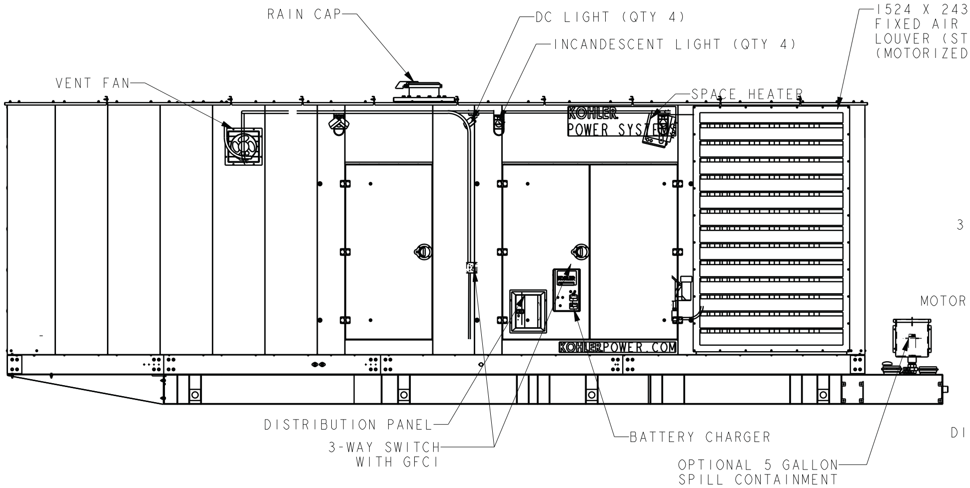
TITLE
DIMENSION PRINT

SCALE 0.04
CAD NO.
SHEET 2 of 6
DWG NO. ADV-8249 D

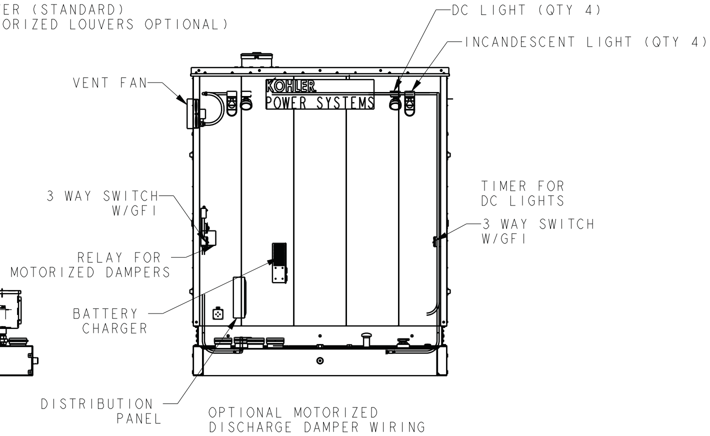








SOUND ENCLOSURE SHOWN



NOTE: DIMENSIONS IN [ ] ARE ENGLISH EQUIVALENTS.

ELECTRICAL & ENCLOSURE ACCESSORY OPTIONS

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT85282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	(B-5) SIDE VIEW UPDATED FOR BETTER VISIBILITY OF ELECTRICAL ACCESSORIES [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 2 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 2 OF 6. (C-3) VIEW OF E-VENTS UPDATED. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30´
SURFACE FINISH
MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

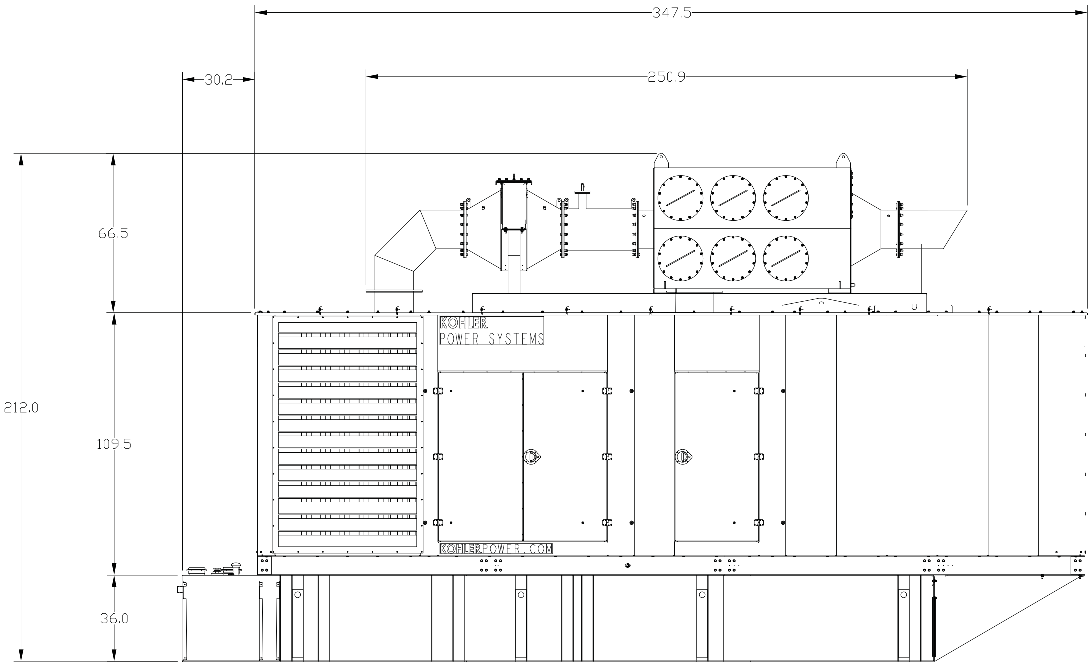
KOHLER CO. METRIC PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

SCALE 0.04
CAD NO.
SHEET 3 of 6
DWG NO.
ADV-8249
D



TANK INFORMATION				
LITERS [GALLONS] MIN HOURS	GENSETS	DIM A MM [INCH]	DIM B MM [INCH]	TANK WEIGHT KG [LBS] (NO FUEL)
LIFT BASE ONLY	700-1000REOZDE / MD	254 [10.0]	8773 [345.4]	934 [2060]
3682 [973] 12 HOURS	700-1000REOZDE / MD	304.8 [12.0]	7967 [313.6]	3512 [7743]
6679 [1791] 24 HOURS	700-1000REOZDE / 750-800REOZMD	508.0 [20.0]	7967 [313.6]	3938 [8681]
8215 [2170] 24 HOURS	900-1000REOZMD	609.6 [24.0]	7967 [313.6]	4139 [9125]
8215 [2170] 36 HOURS	700-800REOZDE	609.6 [24.0]	7967 [313.6]	4139 [9125]
10824 [2859] 36 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4500 [9920]
10824 [2859] 48 HOURS	700-800REOZDE	914.4 [36.0]	7967 [313.6]	4500 [9920]
13970 [3690] 48 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4832 [10653]
16193 [4278] 72 HOURS	700-800REOZDE	914.4 [36.0]	9567 [376.6]	5498 [12120]
20914 [5525] 72 HOURS	900-1000REOZDE / 750-1000REOZMD	914.6 [36.0]	11430 [450.0]	6322 [13938]

TANK/LIFT BASE WEIGHT
+ENCLOSURE WEIGHT
=TOTAL WEIGHT

700-1000 KW SOUND ENCLOSURE
WITH SUB BASE TANK
OR LIFTING BASE OPTION

NOTE: DIMENSIONS IN INCHES, DIMENSIONS AND FEATURES ARE SUBJECT TO CHANGE WITHOUT NOTICE

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
E	03-19-14	SEE SHEET 4 [CT75098]	SSH
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT85282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 1 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 3 OF 6. (D-6) VIEW OF E-VENTS UPDATED. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH
MAX.

THIRD ANGLE PROJECTION

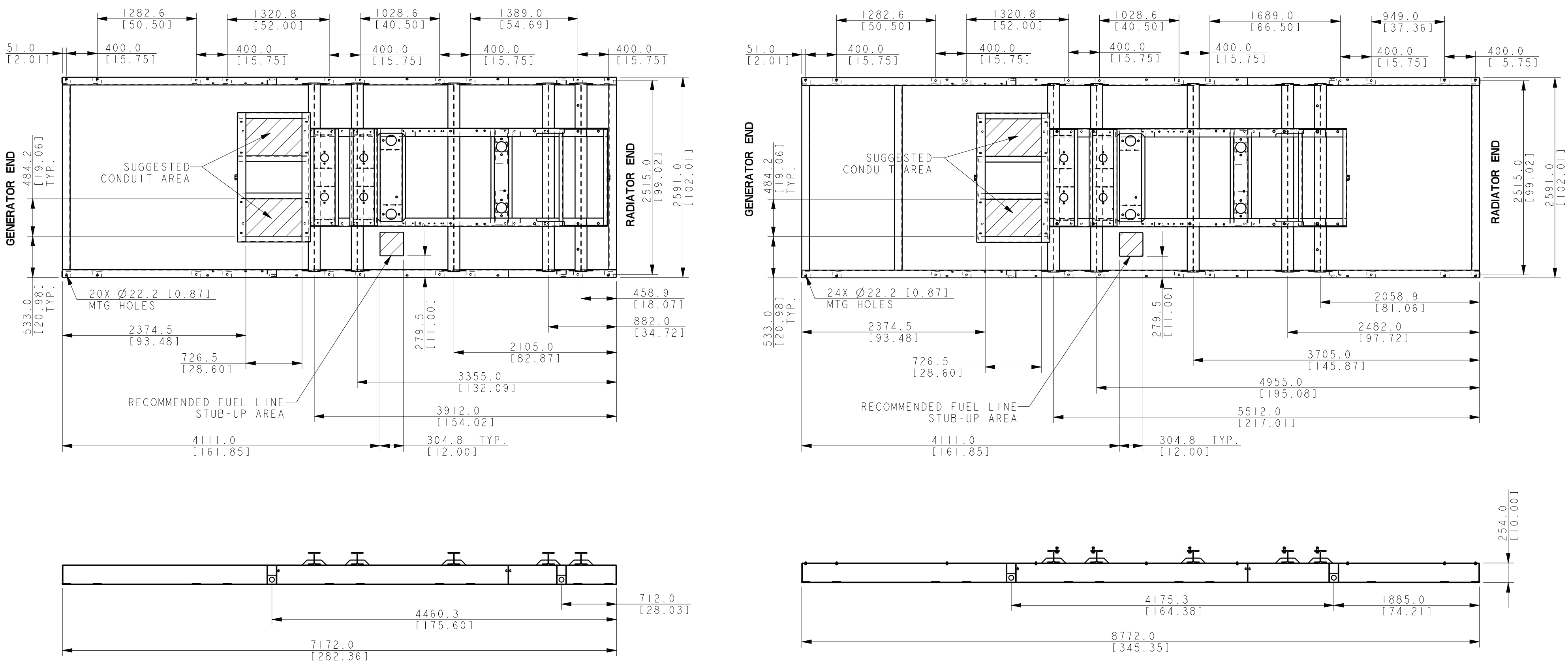
APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

SCALE 0.04
CAD NO.
SHEET 2 of 6
DWG NO. ADV-8249
D



LIFTING BASE FOR
SOUND ENCLOSURES

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
F	6-24-14	LIFTING BASE VIEWS REDRAWN TO SHOW SUGGESTED CONDUIT AREAS. [CT85282]	JMR
G	10-09-14	ADDED RECOMMENDED FUEL LINE STUB UP AREA TO LIFTING BASE DWG VIEWS. [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	SEE SHEETS 1, 2 AND 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1, 2 AND 3 OF 6. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30´

SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

KOHLER CO. METRIC PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

SCALE 0.04
CAD NO.
SHEET 6 of 6
DWG NO. ADV-8249
D

ONLINE CERTIFICATIONS DIRECTORY

EFVT7.GuideInfo
Special-purpose Tanks Certified for Canada

View Listings Page Bottom

[Containment Products Certified for Canada] (Storage Tanks Certified for Canada) Special-purpose Tanks Certified for Canada

See General Information for Storage Tanks Certified for Canada

USE AND INSTALLATION

This category covers special purpose tanks for use as indicated in the individual Listings. These tanks are intended to be installed in accordance with Part 4 of the "National Fire Code of Canada," "CCME Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products," and regulations of the appropriate Authority Having Jurisdiction. Tanks used with oil-burning equipment are installed in accordance with CSA B139, "Installation Code for Oil Burning Equipment."

TANK TYPES

The following types of tank constructions are indicated in the individual Listings:

Generator Base Tank - Aboveground steel rectangular tank incorporated into the support structure of diesel engine generators and used for the storage of the generator's fuel supply. The maximum capacity of these tanks is limited to 100,000 L.

Closed Top Diked (Contained) Generator Base Tank - Generator base tank with an integral steel dike intended to contain liquids resulting from tank leak or rupture. The dike has integral protection on the top to prevent precipitation, debris, or other elements from entering the diked area.

Secondary Containment (Double Wall) Generator Base Tank - Generator base tank consisting of a steel primary containment rectangular tank contained within a steel secondary containment rectangular tank shell forming a sealed interstitial space which is vacuum monitored for leakage.

Protected Secondary Containment Generator Base Tank - Generator base tank that also meets the requirements for protected aboveground steel secondary containment rectangular tanks. These tanks have provisions for monitoring the annular space for leakage. These tanks have not been investigated to determine acceptability for use after fire exposure. These tanks are provided with protection against vehicle impact and small arms attack.

Work Top (Bench) Tank - Aboveground steel rectangular tank for combined use as a working surface and storage of lubricating oils. The maximum capacity is limited to 2500 L.

Secondary Containment Work Top (Bench) Tank - Steel primary rectangular tank contained within a steel secondary containment rectangular tank forming an interstitial space which is capable of being monitored for leakage.

Lubricant Storage Tank - Aboveground steel tank for use as an aboveground storage tank for fuel oil or lubricating oil. The maximum capacity is limited to 1200 L for obround tanks and 2500 L for other tank constructions.

Waste Oil Storage Tank - Aboveground steel tank for use as an aboveground storage tank for waste oil. These tanks are intended for stationary outdoor use only. The maximum capacity is limited to 2000 L and vertical or horizontal cylindrical design.

Secondary Containment Waste Oil Storage Tank - Waste oil storage tank consisting of a steel primary containment tank contained within a steel secondary containment tank shell forming an interstitial space which is capable of being monitored for leakage.

ADDITIONAL INFORMATION

For additional information, see Storage Tanks Certified for Canada (EDQX7) and Flammable and Combustible Liquids and Gases Equipment Certified for Canada (AAPQ7).

REQUIREMENTS

The basic standard used to investigate generator base tanks and work top tanks in this category is ULC/ORD-C142.18-1995, "Rectangular Steel Aboveground Tanks for Flammable and Combustible Liquids." This standard excludes rectangular steel aboveground tanks having capacities less than 2,500 L that are in full compliance with the requirements of CAN/ULC-S602-M92, "Standard for Aboveground Steel Tanks for Fuel Oil and Lubricating Oil."

The basic standard used to investigate closed top dike tank constructions in this category is ULC-S653-94, "Standard for Aboveground Steel Contained Tank Assemblies for Flammable and Combustible Liquids."

The basic standard used to investigate protected tanks in this category is ULC-S655, "Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids."

The basic standard used to investigate lubricant storage tanks in this category is CAN/ULC-S602-M92, "Standard for Aboveground Steel Tanks for Fuel Oil and Lubricating Oil."

The basic standard used to investigate waste oil storage tanks in this category is ULC/ORD-C142.23-1991, "Aboveground Waste Oil Tanks." Additionally, these tanks conform to the general requirements of ULC-S601-00, "Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids" and ULC-S630-00, "Standard for Shop Fabricated Steel Aboveground Vertical Tanks for Flammable and Combustible Liquids."

UL MARK

The Listing Mark of Underwriters Laboratories Inc. on the product is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service. The Listing Mark for these products includes the UL Mark for Canada symbol (as illustrated in the Introduction of this Directory) together with word "LISTED," a control number, and the appropriate tank construction as indicated in the individual Listings.

* *

UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. UL shall not incur any obligation or liability for any loss, expense or damages, including incidental or consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Guide Information.

Last Updated on 2002-06-14

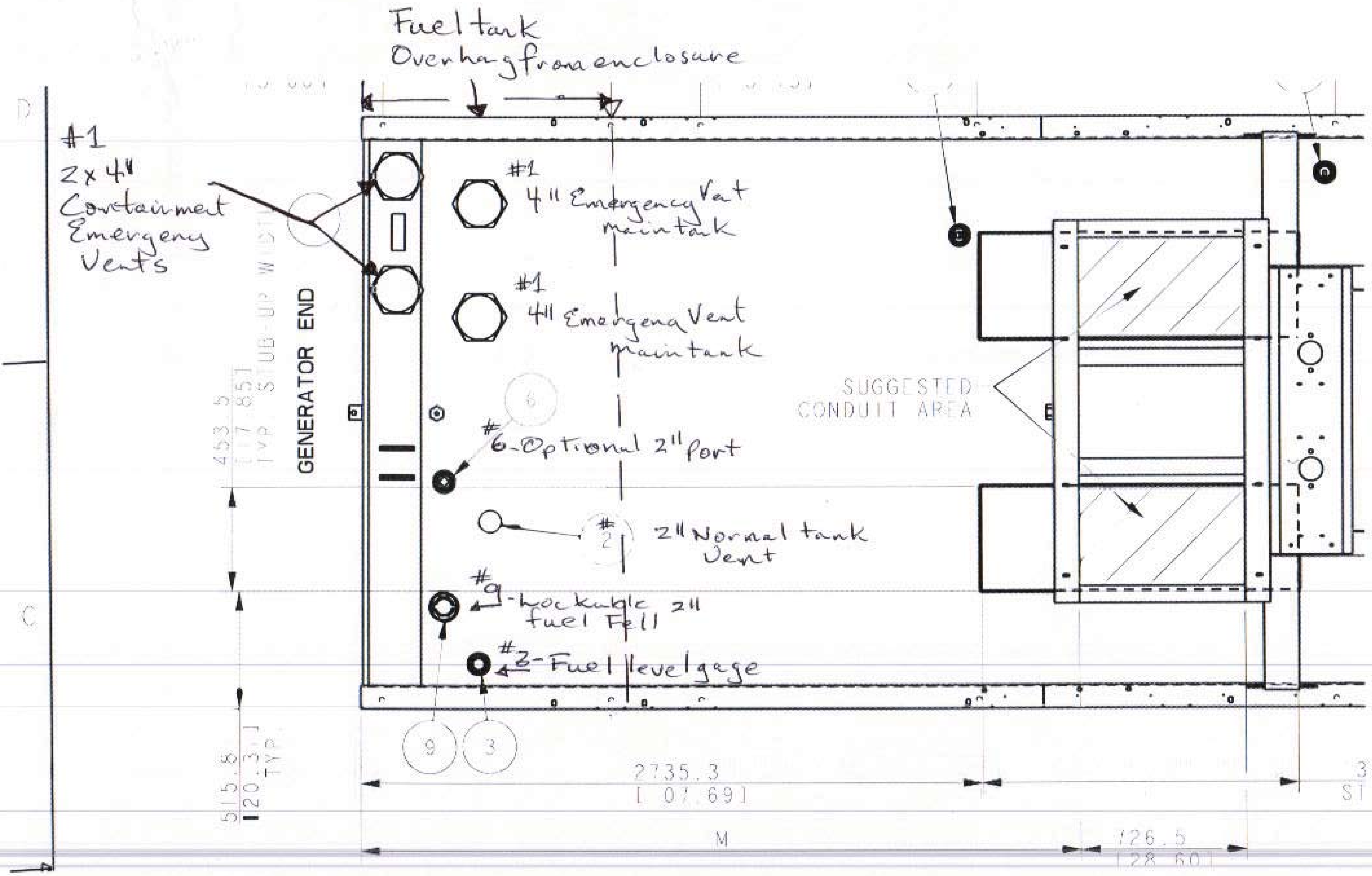
Questions? Notice of Disclaimer Page Top

Copyright © 2009 Underwriters Laboratories Inc.®

The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Listed and covered under UL's Follow-Up Service. Always look for the Mark on the product.

UL permits the reproduction of the material contained in the Online Certification Directory subject to the following conditions: 1. The Guide Information, Designs and/or Listings (files) must be presented in their entirety and in a non-misleading manner, without any manipulation of the data (or drawings). 2. The statement "Reprinted from the Online Certifications Directory with permission from Underwriters Laboratories Inc." must appear adjacent to the extracted material. In addition, the reprinted material must include a copyright notice in the following format: "Copyright © 2009 Underwriters Laboratories Inc.®"

An independent organization working for a safer world with integrity, precision and knowledge.


Fuel tank
Overhang from enclosure
#1
2 x 4"
Containment
Emergency
Vents
GENERATOR END
453.5
[17.85]
TYP. STUB-UP WIDTH
#1
4" Emergency Vent
main tank
#1
4" Emergency Vent
main tank
#6-Optional 2" Port
6
#2
2" Normal tank
Vent
#9-Lockable 2"
fuel Fill
#3-Fuel level gage
9
3
SUGGESTED
CONDUIT AREA
515.8
[20.3]
TYP.
2735.3
[107.69]
M
726.5
[28.60]
D
C

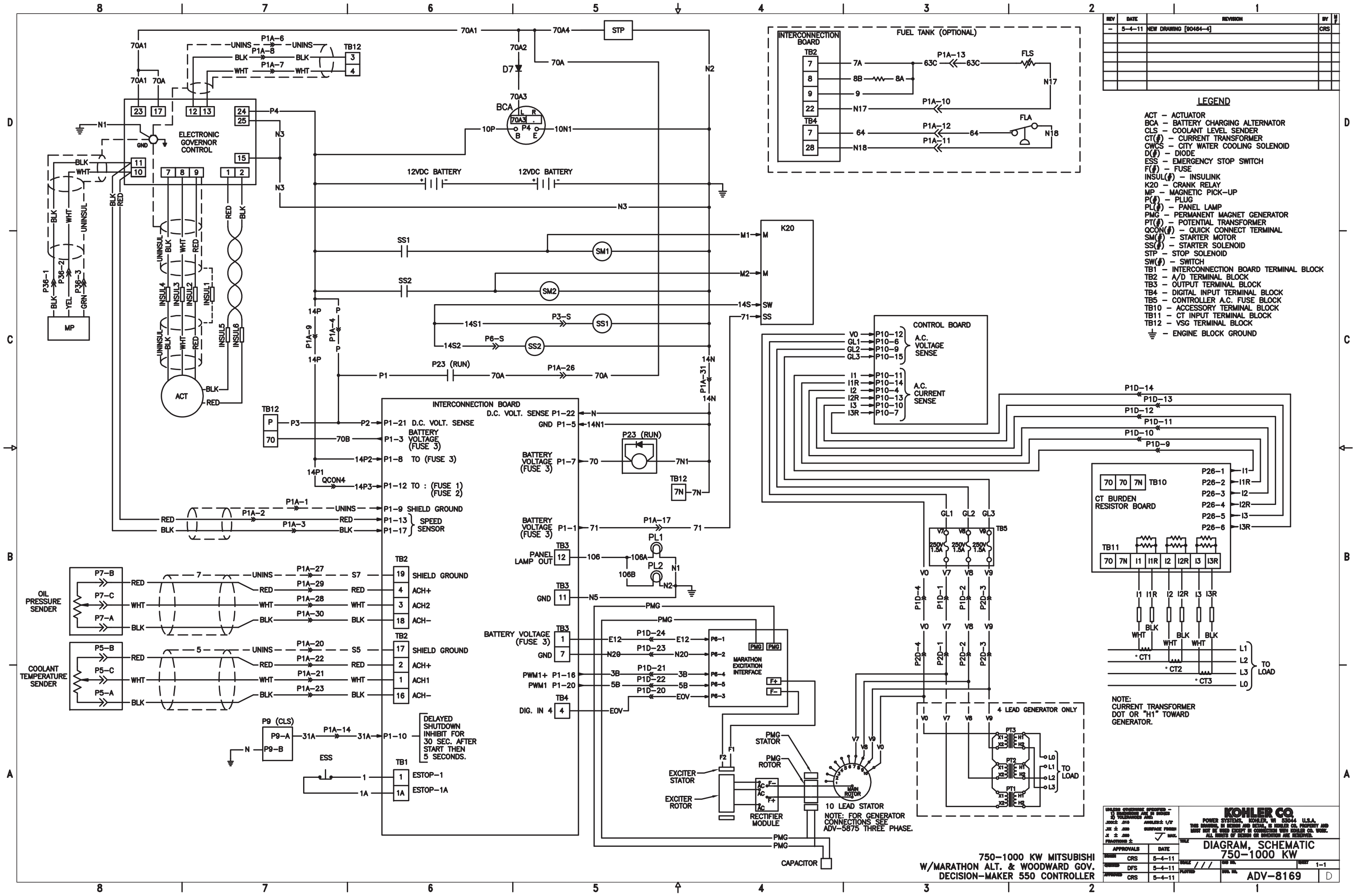
A

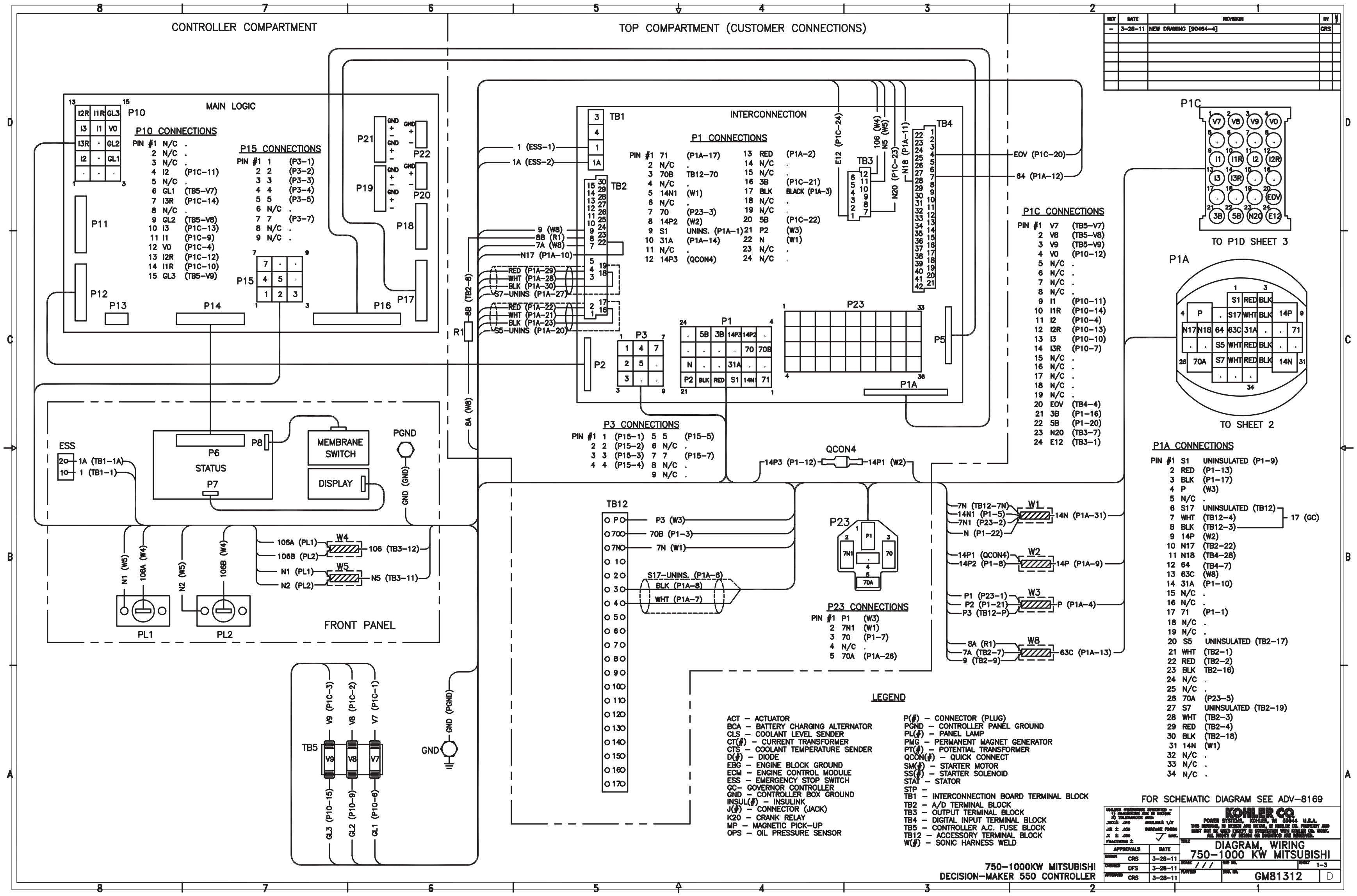
0	CHECK VALVE W/CLOSE NIPPLE ("NPT)
9	FILL CAP, 2" LOCKABLE
8	FUEL LEVEL SENDING UNIT
7	SWITCH ASSY FUEL IN BASIN TOP MTD.
6	2" NPT OPTIONAL FUEL LEVEL SWITCHES
5	2"NPT FITTING, ALT DIP TUBE LOCATION
4	DIP TUBE ASSY ("NPT)
3	GAUGE, FUEL LEVEL, MECHANICAL
2	VENT, NORMAL 2" W/ RISER
1	CAP, VENT, EMERGENCY
ITEM	DESCRIPTION

8 7 6

KOHLER POWER SYSTEMS

Wiring Schematics


REV | DATE | REVISION | BY
– | 5-4-11 | NEW DRAWING [90464-4] | CRS
LEGEND
ACT – ACTUATOR
BCA – BATTERY CHARGING ALTERNATOR
CLS – COOLANT LEVEL SENDER
CT(#) – CURRENT TRANSFORMER
CWCS – CITY WATER COOLING SOLENOID
D(#) – DIODE
ESS – EMERGENCY STOP SWITCH
F(#) – FUSE
INSUL(#) – INSULINK
K20 – CRANK RELAY
MP – MAGNETIC PICK-UP
P(#) – PLUG
PL(#) – PANEL LAMP
PMG – PERMANENT MAGNET GENERATOR
PT(#) – POTENTIAL TRANSFORMER
QCON(#) – QUICK CONNECT TERMINAL
SM(#) – STARTER MOTOR
SS(#) – STARTER SOLENOID
STP – STOP SOLENOID
SW(#) – SWITCH
TB1 – INTERCONNECTION BOARD TERMINAL BLOCK
TB2 – A/D TERMINAL BLOCK
TB3 – OUTPUT TERMINAL BLOCK
TB4 – DIGITAL INPUT TERMINAL BLOCK
TB5 – CONTROLLER A.C. FUSE BLOCK
TB10 – ACCESSORY TERMINAL BLOCK
TB11 – CT INPUT TERMINAL BLOCK
TB12 – VSG TERMINAL BLOCK
– ENGINE BLOCK GROUND
FUEL TANK (OPTIONAL)
INTERCONNECTION BOARD
FLS
FLA
ELECTRONIC GOVERNOR CONTROL
ACT
MP
BCA
STP
D7
12VDC BATTERY
12VDC BATTERY
K20
SM1
SM2
SS1
SS2
P23 (RUN)
INTERCONNECTION BOARD
D.C. VOLT. SENSE
BATTERY VOLTAGE (FUSE 3)
TO (FUSE 3)
TO : (FUSE 1) (FUSE 2)
SHIELD GROUND
SPEED SENSOR
PANEL LAMP OUT
GND
PWM1+
PWM1
DIG. IN 4
ACH+
ACH2
ACH–
ACH1
OIL PRESSURE SENDER
COOLANT TEMPERATURE SENDER
P9 (CLS)
ESS
DELAYED SHUTDOWN INHIBIT FOR 30 SEC. AFTER START THEN 5 SECONDS.
ESTOP-1
ESTOP-1A
PL1
PL2
CONTROL BOARD
A.C. VOLTAGE SENSE
A.C. CURRENT SENSE
CT BURDEN RESISTOR BOARD
TB10
TB11
TB5
MARATHON EXCITATION INTERFACE
EXCITER STATOR
EXCITER ROTOR
PMG STATOR
PMG ROTOR
RECTIFIER MODULE
MAIN ROTOR
10 LEAD STATOR
NOTE: FOR GENERATOR CONNECTIONS SEE ADV-5875 THREE PHASE.
CAPACITOR
4 LEAD GENERATOR ONLY
PT1
PT2
PT3
TO LOAD
CT1
CT2
CT3
NOTE: CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR.
750-1000 KW MITSUBISHI
W/MARATHON ALT. & WOODWARD GOV.
DECISION-MAKER 550 CONTROLLER
KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.
UNLESS OTHERWISE SPECIFIED – 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE:
.XXX ± .010
.XX ± .030
.X ± .080
FRACTIONS ±
ANGLES ± 1/2°
SURFACE FINISH MAX.
APPROVALS | DATE
CRS | 5-4-11
DFS | 5-4-11
CRS | 5-4-11
TITLE DIAGRAM, SCHEMATIC 750-1000 KW
SCALE / / /
SHEET 1-1
DWG. NO. ADV-8169
D



P10 CONNECTIONS

PIN	#1	N/C	.
	2	N/C	.
	3	N/C	.
	4	I2	(P1C-11)
	5	N/C	.
	6	GL1	(TB5-V7)
	7	I3R	(P1C-14)
	8	N/C	.
	9	GL2	(TB5-V8)
	10	I3	(P1C-13)
	11	I1	(P1C-9)
	12	V0	(P1C-4)
	13	I2R	(P1C-12)
	14	I1R	(P1C-10)
	15	GL3	(TB5-V9)

P15 CONNECTIONS

PIN	#1	1	(P3-1)
	2	2	(P3-2)
	3	3	(P3-3)
	4	4	(P3-4)
	5	5	(P3-5)
	6	N/C	.
	7	7	(P3-7)
	8	N/C	.
	9	N/C	.

P1 CONNECTIONS

PIN	#1	71	(P1A-17)	13	RED	(P1A-2)
	2	N/C	.	14	N/C	.
	3	70B	TB12-70	15	N/C	.
	4	N/C	.	16	3B	(P1C-21)
	5	14N1	(W1)	17	BLK	BLACK (P1A-3)
	6	N/C	.	18	N/C	.
	7	70	(P23-3)	19	N/C	.
	8	14P2	(W2)	20	5B	(P1C-22)
	9	S1	UNINS. (P1A-1)	21	P2	(W3)
	10	31A	(P1A-14)	22	N	(W1)
	11	N/C	.	23	N/C	.
	12	14P3	(QCON4)	24	N/C	.

P3 CONNECTIONS

PIN	#1	1	(P15-1)	5	5	(P15-5)
	2	2	(P15-2)	6	N/C	.
	3	3	(P15-3)	7	7	(P15-7)
	4	4	(P15-4)	8	N/C	.
				9	N/C	.

P23 CONNECTIONS

PIN	#1	P1	(W3)
	2	7N1	(W1)
	3	70	(P1-7)
	4	N/C	.
	5	70A	(P1A-26)

P1C CONNECTIONS

PIN	#1	V7	(TB5-V7)
	2	V8	(TB5-V8)
	3	V9	(TB5-V9)
	4	V0	(P10-12)
	5	N/C	.
	6	N/C	.
	7	N/C	.
	8	N/C	.
	9	I1	(P10-11)
	10	I1R	(P10-14)
	11	I2	(P10-4)
	12	I2R	(P10-13)
	13	I3	(P10-10)
	14	I3R	(P10-7)
	15	N/C	.
	16	N/C	.
	17	N/C	.
	18	N/C	.
	19	N/C	.
	20	EOV	(TB4-4)
	21	3B	(P1-16)
	22	5B	(P1-20)
	23	N20	(TB3-7)
	24	E12	(TB3-1)

P1A CONNECTIONS

PIN	#1	S1	UNINSULATED (P1-9)
	2	RED	(P1-13)
	3	BLK	(P1-17)
	4	P	(W3)
	5	N/C	.
	6	S17	UNINSULATED (TB12) — 17 (GC)
	7	WHT	(TB12-4) — 17 (GC)
	8	BLK	(TB12-3) — 17 (GC)
	9	14P	(W2)
	10	N17	(TB2-22)
	11	N18	(TB4-28)
	12	64	(TB4-7)
	13	63C	(W8)
	14	31A	(P1-10)
	15	N/C	.
	16	N/C	.
	17	71	(P1-1)
	18	N/C	.
	19	N/C	.
	20	S5	UNINSULATED (TB2-17)
	21	WHT	(TB2-1)
	22	RED	(TB2-2)
	23	BLK	TB2-16)
	24	N/C	.
	25	N/C	.
	26	70A	(P23-5)
	27	S7	UNINSULATED (TB2-19)
	28	WHT	(TB2-3)
	29	RED	(TB2-4)
	30	BLK	(TB2-18)
	31	14N	(W1)
	32	N/C	.
	33	N/C	.
	34	N/C	.

LEGEND

ACT – ACTUATOR
BCA – BATTERY CHARGING ALTERNATOR
CLS – COOLANT LEVEL SENDER
CT(#) – CURRENT TRANSFORMER
CTS – COOLANT TEMPERATURE SENDER
D(#) – DIODE
EBG – ENGINE BLOCK GROUND
ECM – ENGINE CONTROL MODULE
ESS – EMERGENCY STOP SWITCH
GC– GOVERNOR CONTROLLER
GND – CONTROLLER BOX GROUND
INSUL(#) – INSULINK
J(#) – CONNECTOR (JACK)
K20 – CRANK RELAY
MP – MAGNETIC PICK-UP
OPS – OIL PRESSURE SENSOR
P(#) – CONNECTOR (PLUG)
PGND – CONTROLLER PANEL GROUND
PL(#) – PANEL LAMP
PMG – PERMANENT MAGNET GENERATOR
PT(#) – POTENTIAL TRANSFORMER
QCON(#) – QUICK CONNECT
SM(#) – STARTER MOTOR
SS(#) – STARTER SOLENOID
STAT – STATOR
STP –
TB1 – INTERCONNECTION BOARD TERMINAL BLOCK
TB2 – A/D TERMINAL BLOCK
TB3 – OUTPUT TERMINAL BLOCK
TB4 – DIGITAL INPUT TERMINAL BLOCK
TB5 – CONTROLLER A.C. FUSE BLOCK
TB12 – ACCESSORY TERMINAL BLOCK
W(#) – SONIC HARNESS WELD

750-1000KW MITSUBISHI
DECISION-MAKER 550 CONTROLLER

FOR SCHEMATIC DIAGRAM SEE ADV-8169

REV	DATE	REVISION	BY
–	3-28-11	NEW DRAWING [90464-4]	CRS

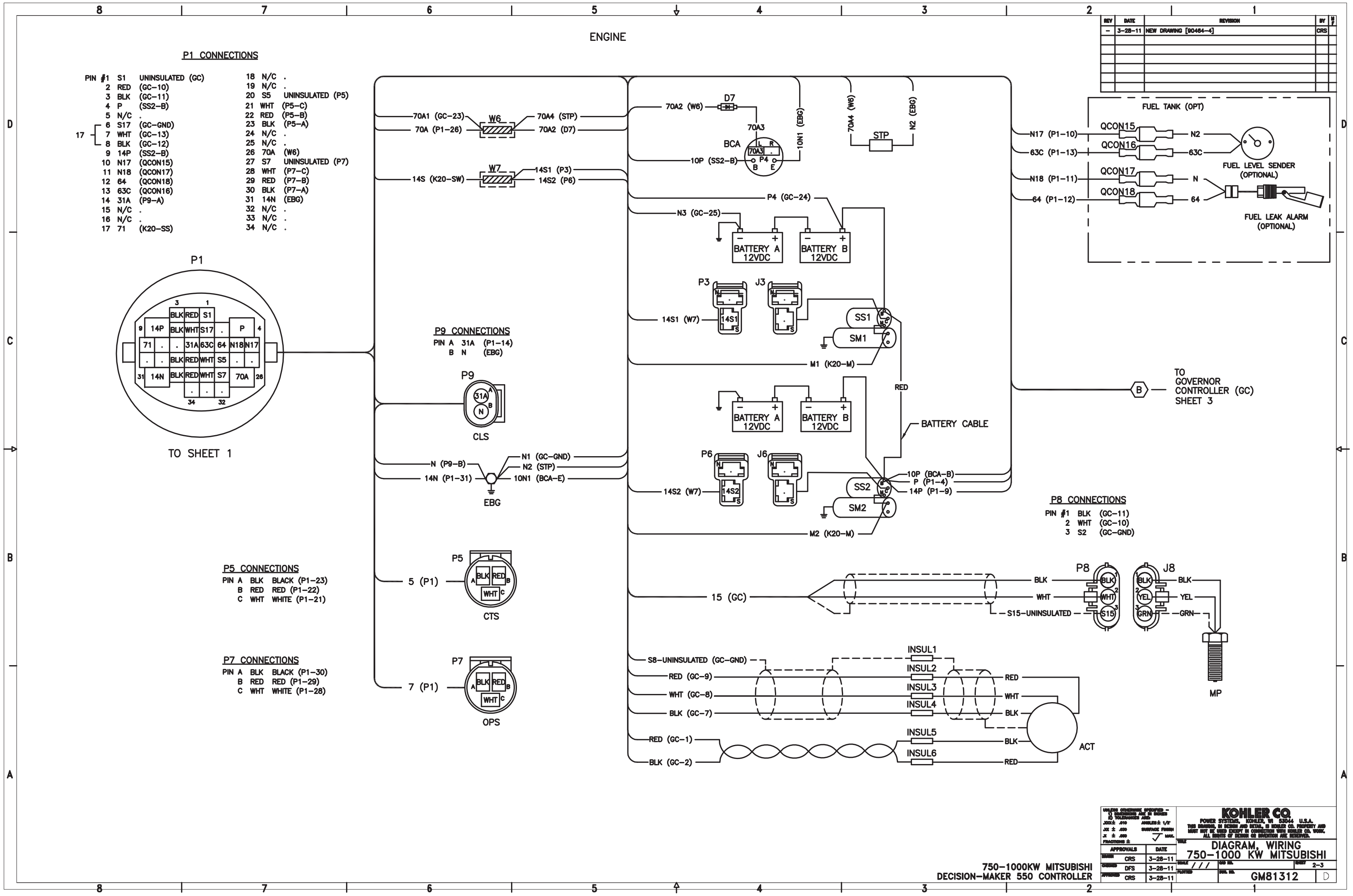
UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .080 MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	CRS	3-28-11
CHECKED	DFS	3-28-11
APPROVED	CRS	3-28-11

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE DIAGRAM, WIRING
750-1000 KW MITSUBISHI
SCALE / / /
CAD NO.
SHEET 1-3
PLOTTED
DWG. NO. GM81312 D



P1 CONNECTIONS

	PIN #1	S1	UNINSULATED (GC)
	2	RED	(GC-10)
	3	BLK	(GC-11)
	4	P	(SS2-B)
	5	N/C	.
17	6	S17	(GC-GND)
	7	WHT	(GC-13)
	8	BLK	(GC-12)
	9	14P	(SS2-B)
	10	N17	(QCON15)
	11	N18	(QCON17)
	12	64	(QCON18)
	13	63C	(QCON16)
	14	31A	(P9-A)
	15	N/C	.
	16	N/C	.
	17	71	(K20-SS)
	18	N/C	.
	19	N/C	.
	20	S5	UNINSULATED (P5)
	21	WHT	(P5-C)
	22	RED	(P5-B)
	23	BLK	(P5-A)
	24	N/C	.
	25	N/C	.
	26	70A	(W6)
	27	S7	UNINSULATED (P7)
	28	WHT	(P7-C)
	29	RED	(P7-B)
	30	BLK	(P7-A)
	31	14N	(EBG)
	32	N/C	.
	33	N/C	.
	34	N/C	.

P9 CONNECTIONS

PIN A	31A	(P1-14)
B	N	(EBG)

P5 CONNECTIONS

PIN A	BLK	BLACK (P1-23)
B	RED	RED (P1-22)
C	WHT	WHITE (P1-21)

P7 CONNECTIONS

PIN A	BLK	BLACK (P1-30)
B	RED	RED (P1-29)
C	WHT	WHITE (P1-28)

P8 CONNECTIONS

PIN #1	BLK	(GC-11)
2	WHT	(GC-10)
3	S2	(GC-GND)

REV	DATE	REVISION	BY	MF
-	3-28-11	NEW DRAWING [90464-4]	CRS	

750-1000KW MITSUBISHI
DECISION-MAKER 550 CONTROLLER

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS ±

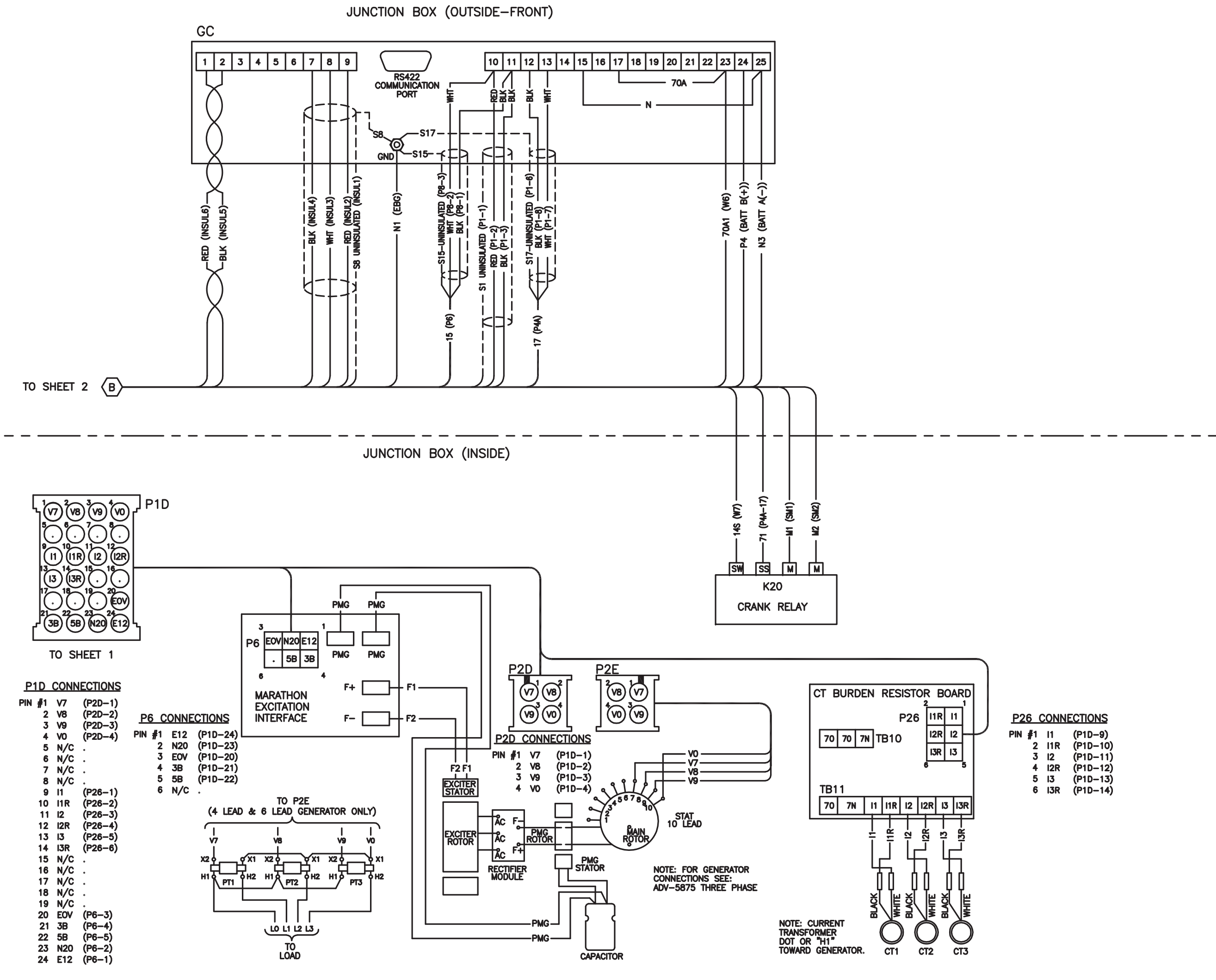
APPROVALS		DATE
DRAWN	CRS	3-28-11
CHECKED	DFS	3-28-11
APPROVED	CRS	3-28-11

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIAGRAM, WIRING
750-1000 KW MITSUBISHI

SCALE / / /
CAD NO.
SHEET 2-3
PLOTTED
DWG. NO. GM81312 D

REV	DATE	REVISION	BY	MF
–	3-28-11	NEW DRAWING [90464-4]	CRS	



P1D CONNECTIONS

PIN #1	V7	(P2D-1)
2	V8	(P2D-2)
3	V9	(P2D-3)
4	V0	(P2D-4)
5	N/C	.
6	N/C	.
7	N/C	.
8	N/C	.
9	I1	(P26-1)
10	I1R	(P26-2)
11	I2	(P26-3)
12	I2R	(P26-4)
13	I3	(P26-5)
14	I3R	(P26-6)
15	N/C	.
16	N/C	.
17	N/C	.
18	N/C	.
19	N/C	.
20	EOV	(P6-3)
21	3B	(P6-4)
22	5B	(P6-5)
23	N20	(P6-2)
24	E12	(P6-1)

P6 CONNECTIONS

PIN #1	E12	(P1D-24)
2	N20	(P1D-23)
3	EOV	(P1D-20)
4	3B	(P1D-21)
5	5B	(P1D-22)
6	N/C	.

P2D CONNECTIONS

PIN #1	V7	(P1D-1)
2	V8	(P1D-2)
3	V9	(P1D-3)
4	V0	(P1D-4)

P26 CONNECTIONS

PIN #1	I1	(P1D-9)
2	I1R	(P1D-10)
3	I2	(P1D-11)
4	I2R	(P1D-12)
5	I3	(P1D-13)
6	I3R	(P1D-14)

NOTE: FOR GENERATOR CONNECTIONS SEE: ADV-5875 THREE PHASE

NOTE: CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR.

750-1000KW MITSUBISHI
DECISION-MAKER 550 CONTROLLER

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	CRS	3-28-11
CHECKED	DFS	3-28-11
APPROVED	CRS	3-28-11

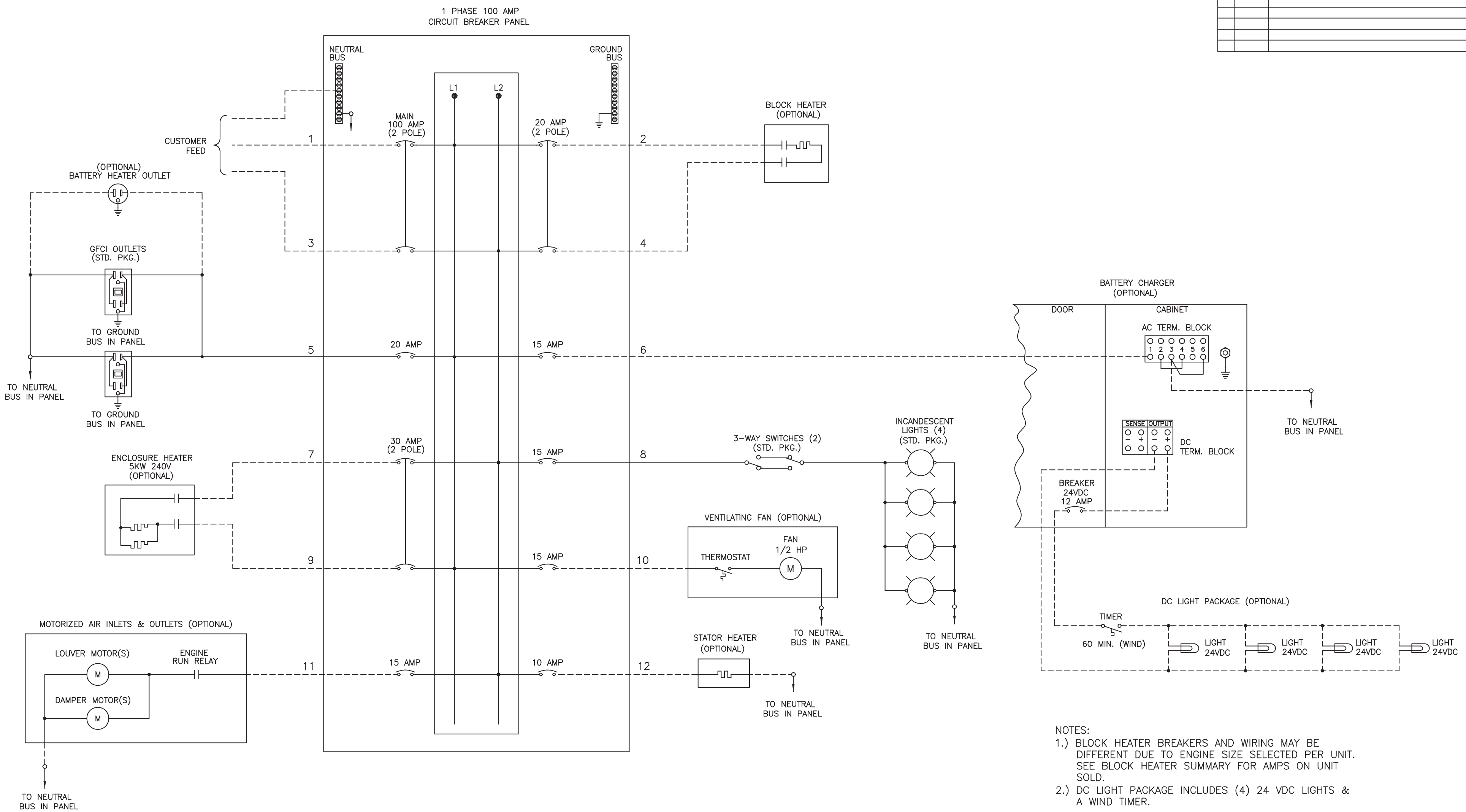
KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIAGRAM, WIRING
750-1000 KW MITSUBISHI

SCALE / / /
CID NO.
SHEET 3-3
PLOTTED
DWG. NO. GM81312 D

REV	DATE	REVISION	BY	M F
–	2-18-05	NEW DRAWING [73953]	DFS	
A	11-10-06	(D-8) OPTIONAL BATTERY HEATER OUTLET ADDED [79794]	SEM	



NOTES:
1.) BLOCK HEATER BREAKERS AND WIRING MAY BE DIFFERENT DUE TO ENGINE SIZE SELECTED PER UNIT. SEE BLOCK HEATER SUMMARY FOR AMPS ON UNIT SOLD.
2.) DC LIGHT PACKAGE INCLUDES (4) 24 VDC LIGHTS & A WIND TIMER.

TPIK HOUSING
ELECTRICAL ACCESSORIES
1 PHASE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS ±

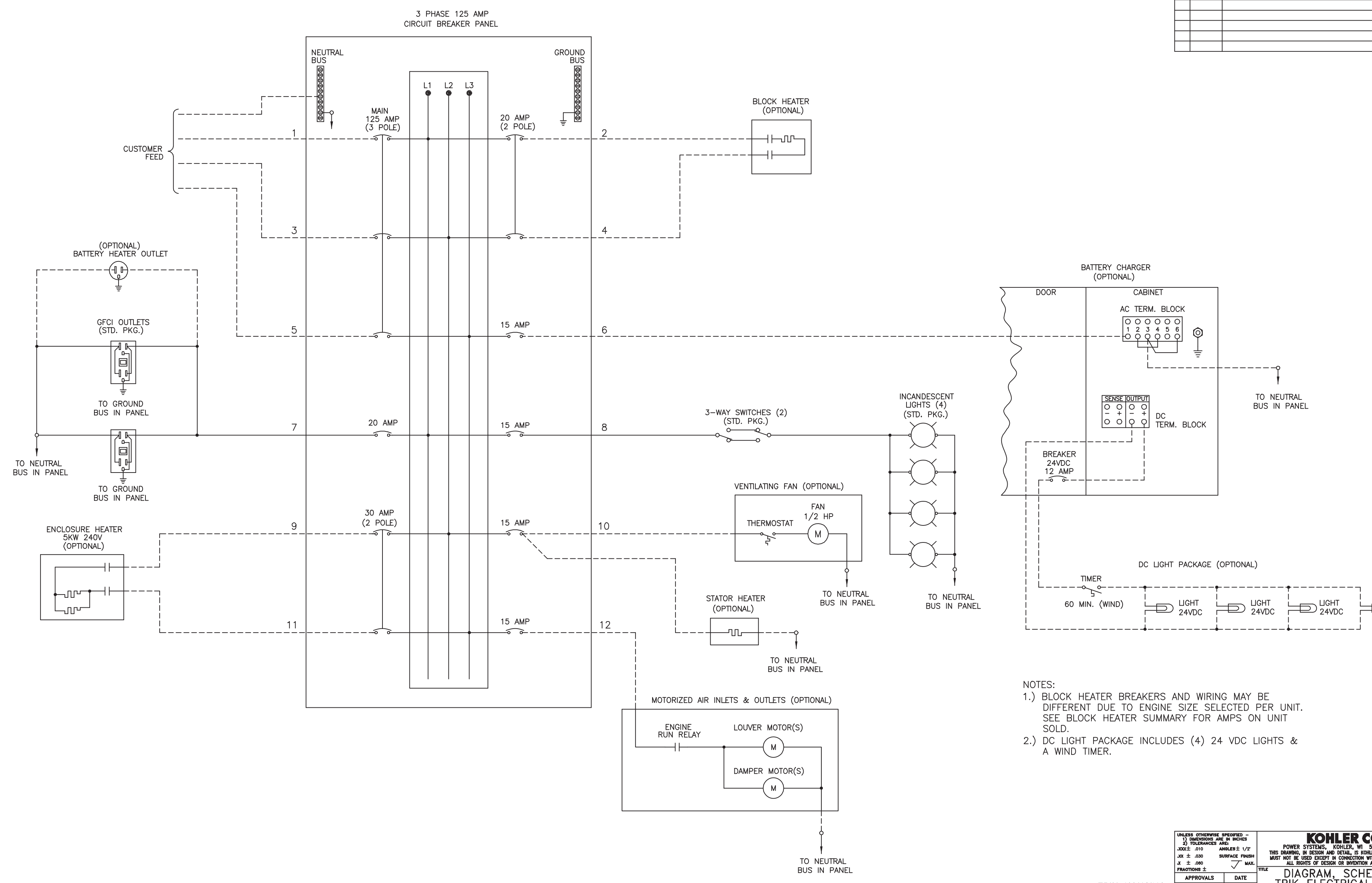
APPROVALS		DATE
DRAWN	DFS	2-18-05
CHECKED	TLK	2-21-05
APPROVED	EB	2-21-05

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIAGRAM, SCHEMATIC
TPIK ELECTRICAL PANEL

SCALE / / /
CAD NO. ADV7035A.DWG
SHEET 1-2
PLOTTED
DWG. NO. ADV-7035
D G

REV	DATE	REVISION	BY	M F
–	2–18–05	NEW DRAWING [73953]	DFS	
A	11–10–06	(C–8) OPTIONAL BATTERY HEATER OUTLET ADDED [79794]	SEM	



NOTES:
1.) BLOCK HEATER BREAKERS AND WIRING MAY BE DIFFERENT DUE TO ENGINE SIZE SELECTED PER UNIT. SEE BLOCK HEATER SUMMARY FOR AMPS ON UNIT SOLD.
2.) DC LIGHT PACKAGE INCLUDES (4) 24 VDC LIGHTS & A WIND TIMER.

TPIK HOUSING
ELECTRICAL ACCESSORIES
3 PHASE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS ±

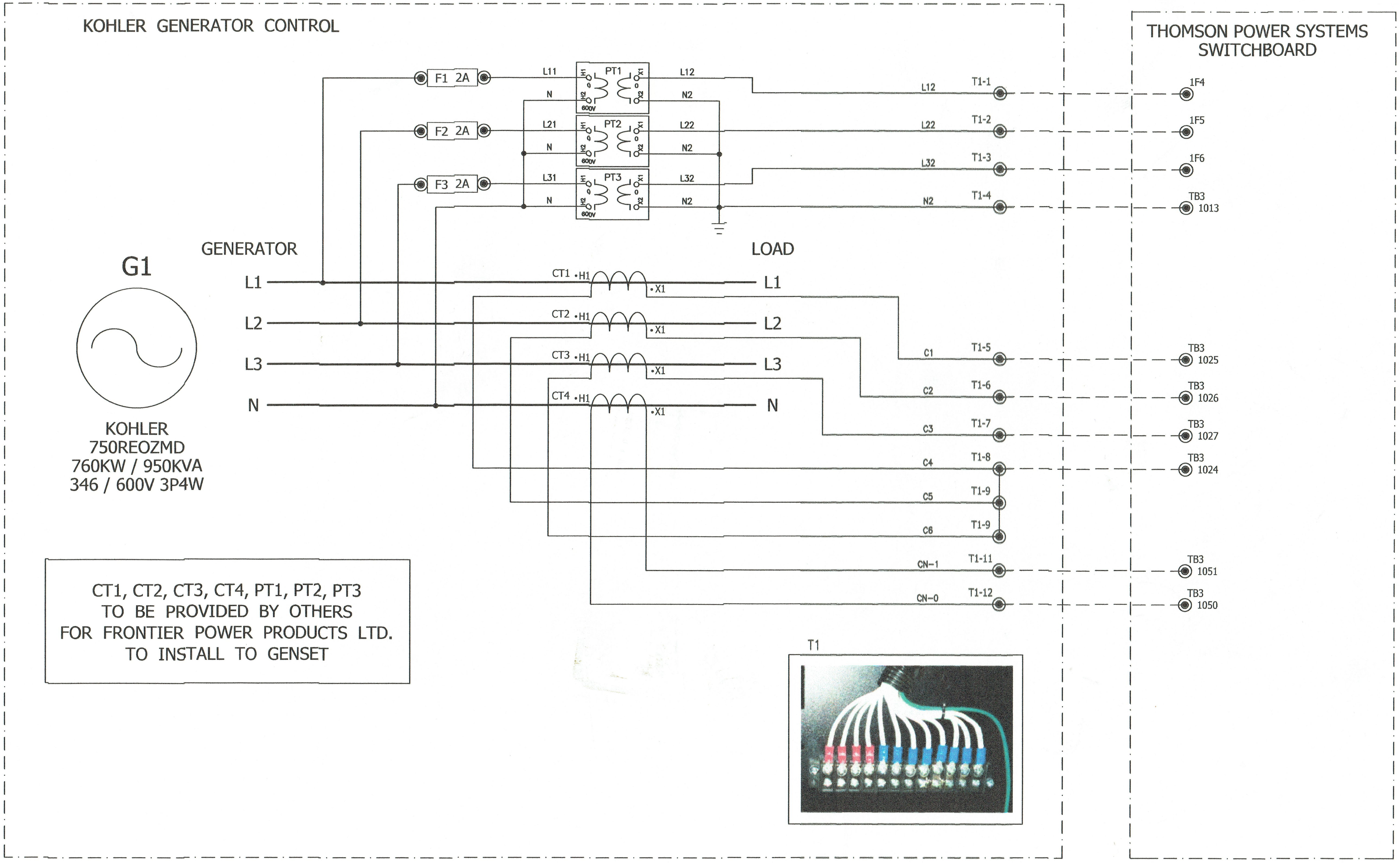
APPROVALS		DATE
DRAWN	DFS	2–18–05
CHECKED	TLK	2–21–05
APPROVED	EB	2–21–05

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIAGRAM, SCHEMATIC
TPIK ELECTRICAL PANEL

SCALE / / /
CAD NO. ADV7035B.DWG
SHEET 2–2
PLOTTED
DWG. NO. ADV–7035
D G



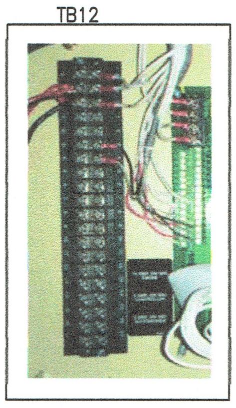
CT1, CT2, CT3, CT4, PT1, PT2, PT3
TO BE PROVIDED BY OTHERS
FOR FRONTIER POWER PRODUCTS LTD.
TO INSTALL TO GENSET

REV 2 CIRCUIT UPDATE
REV 1 ADD PT
REV 0 INITIAL DRAFT

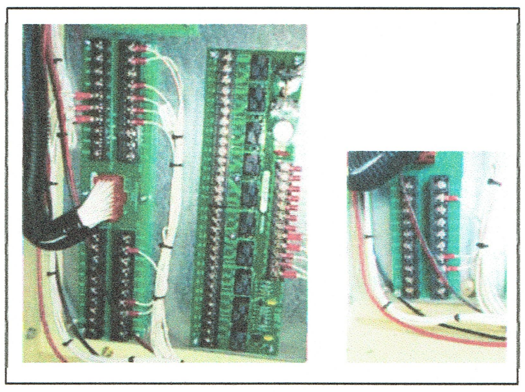
Frontier POWER PRODUCTS

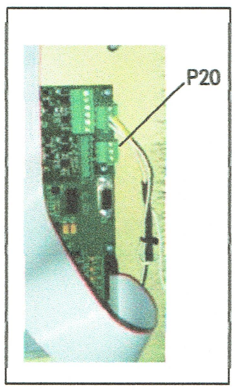
DATE 5/DEC/2016
DWG # 10468
REV 2 24/FEB/2017
CLIENT WESTERN PACIFIC ENTERPRISES LTD.
TITLE INTERFACING DRAWING FOR VOLTAGE AND CURRENT SENSING BETWEEN G1 AND THOMSON POWER SWITCHBOARD
DRN BY HO. K. CHUNG
W/O # 67060

TB12

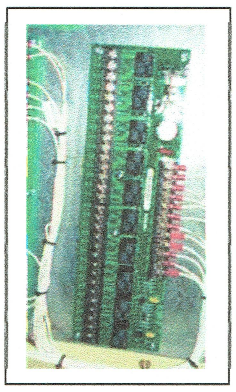


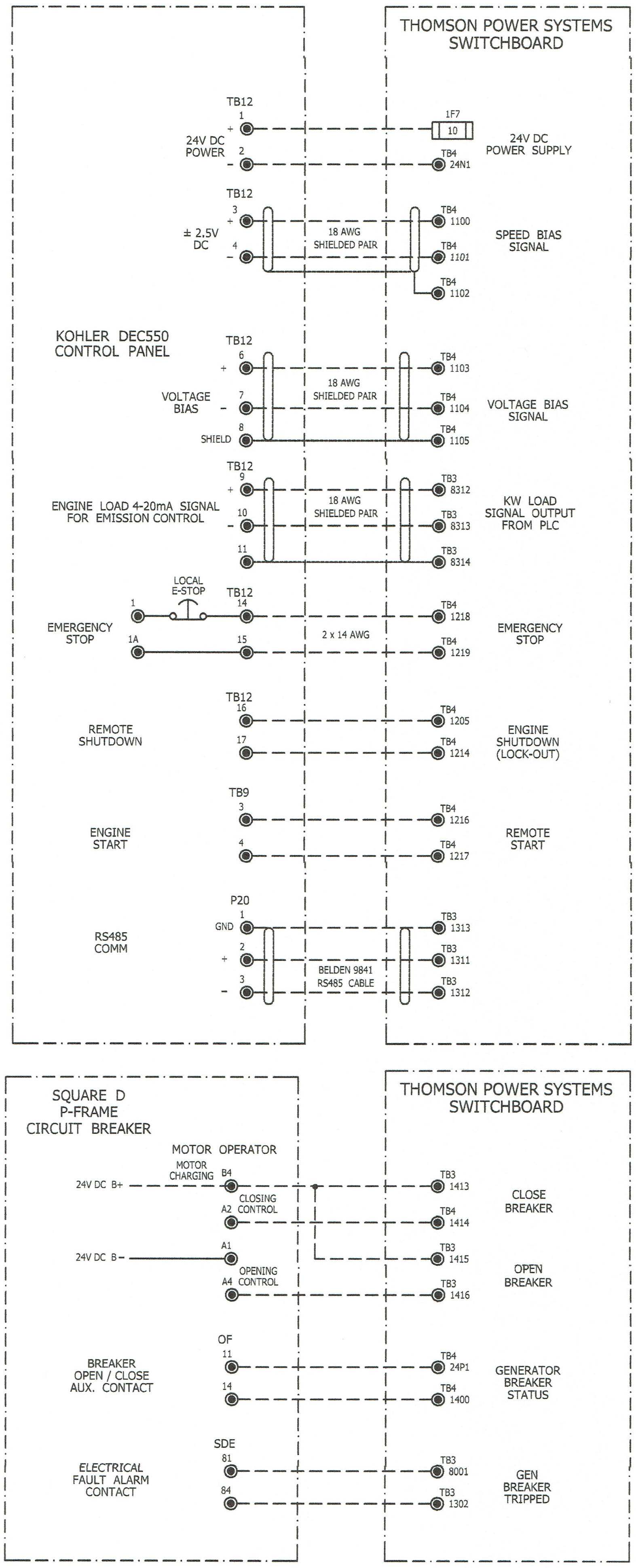
TB9

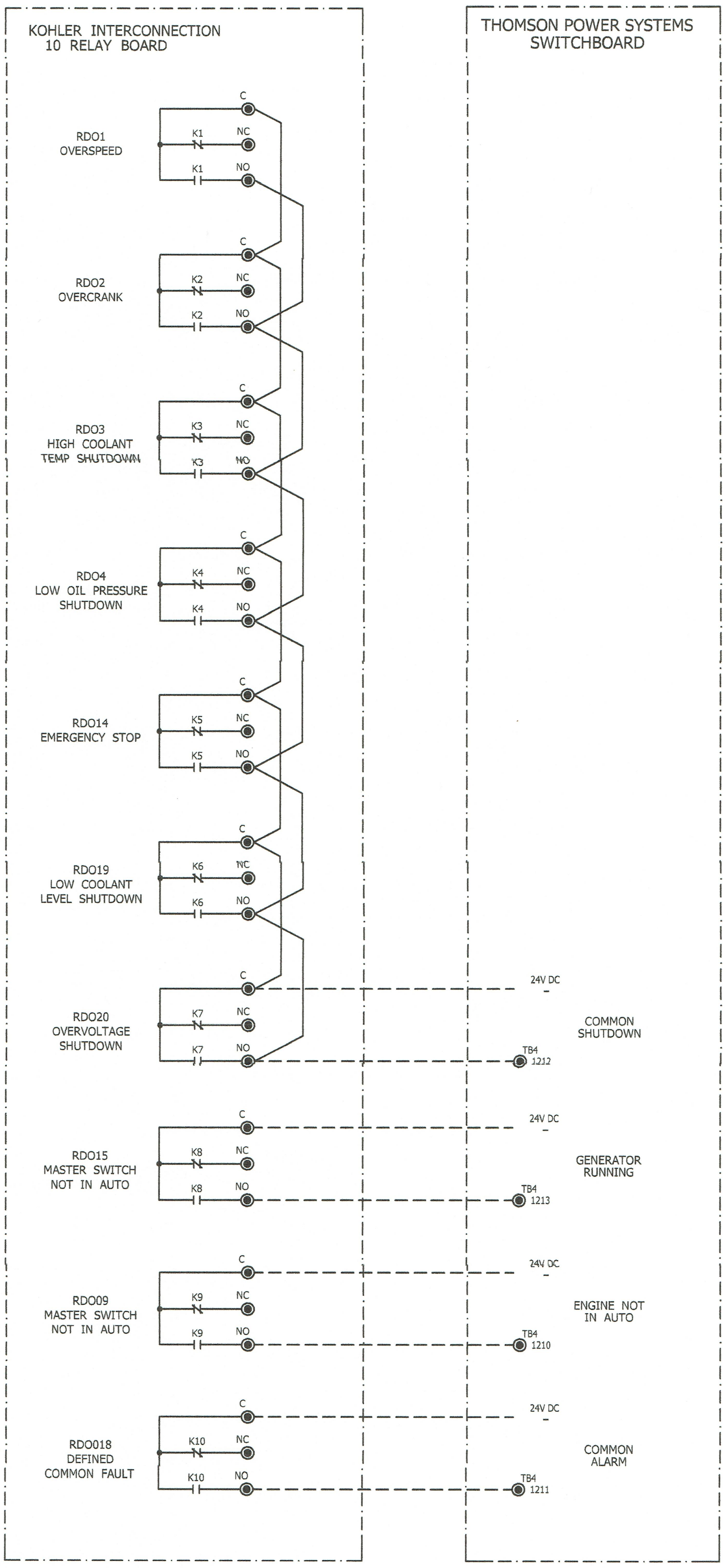


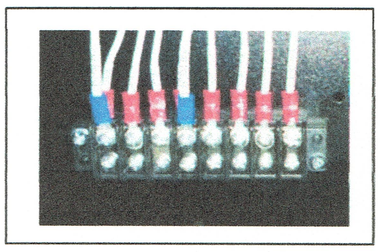


10 RELAY BOARD





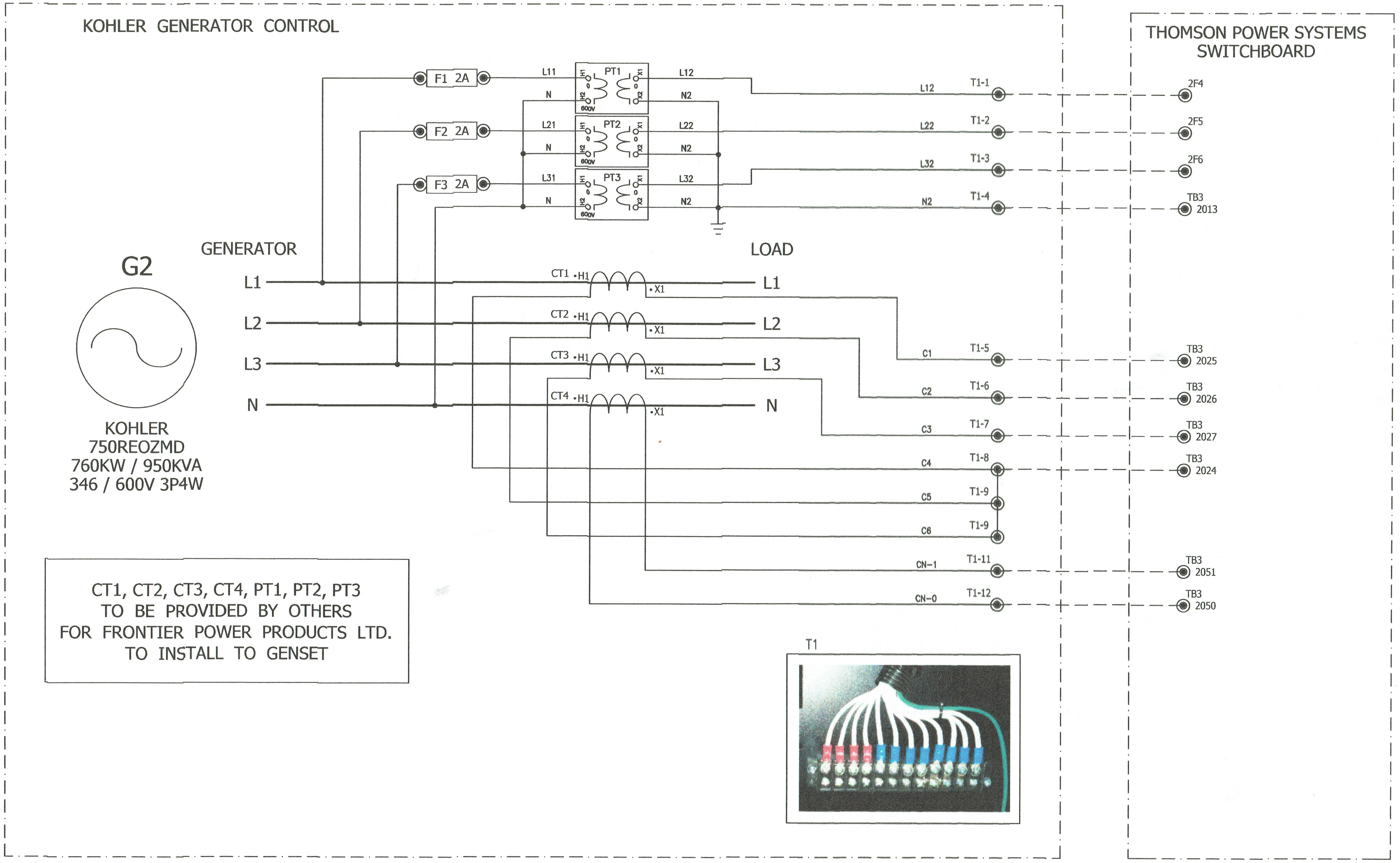




REV 2 CHANGE – TPS DC24V
REV 1 CIRCUIT UPDATE
REV 0 INITIAL DRAFT

Frontier
POWER PRODUCTS

DATE 5/DEC/2016	DWG # 10471
REV 2	27/FEB/2017
CLIENT WESTERN PACIFIC ENTERPRISES LTD.	
TITLE INTERFACING DRAWING FOR GENSET CONTROL BETWEEN G1 AND THOMSON POWER SWITCHBOARD	
DRN BY HO. K. CHUNG	W/O # 67060



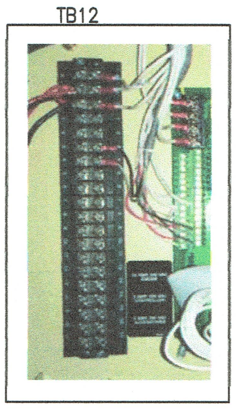
CT1, CT2, CT3, CT4, PT1, PT2, PT3
TO BE PROVIDED BY OTHERS
FOR FRONTIER POWER PRODUCTS LTD.
TO INSTALL TO GENSET

REV 2 CIRCUIT UPDATE
REV 1 ADD PT
REV 0 INITIAL DRAFT

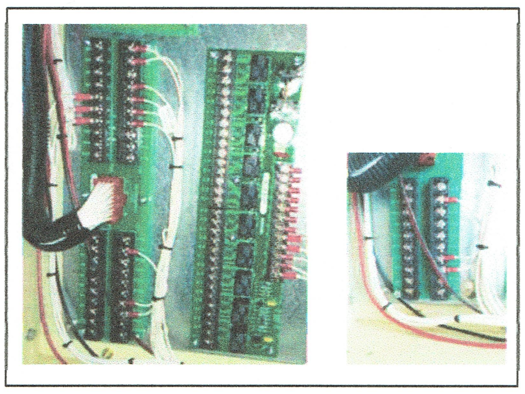
Frontier POWER PRODUCTS

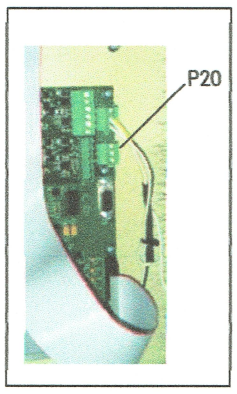
DATE 5/DEC/2016	DWG # 10469
REV 2	24/FEB/2017
CLIENT WESTERN PACIFIC ENTERPRISES LTD.	
TITLE INTERFACING DRAWING FOR VOLTAGE AND CURRENT SENSING BETWEEN G2 AND THOMSON POWER SWITCHBOARD	
DRN BY HO. K. CHUNG	W/O # 67060

TB12

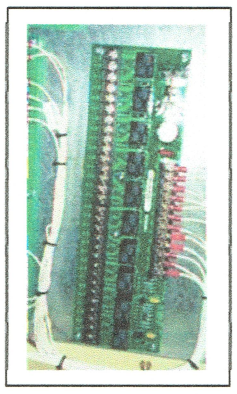


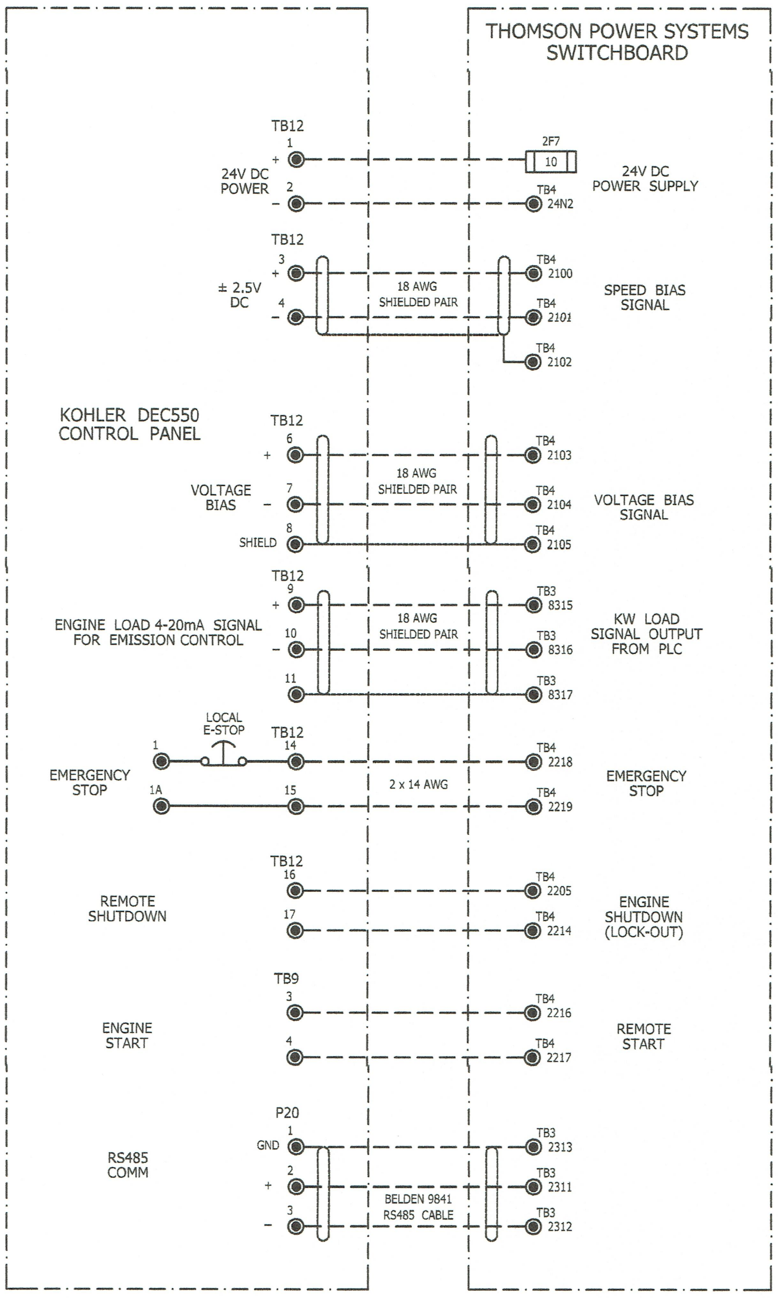
TB9

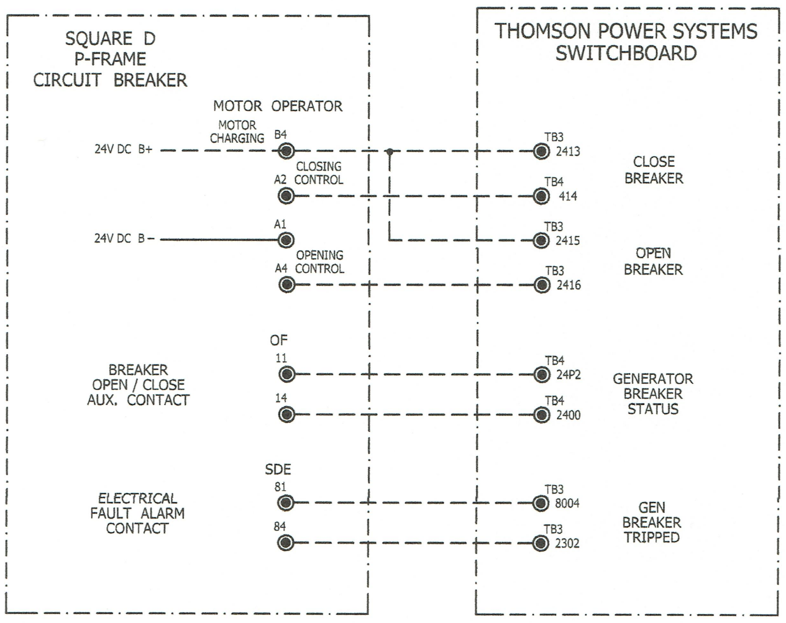


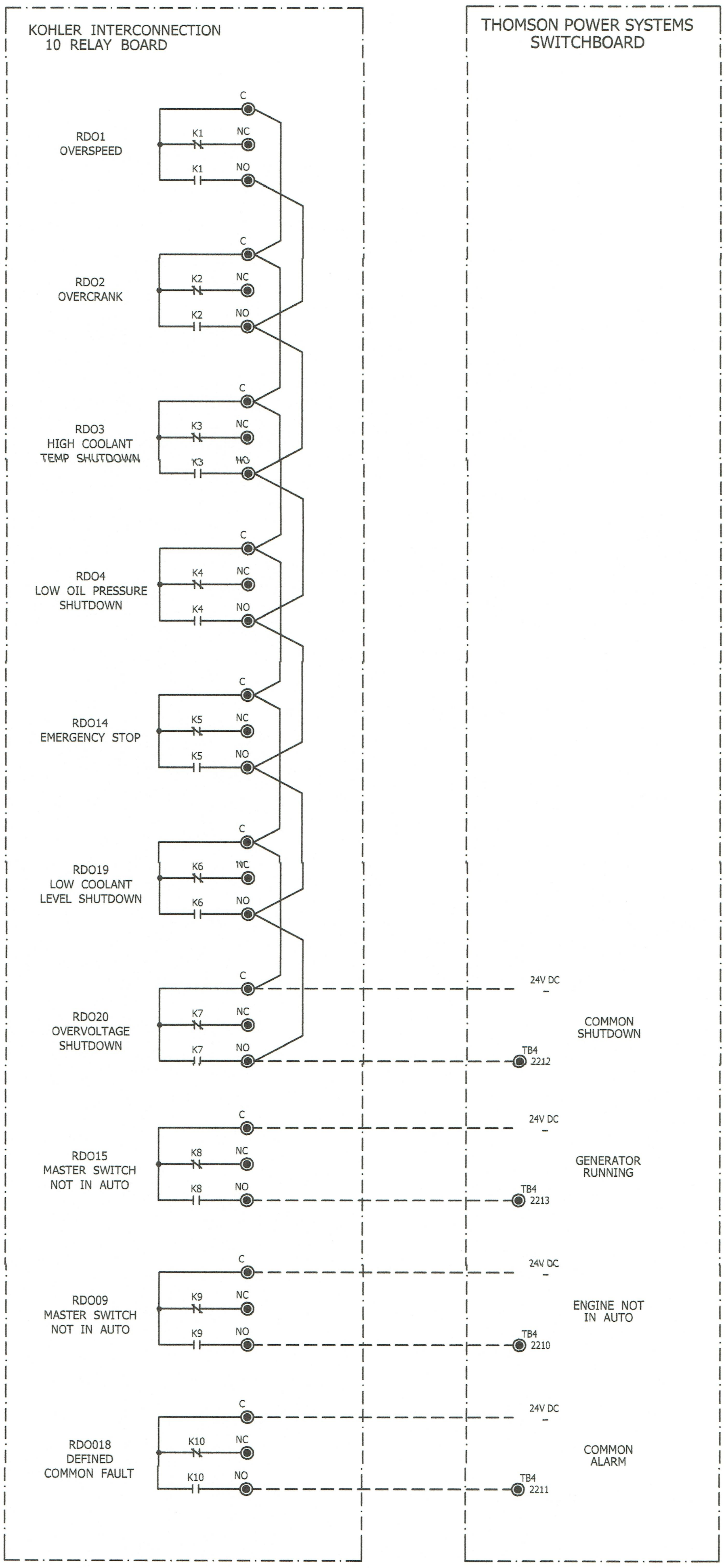


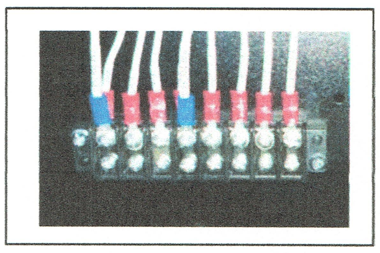
10 RELAY BOARD







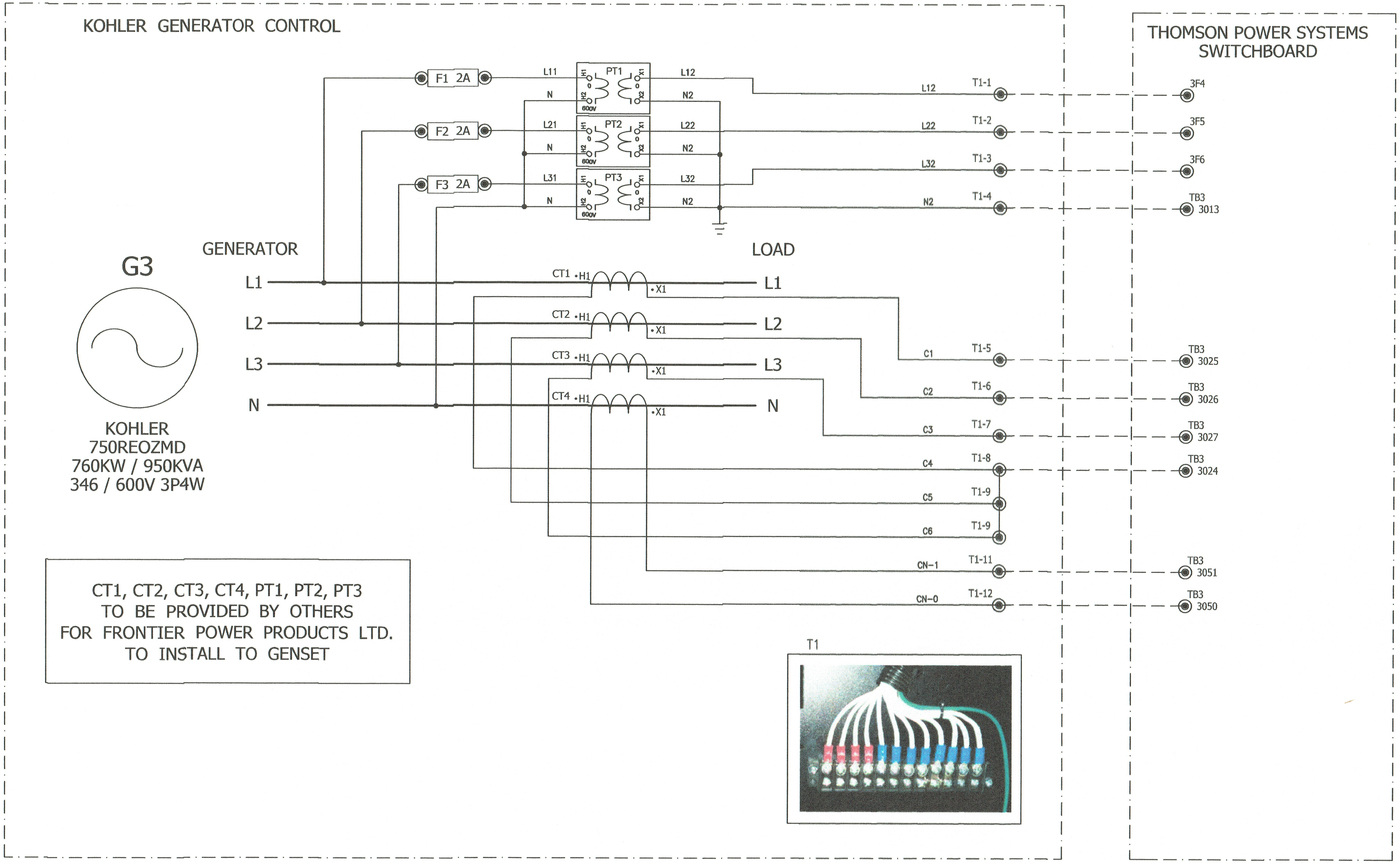




REV 2 CHANGE – TPS DC24V
REV 1 CIRCUIT UPDATE
REV 0 INITIAL DRAFT

Frontier
POWER PRODUCTS

DATE 5/DEC/2016	DWG # 10472
REV 2	27/FEB/2017
CLIENT WESTERN PACIFIC ENTERPRISES LTD.	
TITLE INTERFACING DRAWING FOR GENSET CONTROL BETWEEN G2 AND THOMSON POWER SWITCHBOARD	
DRN BY HO. K. CHUNG	W/O # 67060



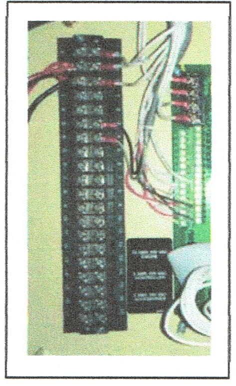
CT1, CT2, CT3, CT4, PT1, PT2, PT3
TO BE PROVIDED BY OTHERS
FOR FRONTIER POWER PRODUCTS LTD.
TO INSTALL TO GENSET

REV 2	CIRCUIT UPDATE
REV 1	ADD PT
REV 0	INITIAL DRAFT

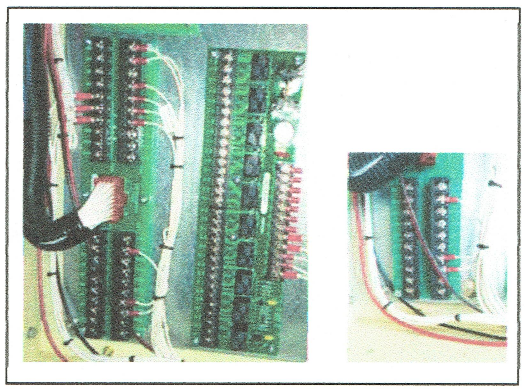
Frontier POWER PRODUCTS

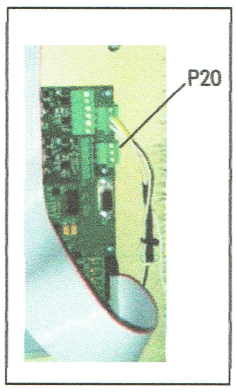
DATE	5/DEC/2016	DWG #	10470
REV	2		24/FEB/2017
CLIENT	WESTERN PACIFIC ENTERPRISES LTD.		
TITLE	INTERFACING DRAWING FOR VOLTAGE AND CURRENT SENSING BETWEEN G3 AND THOMSON POWER SWITCHBOARD		
DRN BY	HO. K. CHUNG	W/O #	67060

TB12

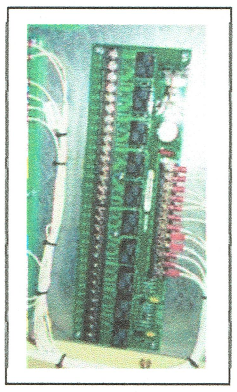


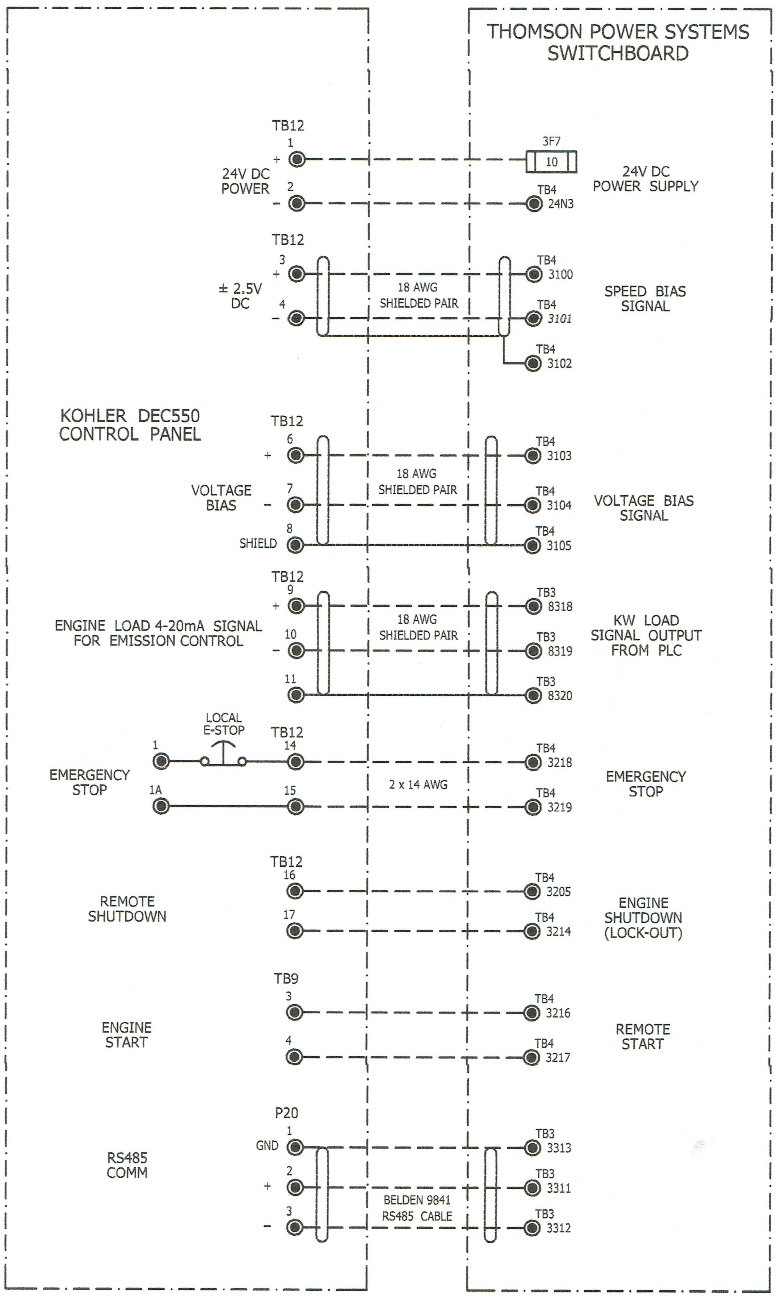
TB9

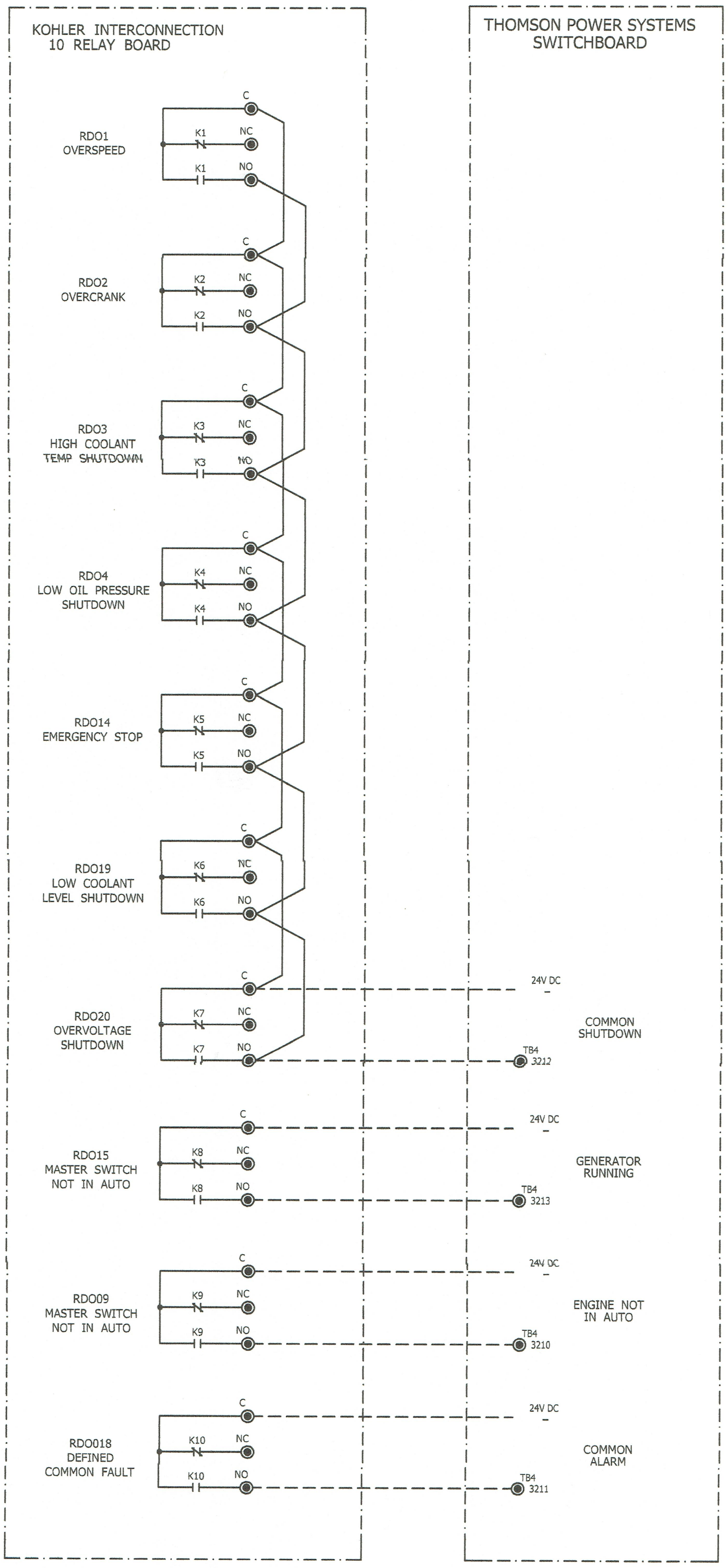


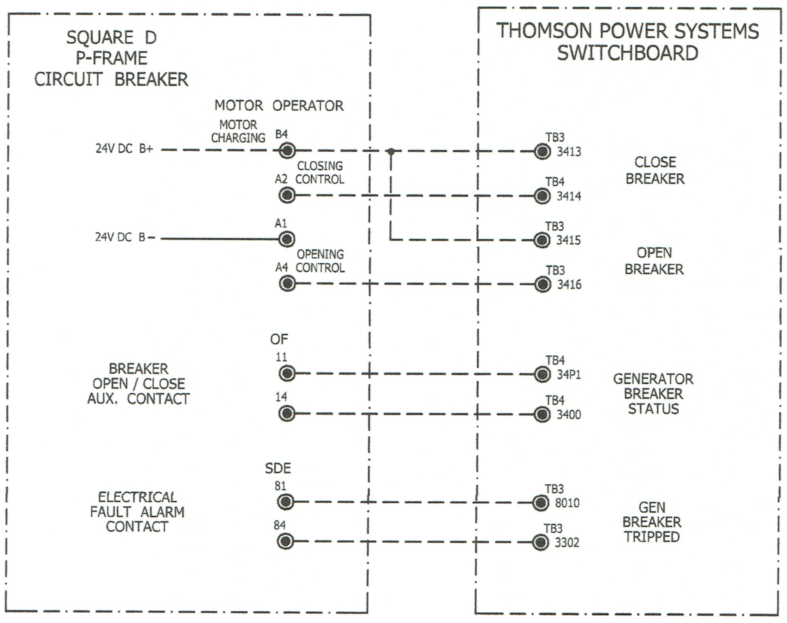


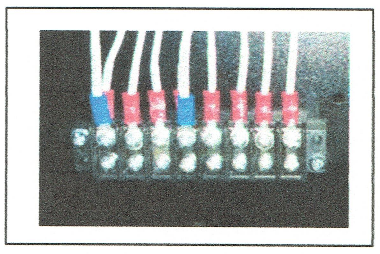
10 RELAY BOARD









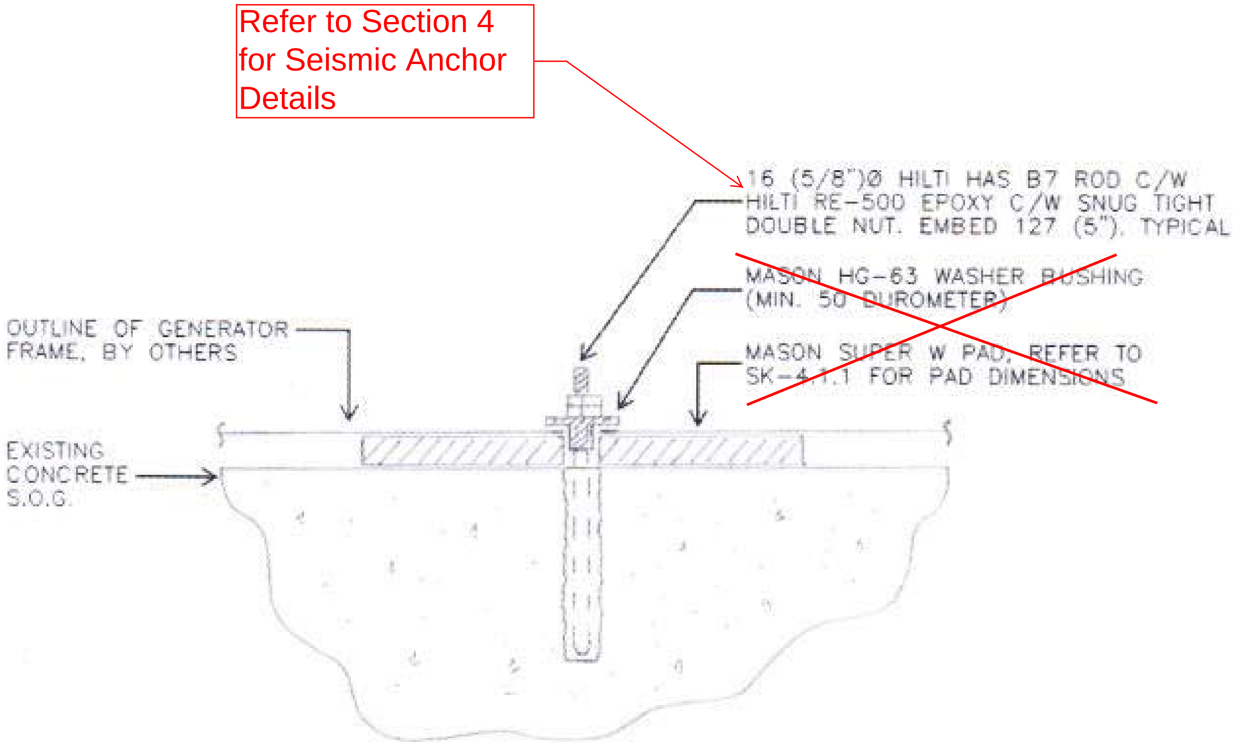


REV 2	CHANGE – TPS DC24V
REV 1	CIRCUIT UPDATE
REV 0	INITIAL DRAFT

Frontier
POWER PRODUCTS

DATE 5/DEC/2016
DWG # 10473
REV 2 27/FEB/2017
CLIENT WESTERN PACIFIC ENTERPRISES LTD.
TITLE INTERFACING DRAWING FOR GENSET CONTROL BETWEEN G3 AND THOMSON POWER SWITCHBOARD
DRN BY HO. K. CHUNG
W/O # 67060

Miscellaneous



Refer to Section 4 for Seismic Anchor Details

Read Jones Christoffersen
Consulting Engineers

Dwg. Ref N/A
Scale N.T.S

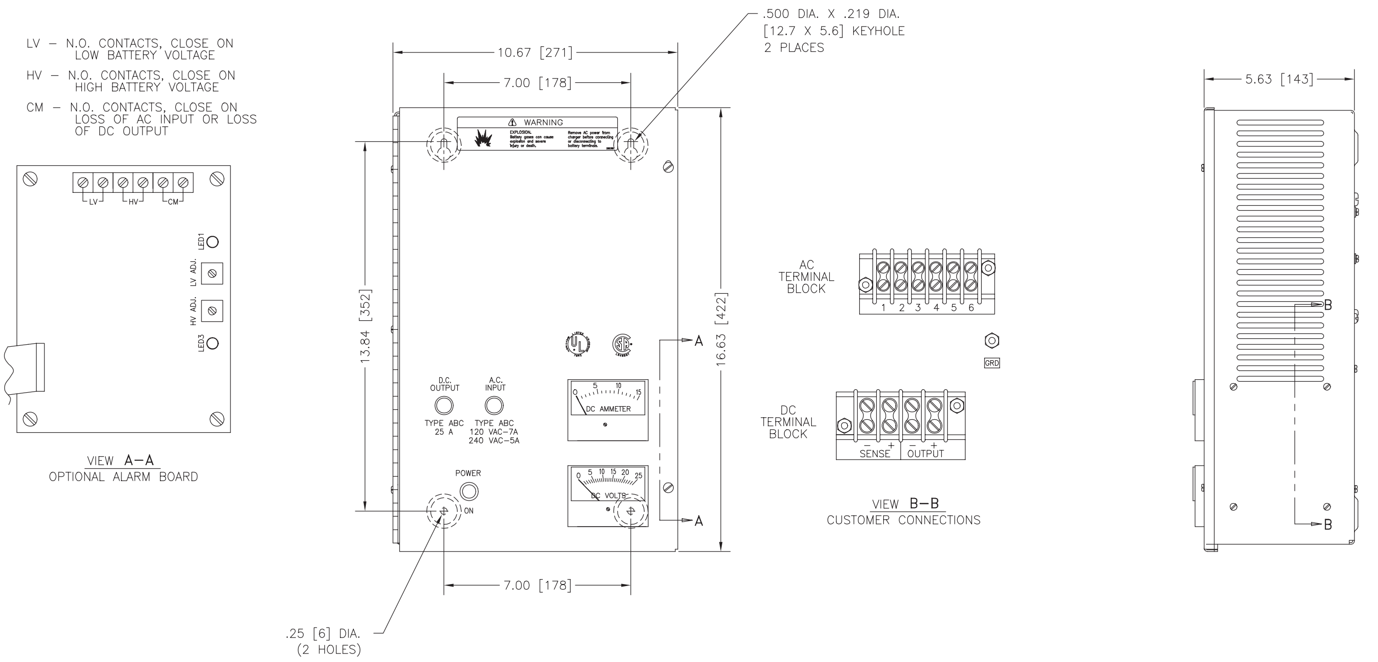
Sketch Title
GENERATOR ANCHOR DETAIL

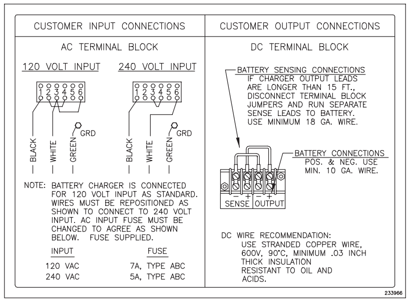
REV	DATE	REVISION	BY	M F
A	12-8-97	(A-4) DC WIRE RECOMMENDATION NOTE REVISED [53068]	KAR	

LV – N.O. CONTACTS, CLOSE ON LOW BATTERY VOLTAGE

HV – N.O. CONTACTS, CLOSE ON HIGH BATTERY VOLTAGE

CM – N.O. CONTACTS, CLOSE ON LOSS OF AC INPUT OR LOSS OF DC OUTPUT





BATTERY SENSING CONNECTIONS
IF CHARGER OUTPUT LEADS ARE LONGER THAN 15 FT., DISCONNECT TERMINAL BLOCK JUMPERS AND RUN SEPARATE SENSE LEADS TO BATTERY. USE MINIMUM 18 GA. WIRE.

BATTERY CONNECTIONS
POS. & NEG. USE MIN. 10 GA. WIRE.

NOTE: BATTERY CHARGER IS CONNECTED FOR 120 VOLT INPUT AS STANDARD. WIRES MUST BE REPOSITIONED AS SHOWN TO CONNECT TO 240 VOLT INPUT. AC INPUT FUSE MUST BE CHANGED TO AGREE AS SHOWN BELOW. FUSE SUPPLIED.

INPUT	FUSE
120 VAC	7A, TYPE ABC
240 VAC	5A, TYPE ABC

DC WIRE RECOMMENDATION:
USE STRANDED COPPER WIRE, 600V, 90°C, MINIMUM .03 INCH THICK INSULATION RESISTANT TO OIL AND ACIDS.

NOTE:

DIMENSIONS IN [ ] ARE MILLIMETERS.

AUTO–FLOAT
12 & 24 VOLT
BATTERY CHARGER

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	LRH	6–28–94
CHECKED	JS	6–29–94
APPROVED	TJM	6–29–94

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

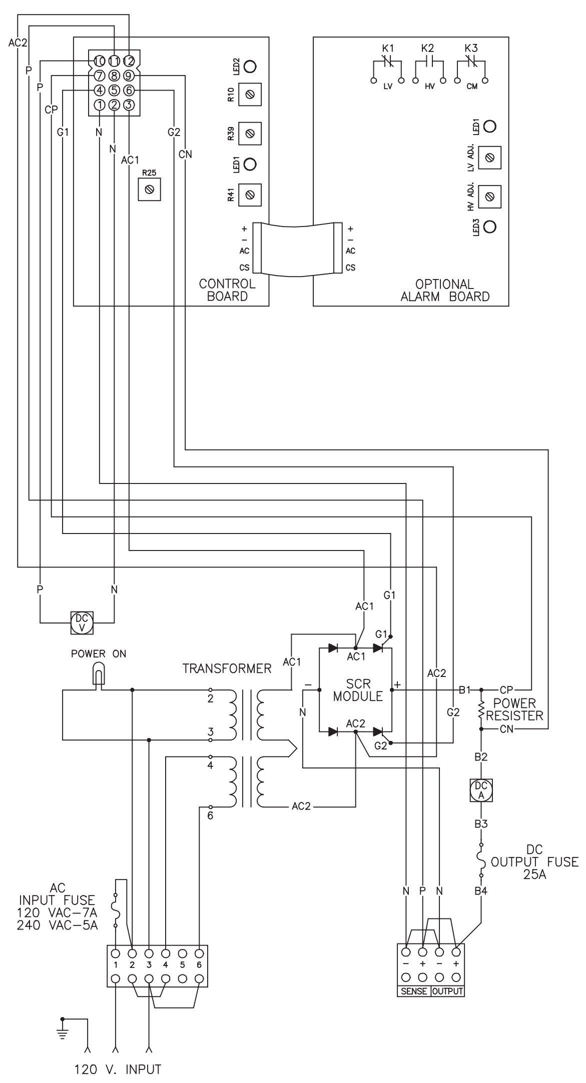
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

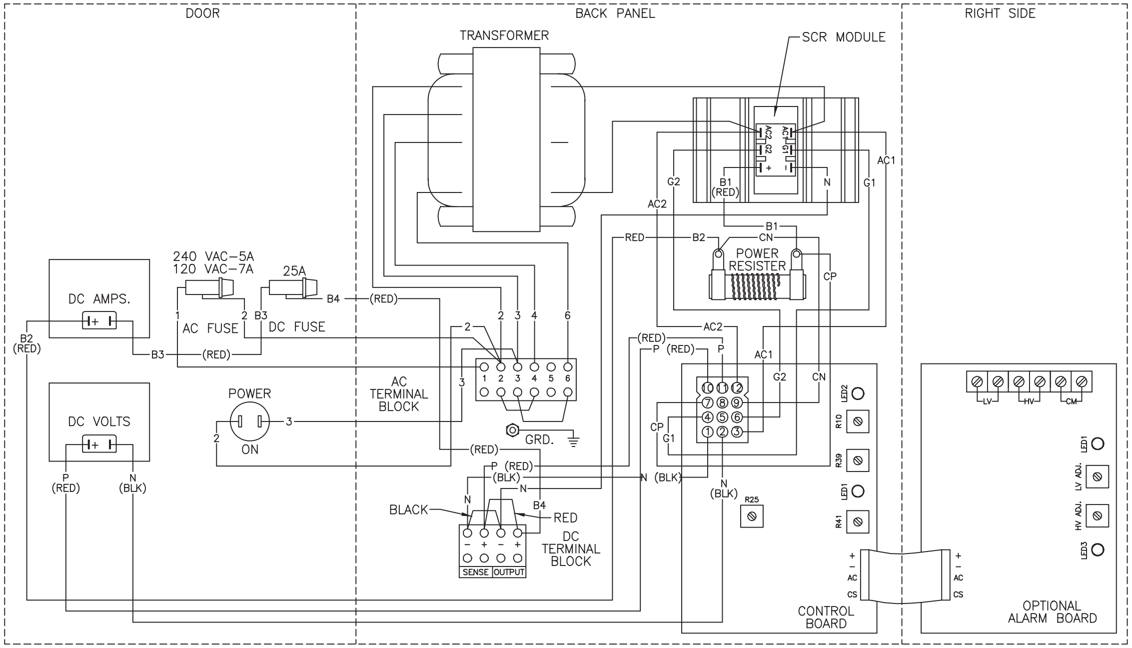
TITLE
DIMENSION PRINT

SCALE 1/2
CAD NO. ADV5971.DWG
SHEET 1–1
PLOTTED
DWG. NO. ADV–5971
D G

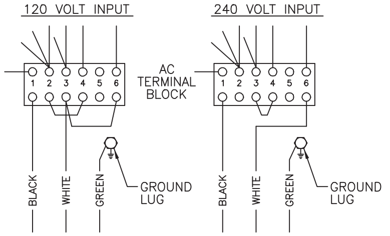
REV	DATE	REVISION	BY	M F
A	2-1-93	(C-5) AC & DC FUSE SYMBOLS REVISED	RSH	
B	9-17-03	(B,C-3,2) "BLK" DESIGNATION REMOVED FROM "N" WIRE [70388]	SAM	

SCHEMATIC





CUSTOMER INPUT CONNECTIONS



NOTE:
WHEN CHANGING AC INPUT VOLTAGE, THE AC INPUT FUSE MUST BE CHANGED TO AGREE AS SHOWN BELOW.

INPUT	FUSE
120 VAC	7A, TYPE ABC
240 VAC	5A, TYPE ABC

AUTO-FLOAT
24 VOLT
BATTERY CHARGER

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	VM	2-11-92
CHECKED	JS	3-3-92
APPROVED	DAH	3-11-92

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

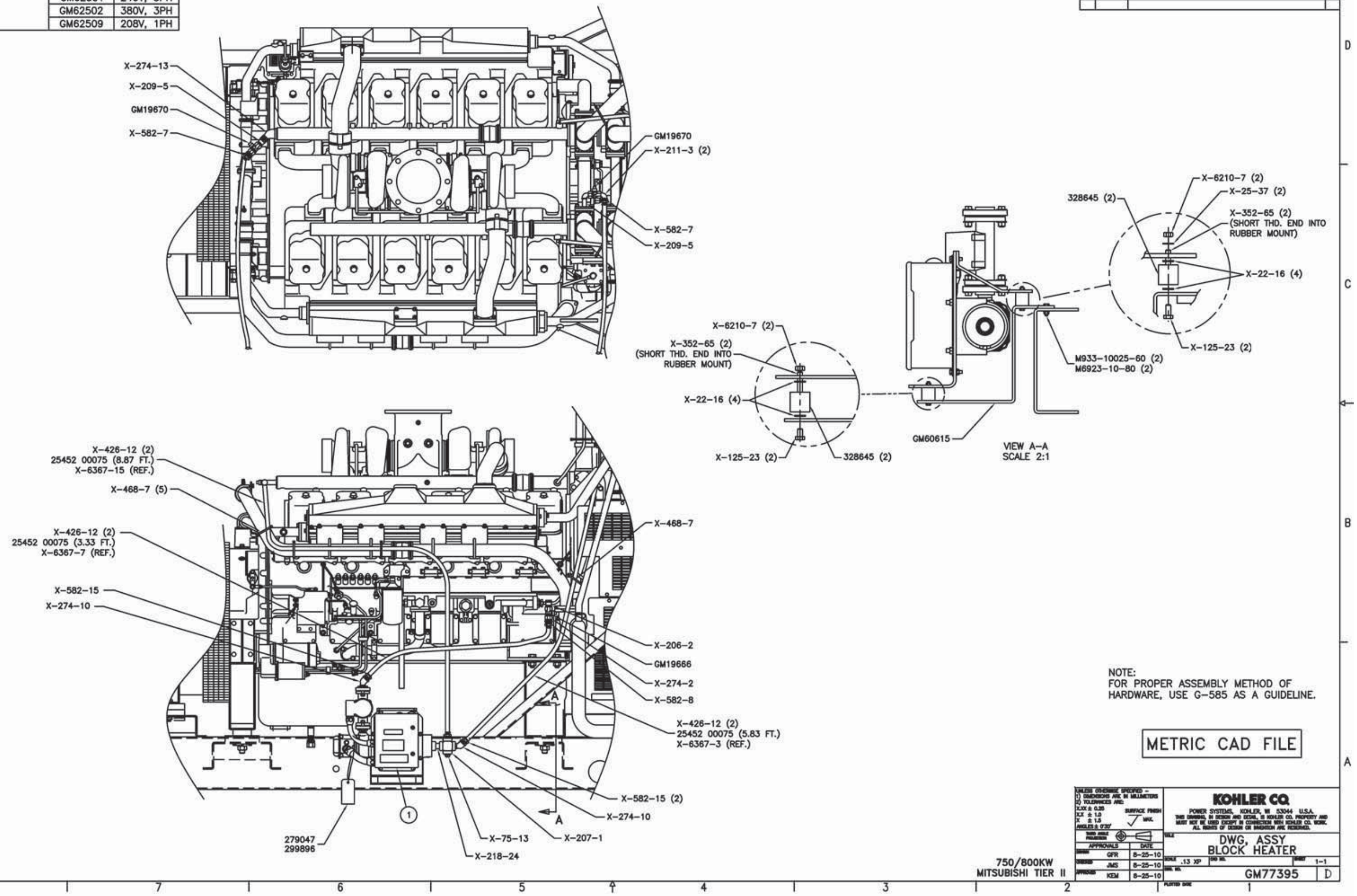
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE DIAGRAM, WIRING

SCALE / / /
CAD NO. 233968.DWG
SHEET 1-1
PLOTTED
DWG. NO. 233968
D G

BLOCK HTR. KIT	BASE GROUP	ITEM 1 BLOCK HTR.	ELECTRICAL RATING
GM77395-KA1	GM77395-KB	GM62498	480V, 3PH
GM77395-KA2		GM62499	240V, 1PH
GM77395-KA3		GM62500	480V, 1PH
GM77395-KA4		GM62501	240V, 3PH
GM77395-KA5		GM62502	380V, 3PH
GM77395-KA6		GM62509	208V, 1PH

REV	DATE	REVISION	BY
–	8-25-10	NEW DRAWING. [90077-3]	GFR
A	3-13-12	(B-4) X-202-1 REMOVED [CT07221]	SAM



NOTE:
FOR PROPER ASSEMBLY METHOD OF HARDWARE, USE G-585 AS A GUIDELINE.

METRIC CAD FILE

750/800KW
MITSUBISHI TIER II

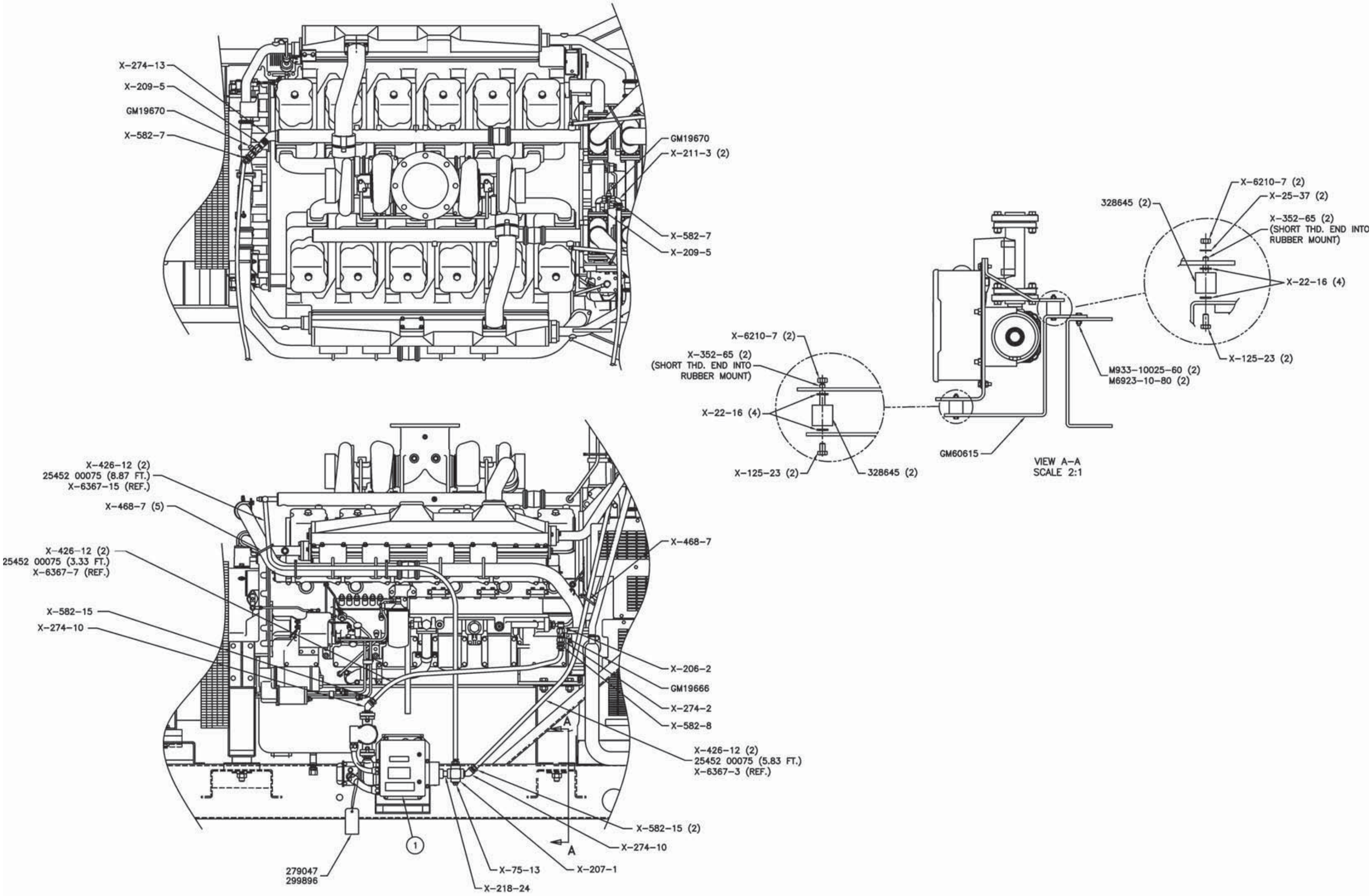
UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0°30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	GFR	8-25-10
CHECKED	JMS	8-25-10
APPROVED	KEM	8-25-10

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

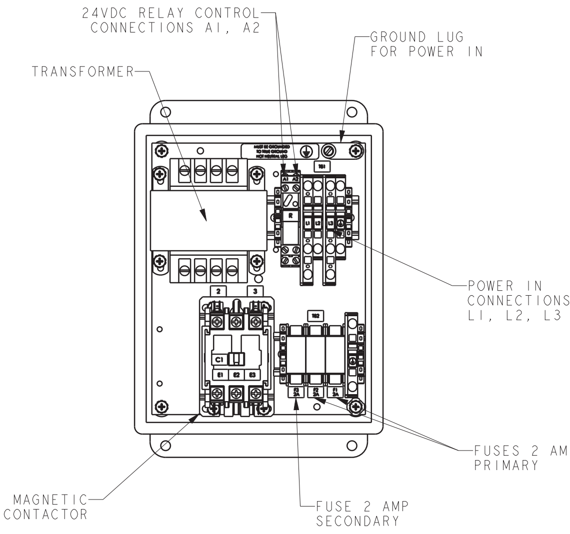
TITLE
DWG, ASSY
BLOCK HEATER

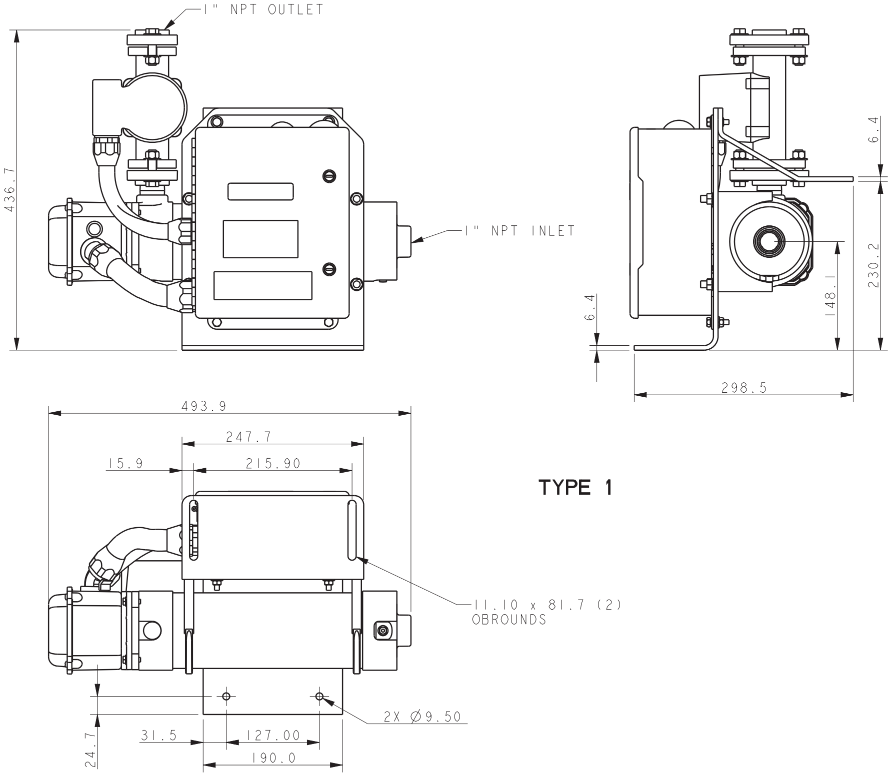
SCALE .13 XP
DWG NO.
SHEET 1-1
DWG. NO. GM77395 D
PLOTTED DATE


X-274-13
X-209-5
GM19670
X-582-7
GM19670
X-211-3 (2)
X-582-7
X-209-5
X-6210-7 (2)
X-25-37 (2)
X-352-65 (2)
(SHORT THD. END INTO
RUBBER MOUNT)
328645 (2)
X-22-16 (4)
X-125-23 (2)
M933-10025-60 (2)
M6923-10-80 (2)
X-6210-7 (2)
X-352-65 (2)
(SHORT THD. END INTO
RUBBER MOUNT)
X-22-16 (4)
X-125-23 (2)
328645 (2)
GM60615
VIEW A-A
SCALE 2:1
X-426-12 (2)
25452 00075 (8.87 FT.)
X-6367-15 (REF.)
X-468-7 (5)
X-426-12 (2)
25452 00075 (3.33 FT.)
X-6367-7 (REF.)
X-582-15
X-274-10
X-468-7
X-206-2
GM19666
X-274-2
X-582-8
X-426-12 (2)
25452 00075 (5.83 FT.)
X-6367-3 (REF.)
A
A
X-582-15 (2)
X-274-10
X-207-1
X-75-13
X-218-24
①
279047
299896

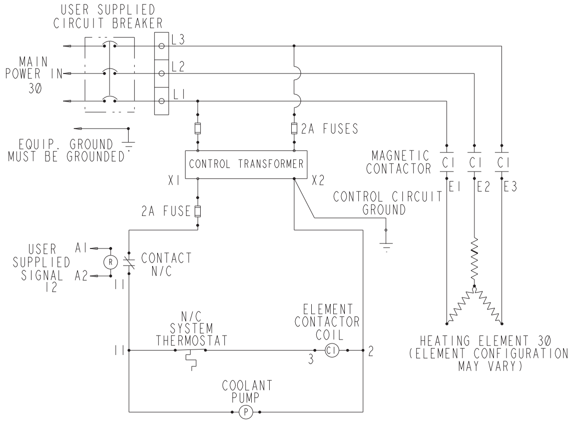
BLOCK HEATER	PART REV		VOLTS/PHASE	REPLACEMENT ELEMENT (SERVICE)	WATTS	TYPE	OPERATING TEMPERATURE
GM62498	D	☐	480V / 3Ø	GM62638	9000	1	120-140
GM62499	D	☐	240V / 1Ø	GM62639	9000	2	120-140
GM62500	D	☐	480V / 1Ø	GM62640	9000	3	120-140
GM62501	D	☐	240V / 3Ø	GM62641	9000	1	120-140
GM62502	D	☐	380V / 3Ø	GM62642	9000	1	120-140
GM62509	D	☐	208V / 1Ø	GM62649	9000	2	120-140
GM62504*	D	☐	240V / 1Ø	GM62644	12000	3	120-140
GM62505	D	☐	480V / 1Ø	GM62645	12000	3	120-140
GM62506	D	☐	240V / 3Ø	GM62646	12000	1	120-140
GM62507	D	☐	380V / 3Ø	GM62647	12000	1	120-140
GM62503	D	☐	480V / 3Ø	GM62643	12000	1	120-140
GM62508	D	☐	208V / 1Ø	GM62648	10500	3	120-140
GM62510	E	☐	480V / 3Ø	GM74181	6000	1	120-140
GM62511	E	☐	240V / 1Ø	GM74182	6000	2	120-140
GM62512	E	☐	480V / 1Ø	GM74183	6000	3	120-140
GM62513	E	☐	240V / 3Ø	GM74184	6000	1	120-140
GM62514	E	☐	380V / 3Ø	GM74185	6000	1	120-140
GM77835	H	☐	208V / 1Ø	GM77836	6000	2	120-140
ES-75396	G	☐	208V / 3Ø	ES-75397	9000	1	120-140
ES-79356	J	☐	208V / 3Ø	ES-79357	6000	1	120-140
ES-80588	A	☐	208V / 3Ø	ES-80589	12000	1	120-140
ES-82106	A	☐	400V / 3Ø	ES-82107	12000	1	120-140

BLOCK HEATER	PART REV		VOLTS/PHASE	REPLACEMENT ELEMENT (SERVICE)	WATTS	TYPE	OPERATING TEMPERATURE
10305000200	B	☐	480V / 3Ø	10305000800	6000	4	120-140
10305000300	B	☐	240V / 1Ø	10305000900	6000	4	120-140
10305000400	B	☐	480V / 1Ø	10305001000	6000	4	120-140
10305000500	B	☐	240V / 3Ø	10305001100	6000	4	120-140
10305000600	B	☐	380V / 3Ø	10305001200	6000	4	120-140
10305000700	B	☐	208V / 1Ø	10305001300	6000	4	120-140
10305001500	A	☐	480V / 3Ø	10305002100	9000	4	120-140
10305001600	A	☐	240V / 1Ø	10305002200	9000	4	120-140
10305001700	A	☐	480V / 1Ø	10305002300	9000	4	120-140
10305001800	A	☐	240V / 3Ø	10305002400	9000	4	120-140
10305001900	A	☐	380V / 3Ø	10305002500	9000	4	120-140
10305002000	A	☐	208V / 1Ø	10305002600	9000	4	120-140
GM97609	A	☐	208V / 1Ø	GM98493	6000	4	100-120
GM97610	A	☐	240V / 1Ø	GM98494	6000	4	100-120
GM97611	A	☐	480V / 1Ø	GM98495	6000	4	100-120
GM97612	A	☐	240V / 3Ø	GM98496	6000	4	100-120
GM97613	A	☐	380V / 3Ø	GM98497	6000	4	100-120
GM97614	A	☐	480V / 3Ø	GM98498	6000	4	100-120
GM97615	A	☐	208V / 1Ø	GM98499	9000	4	100-120
GM97616	A	☐	240V / 1Ø	GM98500	9000	4	100-120
GM97617	A	☐	480V / 1Ø	GM98501	9000	4	100-120
GM97618	A	☐	240V / 3Ø	GM98502	9000	4	100-120
GM97619	A	☐	380V / 3Ø	GM98503	9000	4	100-120
GM97510	A	☐	480V / 3Ø	GM98504	9000	4	100-120





TYPE 1



NOTES:

LABEL ON FRONT CONTROL BOX DOOR MUST INCLUDE KOHLER PART NO.

THE HEATING SYSTEM MUST BE MOUNTED IN THE HORIZONTAL POSITION.

DO NOT EXCEED A CONCENTRATION OF MORE THAN 60% ANTIFREEZE AS ELEMENT FAILURE CAN RESULT.

T-STAT SETTING: SEE CHART

MOUNTING BRACKETS SHIPPED ATTACHED.

*GM62504: REFERENCE TYPE 2 WIRING DIAGRAM

SERIES 2000 DDC

☐ INDICATES PART NUMBERS AFFECTED BY LATEST DRAWING REVISION

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
L	6-23-15	(D-6) 10305001500 THRU 10305002000 ADDED, GM97609 THRU GM97519 & GM97510 ADDED; (D-8) GM62508 & GM62648: WATTS 10500 WAS 12000 [CT112581]	ARG
M	8-14-15	(C-8) ES-82106 ADDED. [CT122952]	JMR
N	10-12-15	(D-8) GM62511 AND GM77835: TYPE 2 WAS TYPE 3 (C-6) GM97619: 380V WAS 280 (D-3,2) VIEWS OF BOX AND ELEMENT REVISED, SEE SHEETS 2, 3 AND 4 [CT123009]	SAM
P	11-2-15	(D-1) ELEMENT REMOVED (B-4) 1 PHASE REMOVED FROM DIAGRAM, SEE SHEET 4 [CT123009]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30´
SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DCF	3-14-08
CHECKED	JMS	3-14-08
APPROVED	JDZ	3-14-08

KOHLER CO. METRIC PRO-E

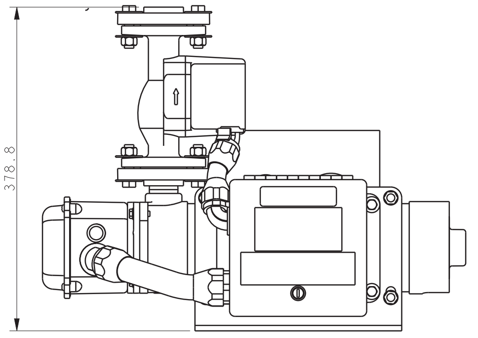
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

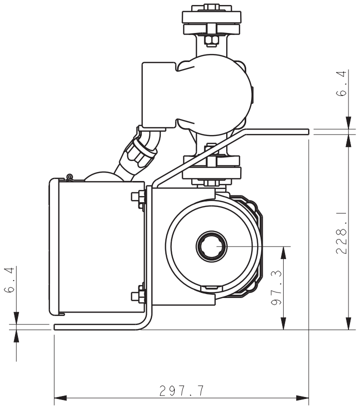
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

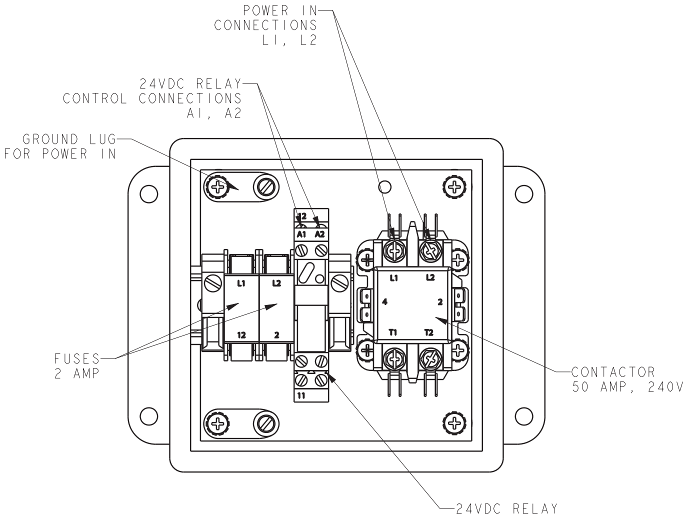
TITLE
DWG, HEATER, BLOCK

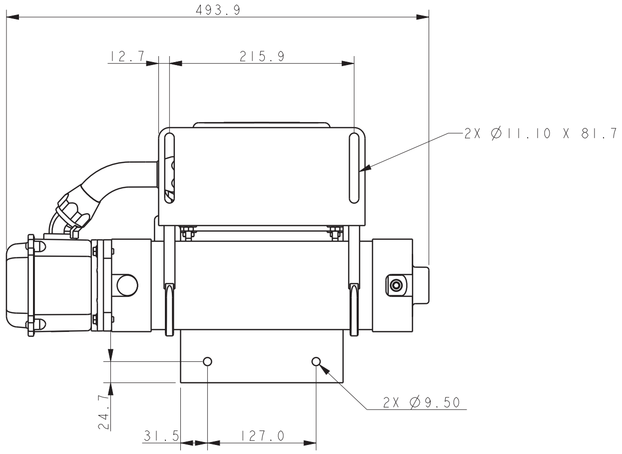
SCALE 0.30 CAD NO. SHEET 1 of 4

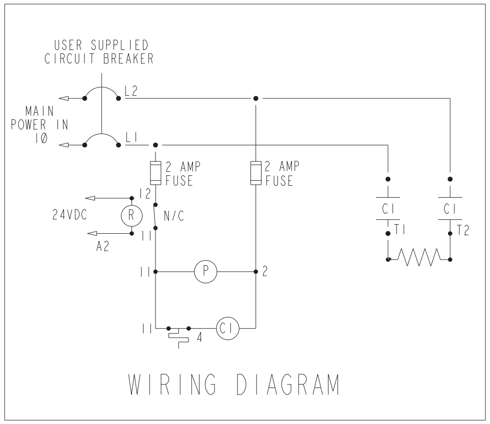
DWG NO. GM62498-CMP D











SERIES 2000 DDC

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
H	8-13-13	SEE SHEET 1 [CT55680]	BSD
J	7-1-14	SEE SHEET 1 [CT85994]	SMS
K	4-15-15	SEE SHEET 1, SHEET 4 ADDED [CT114235]	SVP
L	6-23-15	SEE SHEET 1 [CT112581]	ARG
M	8-14-15	SEE SHEET 1 [CT122952]	JMR
N	10-12-15	(D-8,2) VIEW OF TYPE & ELEMENT REVISED, RANGE WAS RATE, SEE SHEETS 1, 3 & 4 [CT123009]	SAM
P	11-2-15	(D-1) ELEMENT REMOVED, SEE SHEET 4 [CT123009]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DCF	4-7-08
CHECKED	JMS	4-7-08
APPROVED	JDZ	4-7-08

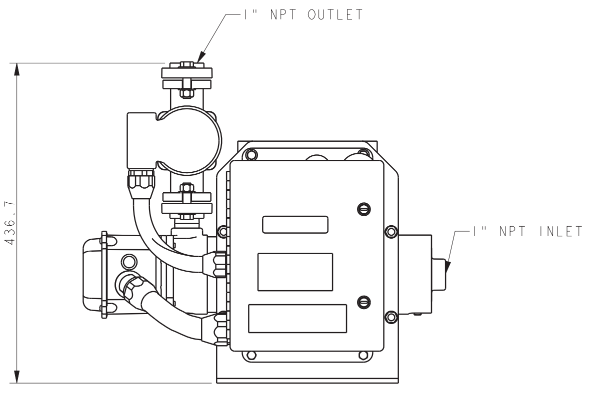
KOHLER CO. METRIC PRO-E

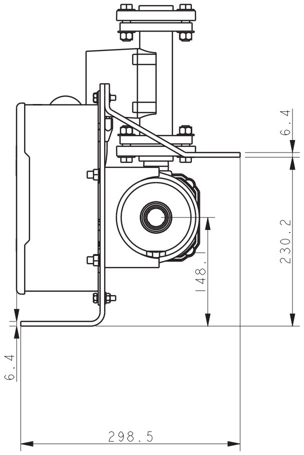
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

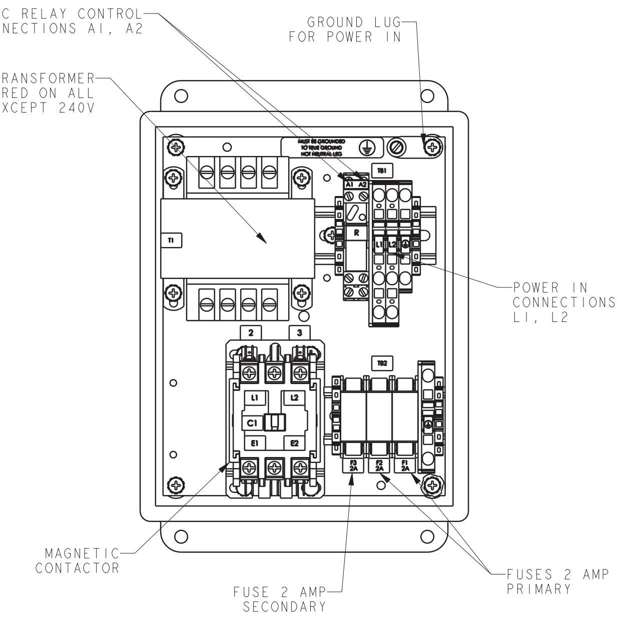
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

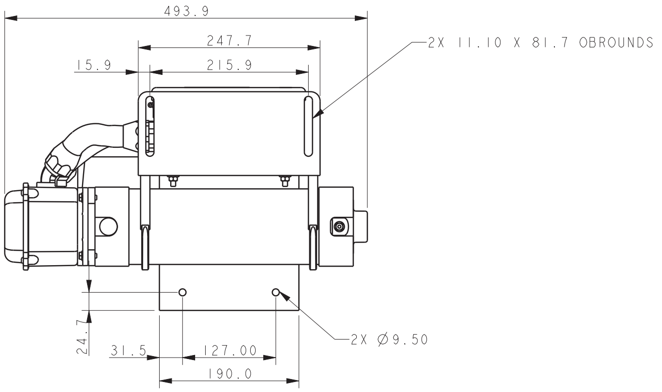
TITLE
DWG, HEATER, BLOCK

SCALE 0.30
CAD NO.
SHEET 2 of 4
DWG NO. GM62498-CMP
D

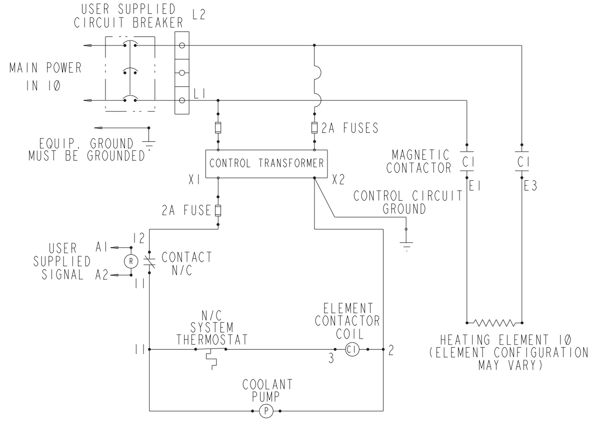








TYPE 3



REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
H	8-13-13	SEE SHEET 1 [CT55680]	BSD
J	7-1-14	SEE SHEET 1 [CT85994]	SMS
K	4-15-15	SEE SHEET 1, SHEET 4 ADDED [CT114235]	SVP
L	6-23-15	SEE SHEET 1 [CT112581]	ARG
M	8-14-15	SEE SHEET 1 [CT122952]	JMR
N	10-12-15	(A-2) 1 PHASE WAS 3 (B-4) OR L3 REMOVED (D-3,2) VIEWS OF BOX AND ELEMENT REVISED, SEE SHEETS 1, 2 AND 4 [CT123009]	SAM
P	11-2-15	(D-1) ELEMENT REMOVED SEE SHEET 4 [CT123009]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DCF	9-15-09
CHECKED	JMS	9-15-09
APPROVED	JDZ	9-15-09

KOHLER CO. METRIC PRO-E

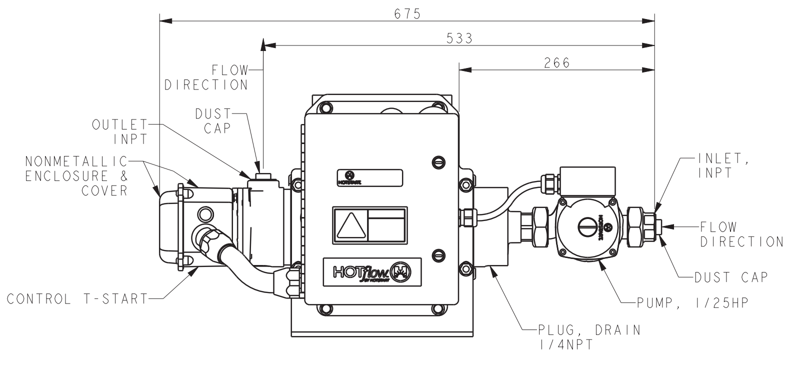
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

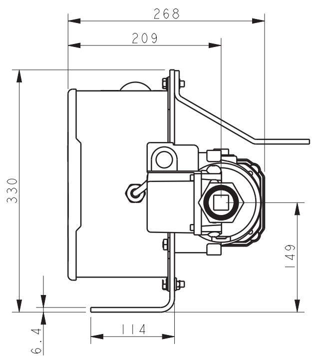
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

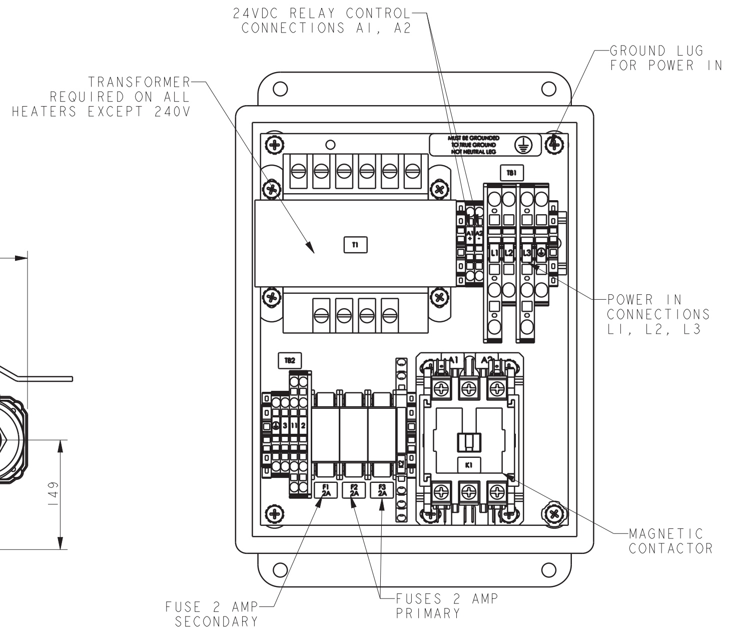
TITLE
DWG, HEATER, BLOCK

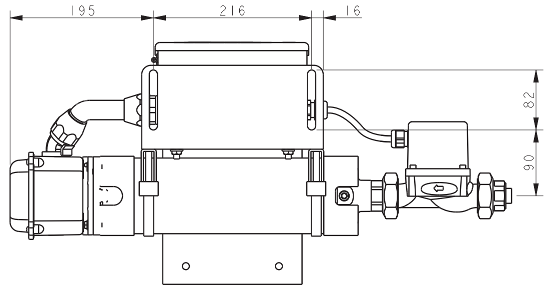
SCALE 0.30 CAD NO. SHEET 3 of 4

DWG NO. GM62498-CMP D

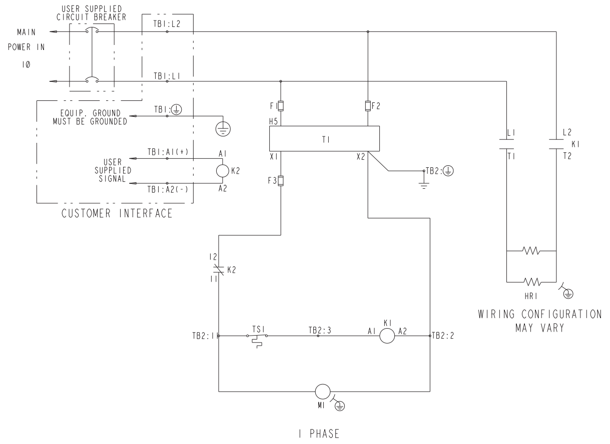


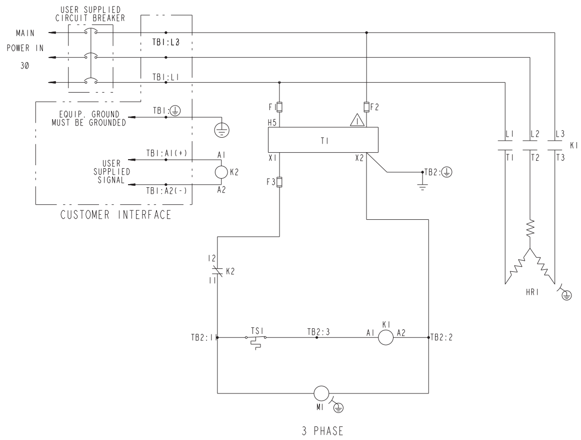






TYPE 4





REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
K	4-15-15	SHEET 4 & TYPE 4 ADDED; SEE SHEET 1 [CT114235]	SVP
L	6-23-15	SEE SHEET 1 [CT112581]	ARG
M	8-14-15	SEE SHEET 1 [CT122952]	JMR
N	10-12-15	(B-4) WIRING DIAGRAM UPDATED (D-3,2) VIEWS OF BOX AND ELEMENT REVISED, SEE SHEETS 1, 2 AND 3 [CT123009]	SAM
P	11-2-15	(D-1) ELEMENT REMOVED (B-4) 1 PHASE WIRING DIAGRAM ADDED [CT123009]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30´

SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	SVP	4-15-15
CHECKED	JMS	4-15-15
APPROVED	JDZ	4-15-15

KOHLER CO. METRIC PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DWG, HEATER BLOCK

SCALE 0.30 CAD NO. SHEET 4 of 4

DWG NO. GM62498-CMP D

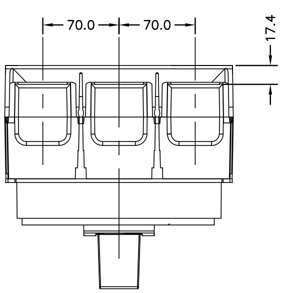
PART NO.	REV	AMPS	% RATING	GFI	VENDOR NO.
GM24181-1	C	600	100	NO	PGP36060CU33A
GM24181-2	C	600	100	YES	PGP36060CU44A
GM24181-3	C	800	80	NO	PGP36080U33A
GM24181-4	C	800	80	YES	PGP36080U44A
GM24181-5	C	800	100	NO	PGP36080CU33A
GM24181-6	C	800	100	YES	PGP36080CU44A
GM24181-7	C	1000	80	NO	PGP36100U33A
GM24181-8	C	1000	80	YES	PGP36100U44A
GM24181-9	C	1000	100	NO	PGP36100CU33A
GM24181-10	C	1000	100	YES	PGP36100CU44A
GM24181-11	C	1200	80	NO	PGP36120U33A
GM24181-12	C	1200	80	YES	PGP36120U44A
GM24181-13	C	1200	100	NO	PGP36120CU33A
GM24181-14	C	1200	100	YES	PGP36120CU44A

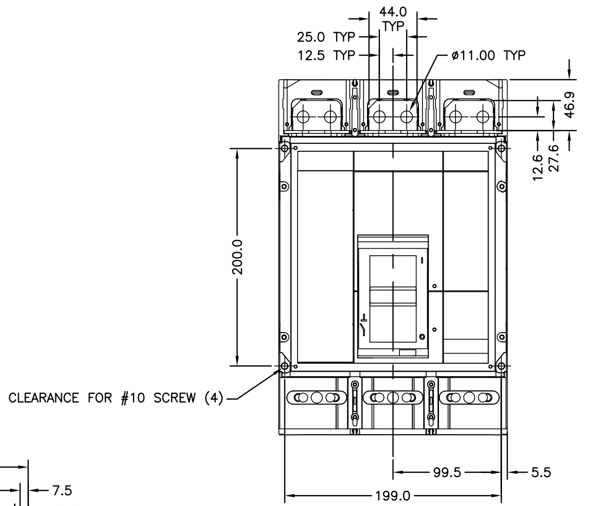
NOTE: (4) #10-32 X 4.5 INCH MOUNTING SCREWS INCLUDED.

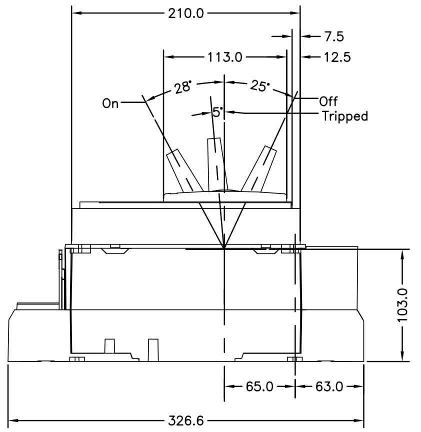
REV	DATE	REVISION	BY
–	3-22-02	NEW DRAWING [66249]	WSD
A	8-12-03	(D-4) THREADED BAR NOTE ADDED. [70090]	SRL
B	11-12-03	(D-7) GM24181-13 GFI: NO WAS YES [70965]	WSD
C	2-23-07	(D-3) KOHLER NOTE ADDED [78285]	GFR

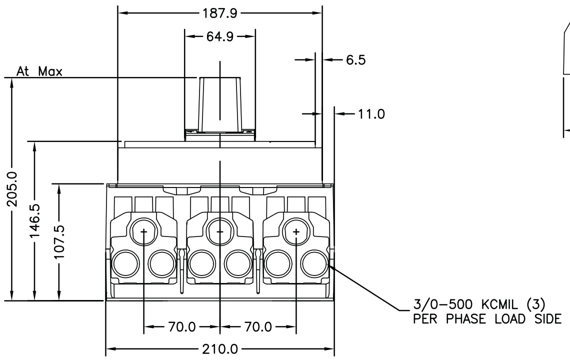
NOTE:
KOHLER PART # TO BE CLEARLY VISIBLE ON CIRCUIT BREAKER AND ON INDIVIDUAL PACKAGING.

NOTE:
THREADED BAR SUPPLIED WITH BREAKER IS USED WITH LUGS OR WHEN BUS BARS ARE INSTALLED WITH BOLTS INSERTED FROM THE FRONT. REMOVE AND DISCARD BAR WHEN BOLTS ARE INSTALLED FROM THE REAR OF BREAKER.

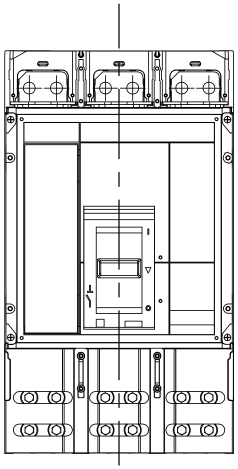


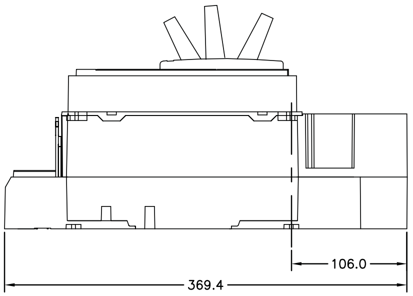


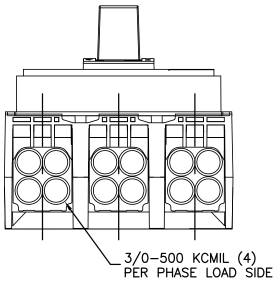




<u>600-800A</u>







<u>1000-1200A</u>
<u>DIMENSIONS SAME AS 600-800A</u>
<u>EXCEPT WHERE NOTED</u>

METRIC CAD FILE

SQUARE D P-FRAME CIRCUIT BREAKER
3 POLE ELECTRONIC TRIP

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0°30'
SURFACE FINISH √ MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	WSD	3-22-02
CHECKED	WSD	3-22-02
APPROVED	AJH	3-22-02

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING, IN DESIGN AND DETAIL, IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE BREAKER, CIRCUIT

SCALE .5XP
CAD NO. GM24181.DWG
SHEET 1-1
DWG. NO. GM24181
D G
PLOTTED DATE

STANDARD BREAKERS

RATING	AMPS	TRIP TYPE	FRAME	MAG TRIP
80% OR 100%	15	THERMAL MAGNETIC	HD	NA
	20			
	25			
	30			
	35			
	40			
	45			
	50			
	60			
	70			
	80			
	90			
	100			
	110			
	125			
	150			
	175		JD	
	200			
	225			
	250			
80%	60	ELECTRONIC LI	HD/HG	
	100			
	150			
	250		JD/JG	
	60	ELECTRONIC LSIG	HD/HG	
	100			
	150			
	250		JD/JG	
100%	60	ELECTRONIC LI	HD/HG	
	100			
	150			
	250		JD/HG	
	60	ELECTRONIC LSIG	HD/HG	
	100			
	150			
	250		JD/JG	
80%	30	MAGNETIC ONLY	HJ	9-325
	50			84-546
	100			180-1040
	150			348-1690
	250		JJ	684-2500
	300	THERMAL MAGNETIC	LA	NA
	350			
	400			
	400	MAGNETIC ONLY	LA	500-1000
				750-1600
				1000-2000
				1125-2250
				1250-2500
				1500-3000
				1750-3500
				2000-4000

STANDARD BREAKERS CONTINUED

RATING	AMPS	TRIP TYPE	FRAME
80%	400	ELECTRONIC LI	LG
		ELECTRONIC LSIG	
	600	ELECTRONIC LI	
		ELECTRONIC LSIG	
	700	THERMAL MAGNETIC	MG
	800		
	1000	THERMAL MAGNETIC	PG
	1200		
	800	ELECTRONIC LSI	
	1000		
	1200		
	800	ELECTRONIC LSIG	
	1000		
	1200		
	1200	THERMAL MAG	PJ
		ELECTRONIC LSI	
		ELECTRONIC LSIG	
100%	400	ELECTRONIC LI	LG
		ELECTRONIC LSIG	
	600	ELECTRONIC LSI	PG
	800		
	1000		
	1200		
	600	ELECTRONIC LSIG	
	800		
	1000		
	1200		
	1200	ELECTRONIC LSI	PJ
		ELECTRONIC LSIG	
80%	1600	THERMAL MAGNETIC	RJ
	2000		
	2500		
80% OR 100%	1600	ELECTRONIC LSI	
	2000		
	2500		
	1600	ELECTRONIC LSIG	
	2000		
	2500		
100%	3000	ELECTRONIC LSI	NW
		ELECTRONIC LSIG	

ELECTRONIC TRIP BREAKERS

FRAME	FUNCTION	TRIP UNIT
H	LI	MICROLOGIC 3.2
	LSIG	MICROLOGIC 6.2A
J	LI	MICROLOGIC 3.2
	LSIG	MICROLOGIC 6.2A
LG	LI	MICROLOGIC 3.3
	LSIG	MICROLOGIC 6.3A
P	LSI	MICROLOGIC 5.0
	LSIG	MICROLOGIC 6.0A
R	LSI	MICROLOGIC 5.0
	LSIG	MICROLOGIC 6.0A
NW	LSI	MICROLOGIC 5.0
	LSIG	MICROLOGIC 6.0A

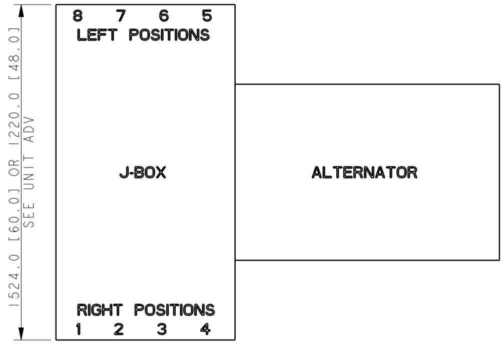
AL/CU MECHANICAL LOAD LUGS PER PHASE

BREAKER FRAME	AMPS	WIRE RANGE	WIRE BENDING SPACE 4M/5M	WIRE BENDING SPACE 7M
H	15-150	(1) #14 TO 3/0	653 [25.7]	785 [30.9]
H 100%	15-150	(1) #14 TO 2/0 CU ONLY		
J	175	(1) 1/0 TO 4/0	639 [25.1]	771 [30.3]
	200-250	(1) 3/0 TO 350 KCMIL		
J 100%	175-250	(1) 3/0 TO 300 KCMIL CU ONLY		
LA	300-400	(1) #1 TO 600 KCMIL OR (2) #1 TO 250 KCMIL	551 [21.6]	683 [26.8]
LG	400-600	(2) 2/0 TO 500 KCMIL AL/CU	559 [22.0]	691 [27.2]
M	700-800	(3) 3/0 TO 500 KCMIL	523 [20.5]	655 [25.7]
P	600-800			
P	1000-1200	(4) 3/0 TO 500 KCMIL	480 [18.9]	612 [24.0]
R	1600-2500	(8) 1/0-750 KCMIL OR (16) 1/0-300 KCMIL	483 [19.0]	615 [24.2]
NW	3000	(8) 1/0-750 KCMIL OR (16) 1/0-300 KCMIL	510 [20.0]	642 [25.2]

WIRE BENDING SPACE DIMENSIONS ARE FROM BOTTOM OF LOAD LUGS TO TOP OF ENTRANCE PANEL

UL INTERRUPT RATINGS

BREAKER	kA @ 240V	kA @ 480V	kA @ 600V
HD	25	18	14
HG	65	35	18
HJ	100	65	25
JD	25	18	14
JG	65	35	18
JJ	100	65	25
LA	42	30	22
LG	65	35	18
MG	65	35	18
PG	65	35	18
PJ	100	65	25
RJ	100	65	25
NW	100	100	85



STANDARD BREAKER COMBINATIONS

POSITIONS (SEE DIAGRAM)			
1 OR 5	2 OR 6	3 OR 7	4 OR 8
H/J			
H/J	H/J		
H/J	H/J	H/J	
H/J	H/J	H/J	H/J
LA			
LA	H/J		
LA	LA		
LA	H/J	H/J	
LA	LA	H/J	
LA	LA	LA	
LA	H/J	H/J	H/J
LA	LA	H/J	H/J
LA	LA	LA	H/J
LA	LA	LA	LA
LG			
LG	H/J		
LG	LA		
LG	LG		
LG	H/J	H/J	
LG	LA	H/J	
LG	LA	LA	
LG	LG	H/J	
LG	LG	LA	
LG	LG	LG	
LG	H/J	H/J	H/J
LG	LA	H/J	H/J
LG	LA	LA	H/J
LG	LA	LA	LA
LG	LG	H/J	H/J
LG	LG	LA	H/J
LG	LG	LA	LA
LG	LG	LG	H/J
LG	LG	LG	LA
LG	LG	LG	LG
M/P			
M/P		H/J	
M/P		LA	
M/P		LG	
M/P		M/P	
M/P		H/J	H/J
M/P		LA	H/J
M/P		LA	LA
M/P		LG	H/J
M/P		LG	LA
M/P		LG	LG
R			
NW			
LOAD BUS			

NOTES:

1) SEE UNIT DIMENSION PRINT (ADV-XXXX) FOR ADDITIONAL DIMENSIONS, JUNCTION BOX AND STUB-UP LOCATION.

2) CONSULT FACTORY FOR BREAKER COMBINATIONS NOT SHOWN ON THIS PRINT.

3) MECHANICAL LUGS ARE AVAILABLE FOR NEUTRAL. SEE ADV-7376.

4) UNITS ARE SHIPPED WITH NEUTRAL BUS ASSEMBLIES THAT ARE NOT BONDED TO GROUND. IF A GROUND FAULT CIRCUIT BREAKER OR GROUND FAULT RELAY IS PROVIDED THE NEUTRAL WILL BE BONDED TO GROUND. CONSULT NEC AND/OR LOCAL ELECTRICAL CODES FOR THE PROPER INSTALLATION REQUIREMENTS.

5) CIRCUIT BREAKER FRAMES REFER TO STANDARD SQUARE-D PRODUCT.

6) STANDARD NEUTRALS PROVIDED ARE SIZED FOR MAXIMUM UNIT AMPS. GFI NEUTRALS ARE MATCHED TO THEIR CIRCUIT BREAKER AMPS.

7) DIMENSIONS IN [ ] ARE INCHES.

8) SEE IB29 FOR PART NUMBER CROSS REFERENCE.

9) BREAKER AND LOAD BUS PHASING ON RIGHT IS A-B-C, ON LEFT IS C-B-A.

10) 48" WIDE JUNCTION BOXES ARE NOT AVAILABLE WITH NW FRAME BREAKERS, OR M OR P FRAMES IN POSITION 3 & 4, OR LG FRAME BREAKERS IN POSITION 4.

NOTE:
H, J AND LG-FRAMES WITH LSIG TRIP REQUIRE (2) SPACES. (ONE FOR BREAKER, ONE FOR LSIG NEUTRAL). THESE COMBINATIONS ARE NOT REFLECTED IN THE CHART ABOVE.

4M/5M/7M GENSETS

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	4-29-11	NEW DRAWING [91732]	WSD
A	12-12-11	(D-5) H 100% AND J 100% ADDED; SEE SHEET 5 [CN00646]	WSD
B	10-3-12	ELECTRONIC TRIP H/J'S ADDED, WITH HG & JG, LG WAS D, 80% LG 400A ADDED, TRIP CHART ADDED, ALL CHARTS UPDATED TO REFLECT NEW OFFERINGS [CT26372]	WSD
C	11-7-12	(A-5) NOTE 10 ADDED; (C-4) J-BOX WIDTH DIMS ADDED; SHEET 6 ADDED [CT28128]	WSD

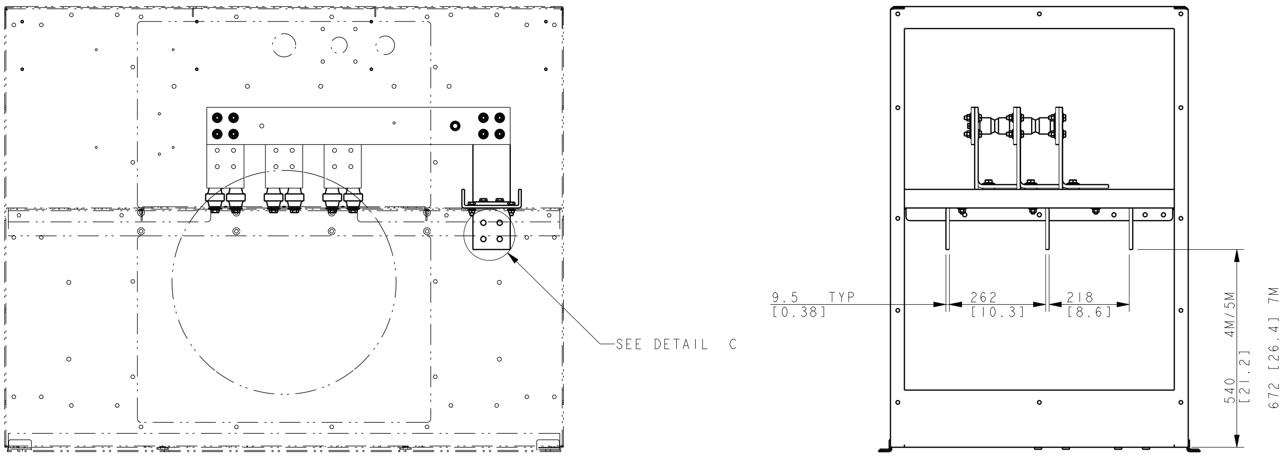
UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30´
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	WSD	4-29-11
CHECKED	WSD	4-29-11
APPROVED	AJH	4-29-11

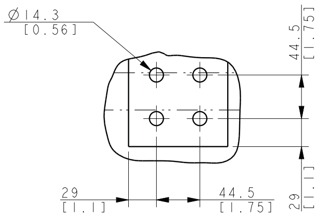
KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

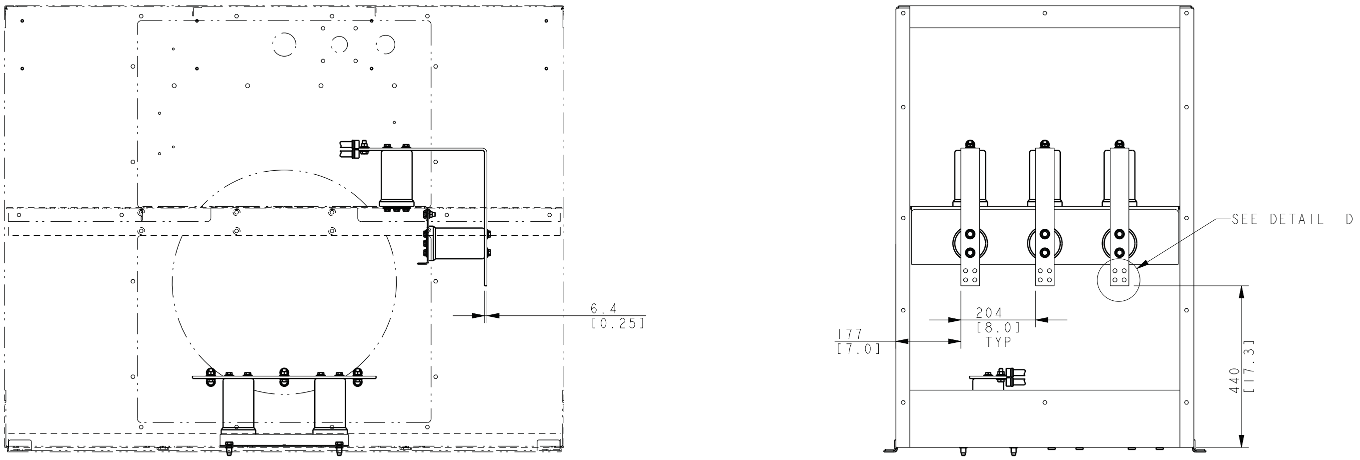
TITLE
DIMENSION PRINT
SCALE 0.15 CAD NO. SHEET 1 of 6
DWG NO. ADV-8030 D



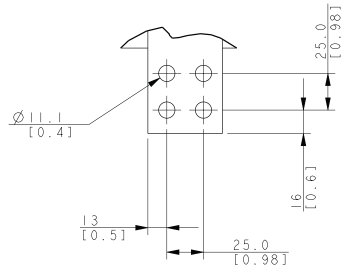
STANDARD LOW VOLTAGE LOAD BUS KIT
RIGHT-FACING SHOWN, LEFT FACING AND DUAL AVAILABLE



DETAIL C
SCALE 0.400



STANDARD MEDIUM VOLTAGE (5kV) LOAD BUS KIT
RIGHT-FACING ONLY



DETAIL D
SCALE 0.600

4M/5M/7M GENSETS

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	5-4-11	NEW DRAWING [91732]	WSD
A	12-12-11	SEE SHEETS 1 & 5 [CN00646]	WSD
B	10-3-12	SEE SHEETS 1 & 3 [CT26372]	WSD
C	11-7-12	SEE OTHER SHEETS [CT28128]	WSD

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	WSD	5-4-11
CHECKED	WSD	5-4-11
APPROVED	AJH	5-4-11

BREAKER AND LOAD BUS PHASING

RIGHT		
A	B	C
LEFT		
C	B	A

METRIC **PRO-E**

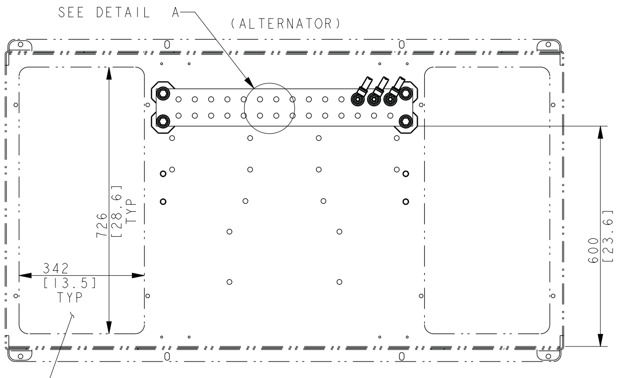
KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

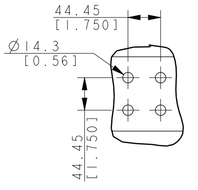
SCALE 0.15 CAD NO. SHEET 2 of 6

DWG NO. ADV-8030 D

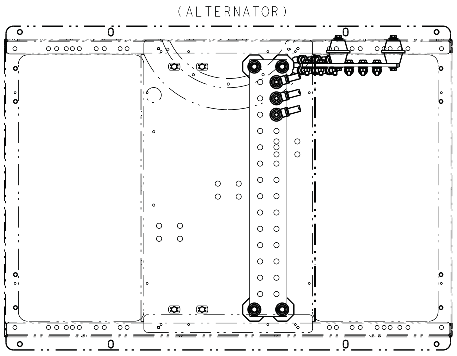


SECTION A-A
STANDARD LOW-VOLTAGE NEUTRAL

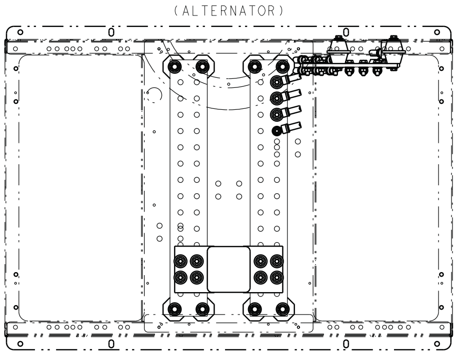
BOTTOM ENTRY (TYP BOTH SIDES)
SEE UNIT ADV FOR RELATION TO GENSET FOOTPRINT



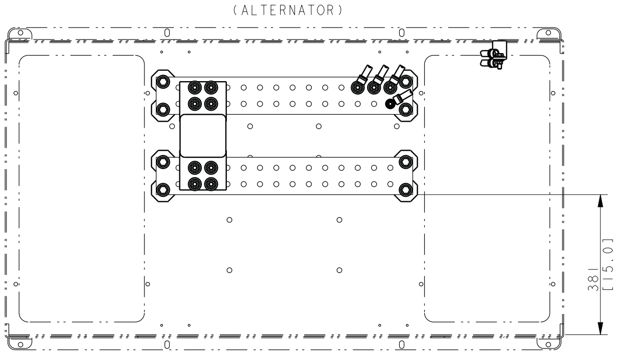
DETAIL A
NEUTRAL BUS
SCALE 0.300



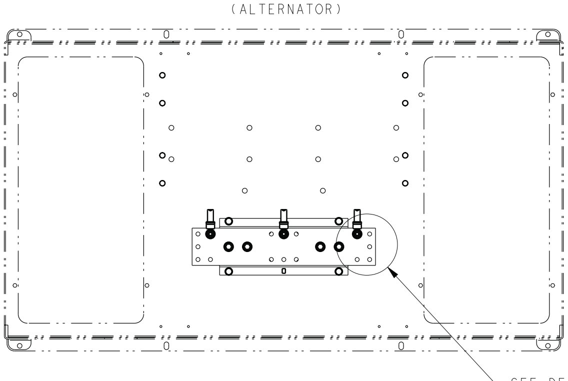
STANDARD LOW-VOLTAGE NEUTRAL
IN 48" WIDE JUNCTION BOX



LSIG LOW-VOLTAGE NEUTRAL
IN 48" WIDE JUNCTION BOX

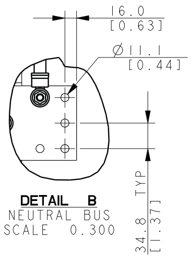


SECTION A-A
R OR NW FRAME LSIG NEUTRAL

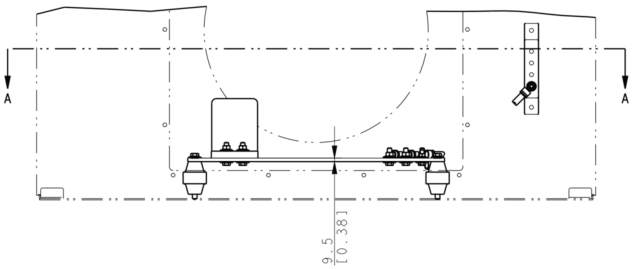


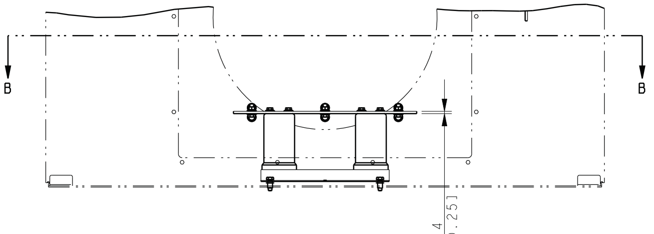
SEE DETAIL B

SECTION B-B
STANDARD MEDIUM VOLTAGE (5kV) NEUTRAL



DETAIL B
NEUTRAL BUS
SCALE 0.300





4M/5M/7M GENSETS

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	3-28-11	NEW DRAWING [91732]	WSD
A	12-12-11	SEE SHEETS 1 & 5 [CN00646]	WSD
B	10-3-12	(D-5) H, J, LG GFI NEUTRAL UPDATED, LUG CHART ADDED [CT26372]	WSD
C	11-7-12	48" J-BOX NEUTRAL VIEWS ADDED [CT28128]	WSD

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′

SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

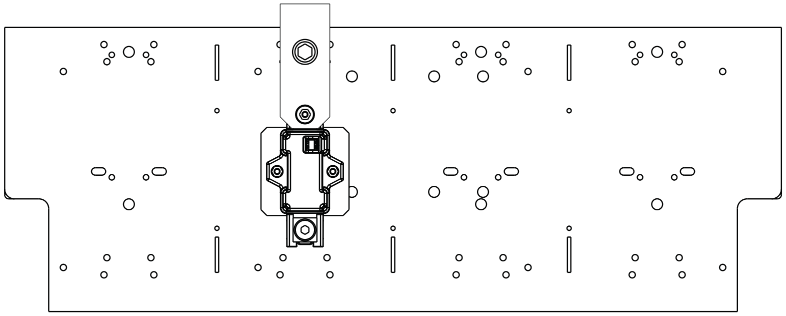
APPROVALS		DATE
DRAWN	WSD	3-28-11
CHECKED	WSD	3-28-11
APPROVED	AJH	3-28-11

KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

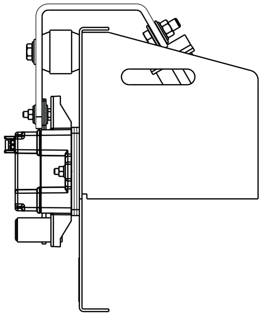
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

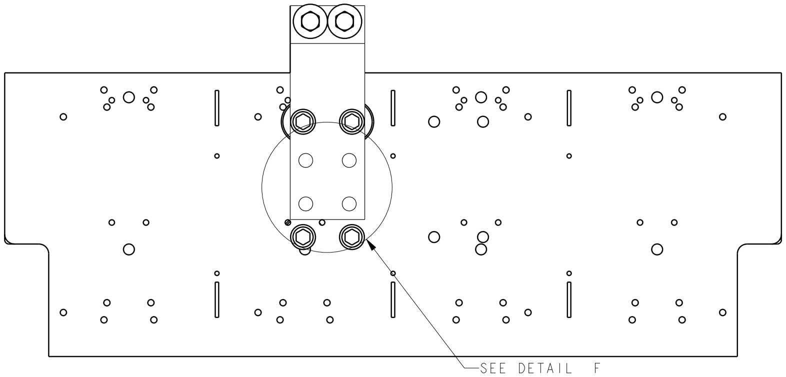
SCALE 0.15 CAD NO. SHEET 3 of 6
DWG NO. ADV-8030 D



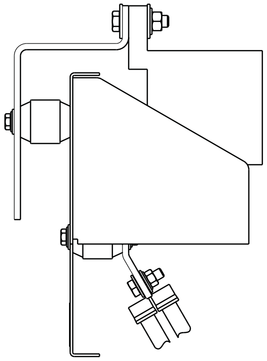
H, J OR LG-FRAME LSIG NEUTRAL
250A J SHOWN
POSITION VARIES BASED ON CONFIGURATION

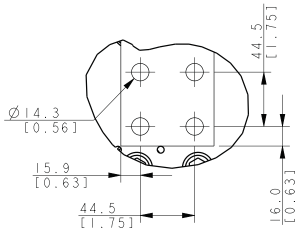


MECHANICAL LOAD LUGS INCLUDED WITH H, J & LG LSIG NEUTRALS		
BREAKER FRAME	**AMPS**	**WIRE RANGE**
H	60-150	(1) #14 TO 3/0 AWG AL/CU
J	250	(1) 3/0 TO 350 KCMIL AL/CU
LG	400-600	(2) 4/0 TO 500 KCMIL AL/CU



P-FRAME LSIG NEUTRAL
POSITION VARIES BASED ON CONFIGURATION





DETAIL F
SCALE 0.500

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	11-7-12	NEW DRAWING []	WSD
C	11-7-12	SEE OTHER SHEETS [CT28128]	WSD

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH
MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	WSD	11-7-12
CHECKED	WSD	11-7-12
APPROVED	AJH	11-7-12

KOHLER CO. METRIC PRO-E

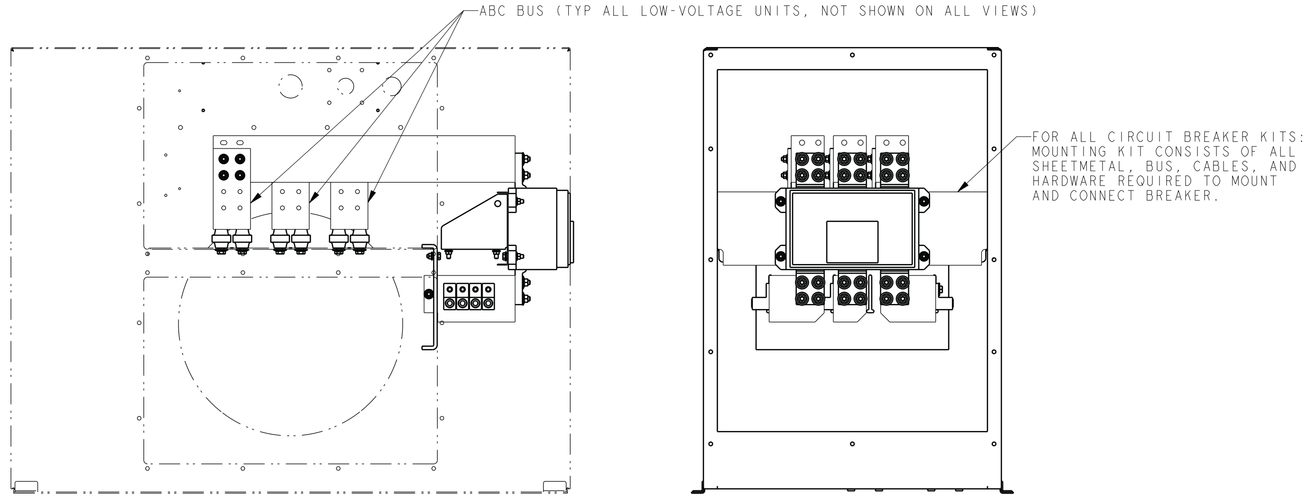
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

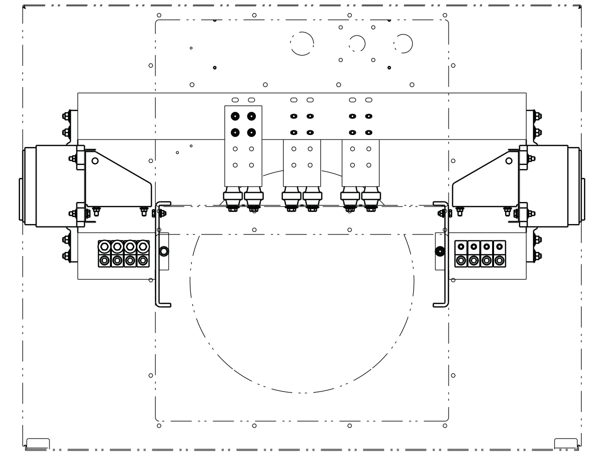
TITLE
DIMENSION PRINT

SCALE 0.15 CAD NO. SHEET 4 of 6

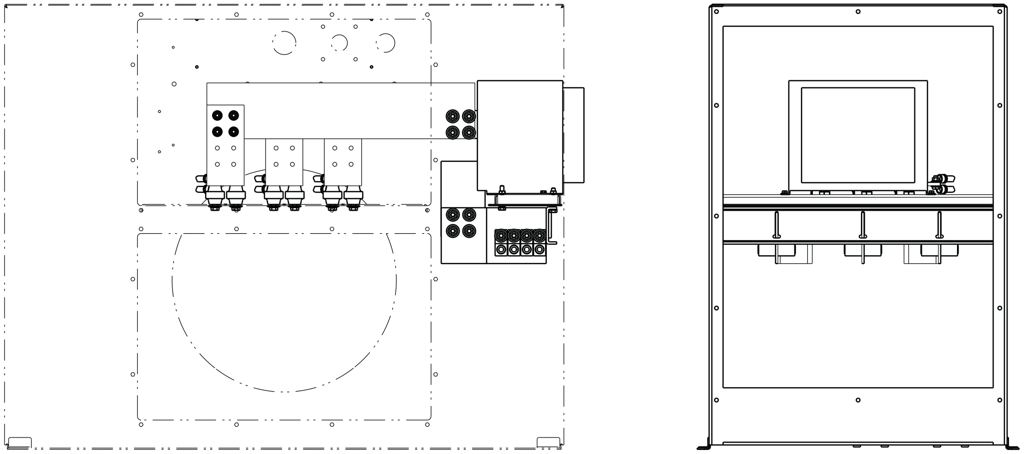
DWG NO. ADV-8030 D



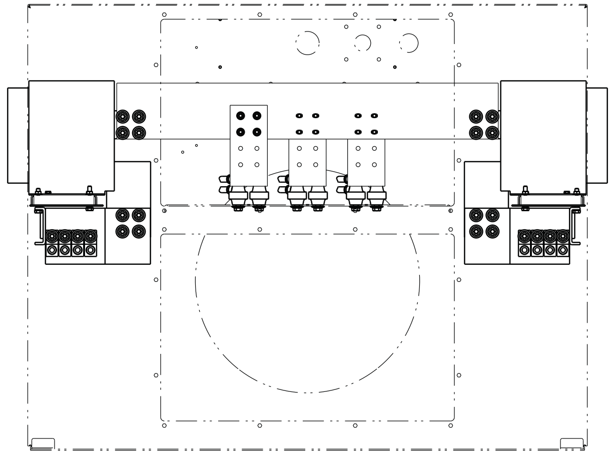
R-FRAME CIRCUIT BREAKER
RIGHT-FACING SHOWN, LEFT FACING AVAILABLE
SEE CHARTS ON PAGE 1 FOR LUGS AND BENDING SPACE



DUAL R-FRAME CIRCUIT BREAKER



NW-FRAME CIRCUIT BREAKER
RIGHT-FACING SHOWN, LEFT FACING AVAILABLE
SEE CHARTS ON PAGE 1 FOR LUGS AND BENDING SPACE



DUAL NW-FRAME CIRCUIT BREAKER

NOTE: COMBINATIONS OF R-FRAME WITH NW-FRAME NOT AVAILABLE.

BREAKER AND LOAD BUS PHASING		
RIGHT		
A	B	C
LEFT		
C	B	A

4M/5M/7M GENSETS

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	5-6-11	NEW DRAWING [91732]	WSD
A	12-12-11	SEE SHEETS 1 & 5 [CN00646]	WSD
B	10-3-12	SEE SHEETS 1 & 3 [CT26372]	WSD
C	11-7-12	SEE OTHER SHEETS [CT28128]	WSD

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH
MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	WSD	5-6-11
CHECKED	WSD	5-6-11
APPROVED	AJH	5-6-11

KOHLER CO.
METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

SCALE 0.40
CAD NO.
SHEET 5 of 6
DWG NO. ADV-8030
D

KOHLER. POWER SYSTEMS

Warranty

Stationary Standby and Prime Power Industrial Generator Set One-Year or Two Thousand (2000)-Hour Limited Warranty

Your Kohler product has been manufactured and inspected with care by experienced craftsmen. If you are the original end user, Kohler Co. warrants, for the period indicated below, each product to be free from defects in materials and workmanship. In the event of a defect in materials or workmanship, Kohler Co. will repair, replace, or make appropriate adjustment at Kohler Co.'s option if the product, upon Kohler Co.'s inspection, is found to be properly installed, maintained, and operated in accordance with Kohler Co.'s instruction manuals. A Kohler distributor, dealer, or authorized service representative must perform startup.

Kohler Product	Warranty Coverage
Stationary Standby Generator Set & Accessories	One (1) year from registered startup or two thousand (2000) hours (whichever occurs first). In any event, the warranty period will expire not later than thirty (30) months from the date of shipment from Kohler Co.'s factory.
Stationary Prime Power Generator Set & Accessories	One (1) year from registered startup or two thousand (2000) hours (whichever occurs first). In any event, the warranty period will expire not later than thirty (30) months from the date of shipment from Kohler Co.'s factory.

The following will **not** be covered by the warranty:

1. Normal wear, routine tuneups, tuneup parts, adjustments, and periodic service.
2. Damage, including but not limited to damage caused by accidents, improper installation or handling, faulty repairs not performed by an authorized Kohler service representative, improper storage, or acts of God.
3. Damage caused by operation at speeds, or with fuel, loads, conditions, modifications or installation contrary to published specifications.
4. Damage caused by negligent maintenance such as:
   a. Failure to provide the specified type and sufficient quantity of lubricating oil.
   b. Failure to keep the air intake and cooling fin areas clean.
   c. Failure to service the air cleaner.
   d. Failure to provide sufficient coolant and/or cooling air.
   e. Failure to perform scheduled maintenance as prescribed in supplied manuals.
   f. Failure to regularly exercise the generator set under load (stationary applications only).
5. Original installation charges and startup costs.
6. Starting batteries and the following related expenses:
   a. Labor charges related to battery service.
   b. Travel expenses related to battery service.
7. Additional expenses for repairs performed after normal business hours, i.e. overtime or holiday labor rates.
8. Rental of equipment during the performance of warranty repairs.
9. Removal and replacement of non-Kohler-supplied options and equipment.
10. Non-Kohler replacement parts. Replacement of a failed Kohler part with a non-Kohler part voids the warranty on that part.
11. Radiators replaced rather than repaired.
12. Fuel injection pumps not repaired by an authorized Kohler service representative.
13. Non-Kohler-authorized repair shop labor without prior approval from Kohler Co. Warranty Department.
14. Engine fluids such as fuel, oil, or coolant/antifreeze.
15. Shop supplies such as adhesives, cleaning solvents, and rags.
16. Expenses incurred investigating performance complaints unless the problem is caused by defective Kohler materials or workmanship.
17. Maintenance items such as fuses, lamps, filters, spark plugs, loose or leaking clamps, and adjustments.
18. Travel time and mileage exceeding 300 miles round trip.

To obtain warranty service, call 1-800-544-2444 for your nearest authorized Kohler service representative or write Kohler Co., Kohler Power Systems Service Department, MS072, Kohler, WI 53044 USA.

KOHLER CO. SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL, AND/OR CONSEQUENTIAL DAMAGES OF ANY KIND including, but not limited to, incidental and/or consequential labor costs, installation charges, telephone charges, or transportation charges in connection with the replacement or repair of defective parts.

This is our exclusive written warranty. We make no other express warranty nor is anyone authorized to make any on our behalf.

ANY IMPLIED OR STATUTORY WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, IS EXPRESSLY LIMITED TO THE DURATION OF THIS WARRANTY. Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental and/or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

KOHLER Power Systems

KOHLER CO. Kohler, Wisconsin 53044
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales/service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Certification

Certificate US95/0189

The management system of

Kohler Power Systems, a Business Unit of Kohler Co.

N7650 Lakeshore Drive (known as Mosel Plant)
Sheboygan, WI, 53083, United States

has been assessed and certified as meeting the requirements of

ISO 9001:2008

For the following activities

Design, manufacture, and distributor support for electrical generators, alternators, automatic transfer switches, and switchgear.

Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2008 requirements may be obtained by consulting the organization

This certificate is valid from 6 November 2015 until 15 September 2018 and remains valid subject to satisfactory surveillance audits.
Recertification audit due a minimum of 60 days before the expiration date.
Issue 12 : 14 October 2015. Certified since November 2003

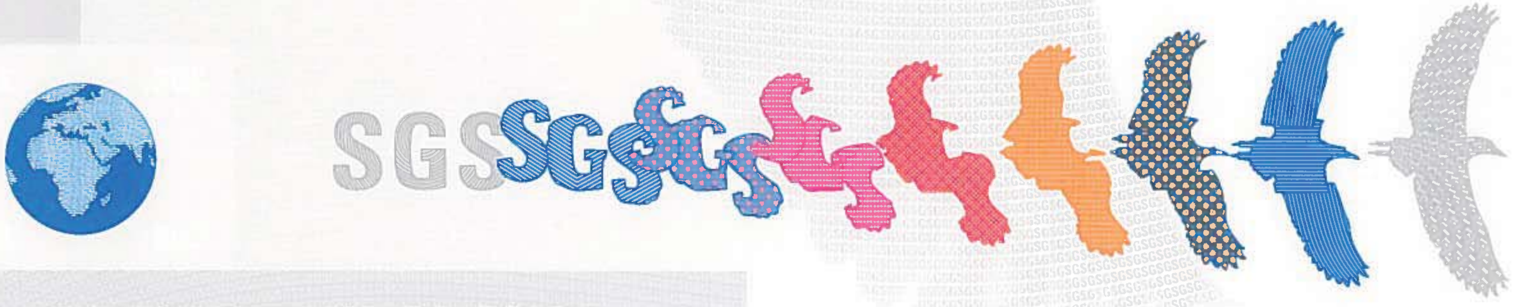
This is a multi-site certification.
Additional site details are listed on subsequent pages.

ANAB ACCREDITED ISO/IEC 17021 MANAGEMENT SYSTEMS CERTIFICATION BODY

Authorized by

John Woodman
Senior Vice President SSC, North America
SGS Systems & Services Certification, a Division of SGS North America, Inc.
201 Route 17 North, Rutherford, NJ 07070, USA
t (201) 508-3000 f (201) 935-4555 www.us.sgs.com

This certificate remains the property of SGS and shall be returned upon request



This document is issued by the Company subject to its General Conditions of Certification Services accessible at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein. The authenticity of this document may be verified at http://www.sgs.com/en/Our-Company/Certified-Client-Directories/Certified-Client-Directories.aspx. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Certificate US95/0189, continued

Kohler Power Systems, a Business Unit of Kohler Co.

ISO 9001:2008

Issue 12 : 14 October 2015

Additional facilities

.300 N. Dekora Woods Blvd., Saukville, WI 53080 (Known as Sauk)
Scope: Manufacturer of fuel tanks, skids, fabricated components, enclosures, and assembly of enclosures and generators.

4327 County EE, Sheboygan, WI 53081 (Known as KWIP Warehouse)
Scope: Receiving and storage of generator components & receiving and shipping of generator sets.

ANAB ACCREDITED
ISO/IEC 17021
MANAGEMENT SYSTEMS CERTIFICATION BODY

This document is issued by the Company subject to its General Conditions of Certification Services accessible at www sgs com/terms_and_conditions.htm Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein The authenticity of this document may be verified at http.//www sgs com/en/Our-Company/Certified-Client Directories/Certified-Client Directories.aspx. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law

Kohler Standby/Prime Generator Set Test Program

Testing is an integral part of quality assurance. In keeping with our uncompromising commitment to quality, safety, and reliability, every Kohler Standby/Prime power generator set undergoes an extensive series of prototype and production testing.

Prototype Testing

Prototype testing includes the potentially destructive tests necessary to verify design, proper function of protective devices and safety features, and reliability expectations. Kohler's prototype testing includes the following:

- Alternator temperature rise test per NEMA MG1-32.6. Standby and prime ratings of the alternator are established during this test.
- Maximum power test to assure that the prime mover and alternator have sufficient capacity to operate within specifications.
- Alternator overload test per NEMA MG1-32.8.
- Steady-state load test to ensure voltage regulation meets or exceeds ANSI C84.1, NEMA MG1-32.17 requirements and to verify compliance with steady-state speed control specifications.
- Transient test to verify speed controls meets or exceeds specifications.
- Transient load tests per NEMA MG1-32.18, and ISO 8528 to verify specifications of transient voltage regulation, voltage dip, voltage overshoot, recovery voltage, and recovery time.
- Motor starting tests per NEMA MG1-32.18.5 to evaluate capabilities of generator, exciter, and regulator system.
- Three-phase symmetrical short-circuit test per NEMA MG1-32.13 to demonstrate short circuit performance, mechanical integrity, ability to sustain short-circuit current.
- Harmonic analysis, voltage waveform deviation per NEMA MG1-32.10 to confirm that the generator set is producing clean voltage within acceptable limits.
- Generator set cooling and air flow tests to verify maximum operating ambient temperature.
- Reliability tests to demonstrate product durability, followed by root cause analysis of discovered failures and defects. Corrective action is taken to improve the design, workmanship, or components.
- Acoustical noise intensity and sound attenuation effects tests.

Production Testing

In production, Kohler Standby/Prime generator sets are built to the stringent standards established by the prototype program. Every Kohler Generator set is fully tested prior to leaving the factory. Production testing includes the following:

- Stator and exciter winding high-potential test on all generators. Surge transient tests on stators for generators 180 kW or larger. Continuity and balance tests on all rotors.
- One-step, full-load pickup tests to verify that the performance of each generator set, regulator, and governor meets published specifications.
- Regulation and stability of voltage and frequency are tested and verified at no load, 1/4 load, 1/2 load, 3/4 load, and full-rated load.
- Voltage, amperage, frequency and power output ratings verified by full-load test.
- The proper operation of controller logic circuitry, prealarm warnings, and shutdown functions is tested and verified.
- Any defect or variation from specification discovered during testing is corrected and retested prior to approval for shipment to the customer.

Torsional analysis data, to verify torsional effects are not detrimental and that the generator set will provide dependable service as specified, is available upon request.

Kohler offers other testing at the customer's request at an additional charge. These optional tests include power factor testing, customized load testing for specific application, witness testing, and a broad range of MIL-STD-705c testing. A certified test report is also available at an additional charge.

KOHLER®
POWER SYSTEMS

KOHLER CO. Kohler, Wisconsin 53044
Phone 920-565-3381, Fax 920-459-1646
For the nearest sales/service outlet in the
US and Canada, phone 1-800-544-2444
KohlerPowerSystemscom

KOHLER POWER SYSTEMS

Prestartup Checklist

Generator Set/Transfer Switch Installation Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Make the following installation checks before performing the Startup Checklist.

Note: Use this form as a general guide, along with any applicable codes or standards. Comply with all applicable codes and standards. Improper installation voids the warranty.

Equipment Room or Weather Housing

Yes Does Not Apply

☐ ☐ 1. Is the equipment installed in a fire-resistant room (made of non-combustible material) or in an outdoor weather housing?
☐ ☐ 2. Is there adequate clearance between the engine and floor for service maintenance?
☐ ☐ 3. Is there emergency lighting available at the equipment room or weather housing?
☐ ☐ 4. Is there adequate heating for the equipment room or outdoor weather housing?
☐ ☐ 5. Is the equipment room clean with all materials not related to the emergency power supply system removed?
☐ ☐ 6. Is the equipment room protected with a fire protection system?

Engine and Mounting

☐ ☐ 7. Is the mounting surface(s) properly constructed and leveled?
☐ ☐ 8. Is the mounting surface made from non-combustible material?
☐ ☐ 9. Was the generator-to-engine alignment performed after attaching the skid to the mounting base? Generator sets with two-bearing generators require alignment.

Lubrication

☐ ☐ 10. Is the engine crankcase filled with the specified oil?

Cooling and Ventilation

☐ ☐ 11. Is the cooling system filled with the manufacturer's specified coolant/antifreeze and purged of air?
☐ ☐ 12. Is there adequate inlet and outlet air flow (electric louvers adjusted and ventilation fan motor(s) connected to the corresponding voltage)?
☐ ☐ 13. Is the radiator duct properly sized and connected to the air vent or louver?
☐ ☐ 14. Are flexible sections installed in the cooling water lines?

Fuel

☐ ☐ 15. Is there an adequate/dedicated fuel supply?
☐ ☐ 16. Are the fuel filters installed?
☐ ☐ 17. Are the fuel tanks and piping installed in accordance with applicable codes and standards?
☐ ☐ 18. Is there adequate fuel transfer tank pump lift capacity and is the pump motor connected to the corresponding voltage?
☐ ☐ 19. Is the fuel transfer tank pump connected to the emergency power source?
☐ ☐ 20. Are flexible fuel lines installed between the engine fuel inlet and fuel piping?
☐ ☐ 21. Is the specified gas pressure available at the fuel regulator inlet?
☐ ☐ 22. Does the gas solenoid valve function?
☐ ☐ 23. Are the manually operated fuel and cooling water valves installed allowing manual operation or bypass of the solenoid valves?

Exhaust

☐ ☐ 24. Is the exhaust line sized per guidelines and does it have flexible connector(s)? Is the flexible connector(s) straight?

Yes Does Not Apply

☐ ☐ 25. Is there an exhaust line condensate trap with a drain installed?
☐ ☐ 26. Is the specified silencer installed and are the hanger and mounting hardware tightened?
☐ ☐ 27. Is a heat-isolating thimble(s) installed at points where exhaust lines pass through combustible wall(s) or partition(s)?
☐ ☐ 28. Is the exhaust line free of excessive bends and restrictions? Is the backpressure within specifications?
☐ ☐ 29. Is the exhaust line installed with a downward pitch toward the outside of the building?
☐ ☐ 30. Is the exhaust line protected from entry by rain, snow, and animals?
☐ ☐ 31. Does the exhaust system outlet location prevent entry of exhaust gases into buildings or structures?
☐ ☐ 32. Are individuals protected from exposure to high temperature exhaust parts and are hot parts safety decals present?

AC Electrical System

☐ ☐ 33. Does the nameplate voltage/frequency of the generator set and transfer switch match normal/utility source ratings?
☐ ☐ 34. Do the generator set load conductors have adequate ampacity and are they correctly connected to the circuit breakers and/or the emergency side of the transfer switch?
☐ ☐ 35. Are the load conductors, engine starting cables, battery charger cables, and remote annunciator leads installed in separate conduits?
☐ ☐ 36. Is the battery charger AC circuit connected to the corresponding voltage?

Transfer Switch, Remote Control System, Accessories

☐ ☐ 37. Is the transfer switch mechanism free of binding? **Note:** Disconnect all AC sources and operate the transfer switch manually.
☐ ☐ 38. Are the transfer switch AC conductors correctly connected? Verify lead designations using the appropriate wiring diagrams.
☐ ☐ 39. Is all other wiring connected, as required?

Batteries and DC Electrical System

☐ ☐ 40. Does the battery(ies) have the specified CCA rating and voltage?
☐ ☐ 41. Is the battery(ies) filled with electrolyte and connected to the battery charger?
☐ ☐ 42. Are the engine starting cables connected to the battery(ies)?
☐ ☐ 43. Do the engine starting cables have adequate length and gauge?
☐ ☐ 44. Is the battery(ies) installed with adequate air ventilation?
☐ ☐ 45. Are the ends of all spark plug wires properly seated onto the coil/distributor and the spark plug?

Special Requirements

☐ ☐ 46. Is the earthquake protection adequate for the equipment and support systems?
☐ ☐ 47. Is the equipment protected from lightning damage?

Generator Set/Transfer Switch Startup Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Complete the Installation Checklist before performing the initial startup checks. Refer to Service Bulletin 616 for Warranty Startup Procedure Requirements regarding generator set models with ECM-controlled engines.

Yes	Does Not Apply		
☐	☐	1.	Verify that the engine is filled with oil and the cooling system is filled with coolant/antifreeze.
☐	☐	2.	Prime the fuel system.
☐	☐	3.	Open all water and fuel valves. Temporarily remove the radiator cap to eliminate air in the cooling system. Replace radiator cap in step 21.
☐	☐	4.	Place the generator set master switch in the OFF/RESET position. Observe Not-in-Auto lamp and alarm, if equipped, on the controller.
☐	☐	5.	Press the lamp test, if equipped on controller. Do all the alarm lamps on the panel illuminate?
☐	☐	6.	Open the main line circuit breakers, open the safeguard breaker, and/or remove fuses connected to the generator set output leads.
☐	☐	7.	Turn down the speed control (electronic governor) or speed screw (mechanical governor).*
☐	☐	8.	Verify the presence of lube oil in the turbocharger, if equipped. See the engine and/or generator set operation manual.
☐	☐	9.	Place the generator set master switch in the RUN position. Allow the engine to start and run for several seconds.
☐	☐	10.	Verify that the day tank, if equipped, is energized.
☐	☐	11.	Place the generator set master switch in the OFF/RESET position. Check for oil, coolant, and exhaust leaks.
☐	☐	12.	Turn on the water/oil heaters and fuel lift pumps.
☐	☐	13.	Check the battery charger ammeter for battery charging indication.
☐	☐	14.	Place the generator set master switch in the RUN position. Verify whether there is sufficient oil pressure. Check for oil, coolant, and exhaust leaks.
☐	☐	15.	Close the safeguard circuit breaker. Adjust the engine speed to 50/60 Hz if equipped with an electronic governor or to 52.8/63 Hz if equipped with a mechanical governor.*
☐	☐	16.	If the speed is unstable, adjust according to the appropriate engine and/or governor manual.*
☐	☐	17.	Adjust the AC output voltage to match the load voltage using the voltage adjusting control. See the generator set/controller operation manual.
☐	☐	18.	Allow the engine to reach normal operating coolant temperature.
☐	☐	19.	Check the operating temperature on city water-cooled models and adjust the thermostatic valve as necessary.
☐	☐	20.	Manually overspeed the engine to cause an engine shutdown (68-70 Hz on 60 Hz models and 58-60 Hz on 50 Hz models). Place the generator set master switch in the OFF/RESET position.*
☐	☐	21.	Check the coolant level, add coolant as necessary, and replace the radiator cap. Verify that all hose clamps are tight and secure.
☐	☐	22.	Place the generator set master switch in the RUN position.
☐	☐	23.	Verify the engine low oil pressure and high coolant temperature shutdowns.*
☐	☐	24.	Check the overcrank shutdown.*
☐	☐	25.	Place the generator set master switch in the OFF/RESET position.
☐	☐	26.	Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	27.	Disconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	28.	Manually transfer the load to the emergency source.
☐	☐	29.	Close the normal source circuit breaker or replace fuses to the transfer switch.
☐	☐	30.	Check the normal source voltage, frequency, and phase sequence on three-phase models. The normal source must match the load.
☐	☐	31.	Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	32.	Manually transfer the load to the normal source.
☐	☐	33.	Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	34.	Place the generator set master switch in the RUN position.
☐	☐	35.	Check the generator set voltage, frequency, and phase sequence on three-phase models. The generator set must match normal source and load.
☐	☐	36.	Place the generator set master switch in the OFF/RESET position.
☐	☐	37.	Open the generator set main line circuit breakers, open the safeguard breaker, and/or remove the fuses connected to the transfer switch.
☐	☐	38.	Reconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	39.	Close the normal source circuit breaker or replace fuses to the transfer switch. Place the generator set master switch to the AUTO position.
☐	☐	40.	Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	41.	Place the transfer switch in the TEST position (load test or open normal source circuit breaker). **NOTE:** Obtain permission from the building authority before proceeding. This procedure tests transfer switch operation and connects building load to generator set power.
☐	☐	42.	Readjust frequency to 50 or 60 Hz with total building loads.*
☐	☐	43.	Verify that the current phase is balanced for three phase systems.
☐	☐	44.	Release the transfer switch test switch or close the normal circuit breaker. The transfer switch should retransfer to the normal source after appropriate time delay(s).
☐	☐	45.	Allow the generator set to run and shut down automatically after the appropriate cool down time delay(s).
☐	☐	46.	Set the plant exerciser to the customer's required exercise period, if equipped.
☐	☐	47.	Verify that all options on the transfer switch are adjusted and functional for the customer's requirements.
☐	☐	48.	If possible, run the building loads on the generator set for several hours or perform the load bank test if required.
☐	☐	49.	Verify that all the wire connections from the generator set to the transfer switch and optional accessories are tight and secure.
☐	☐	50.	Verify that the customer has the appropriate engine/generator set and transfer switch literature. Instruct the customer in the operation and maintenance of the power system.
☐	☐	51.	Fill out the startup notification at this time and send the white copy to the Generator Warranty Dept. Include the warranty form if applicable.

* Some models with an Engine Electronic Control Module (ECM) may limit or prohibit adjusting the engine speed or testing shutdowns. Refer to appropriate documentation available from the manufacturer.

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Oct 19, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 035

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – 750KW Generator Tier 4 compliant r1**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**AeriNOx Emission Control System (58pgs)**	
		ADV-8249 (2pgs)	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 32 10 item 2.3

Emission Controller to be located inside the generator enclosure.
Compressor and Pump to be located with in the generator enclosure - location to be confirmed.

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

Applied Engineering Solutions Ltd.
3rd Floor, 1815 Blanshard Street
Victoria, BC V8T 5A4

☐ Reviewed
☐ Revise and Resubmit
☒ Reviewed as Modified
☐ Not Reviewed

This review is only for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on shop drawings during this review do not relieve the contractor from compliance with the requirement of the plans and specifications. Review of the specific item shall not include review of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades; and for performing all Work in a safe and satisfactory manner.

Project No.: 16-008
Date: October 20, 2016
By: Iain Barnes

This review is completed with comments and is based on the design presented. It is reviewed with the understanding that follow up will be provided on the items noted, and for complete compliance with the contract documents.
This review does not preclude further commentary on subsequent submissions or corresponce.

1. Finalized drawings showing compressor, pump, control panel, tank, wiring, etc to be provided as made available. Final drawings to indicated integration to generator and SCADA systems as applicable.
2. Vendor notes that emissions equipment should only be installed after engine break in is complete. Confirm how this will be complied with.
3. Urea pump to be 120/208V.
4. Urea tank mounting shall easily accessed for filling, and shall not compromise access to fuel tank ports/fillers. Show final location.
5. Vendor notes that stainless steel exhaust components should be used. Confirm that this is complied with.
6. Certificate of compliance to Tier 4F emissions level to be provided. As on site testing is not specically noted in contract, Owner may choose to confirm emissions levels on site using a third party. Provide assurance that expected emissions levels at time of commissioning will be observed, and that remedial work (if required) will be provided at no cost to the owner.
7. All piping, wiring, cabling, hoses, etc for integration to generator to be be included. Provide final drawings.
8. General acceptance of concept and overall arrangement is provided pending follow up on the items noted.

9. All equipment shall be CSA (or equivalent approval marking) approved.
10. All integration and interconnection systems (cables, hoses, piping ,etc) is the responsibility of this contractor.
11. All hardware and equipment shall be corrosion resistant.
12. Provide supplementary information from generator manufacturer regarding Tier 4F and prohibition of overfuelling/overdutying of diesel. This information to be provided for PWGSC filing purposes.
13. Proposed urea concentration must be maintained above -11 deg C. Provide suitable heating method to ensure this requirement is met.
14. Training for operation and maintenance of this system to be be part of the generator demonstration/training.
15. Submit a fully compliant, integrated shop drawing of generator and emissions equipment at the soonest.

Esquimalt Graving Dock

Project Number: PN16084

AeriNOx™ Emission Control System to Reduce Emissions from (3) Mitsubishi, S12A2-Y2PTAW-2 Diesel Engines

AeriNOx Inc.
PO Box 490
Eaton, CO 80615

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: Oct 19, 2016
REVIEWED by _GW_

1 Introduction and setting of tasks

1.1 General

This introductory installation manual does not include complete, detailed information on the product and cannot cover every conceivable aspect of installation, operation and maintenance. For more detailed information refer to the system manuals.

1.2 Safety notes

This technical description contains introductions concerning major personal safety issues and how to prevent property damage, however, these instructions are intended to complement general CLASSIFICATION and company safety instructions only.

1.3 Qualified personnel

Installation, commissioning, operation and maintenance/repairs of the AeriNOx SCR-System shall be performed by skilled personnel only.
Please read this system description and the safety instructions prior to working on or operating the SCR-System.

1.4 Operation in accordance with intended purposes

Please note:
The AeriNOx SCR - System may only be used as specified in the system documentation.
When used with material, parts and components other than specified without prior approval by AeriNOx all guarantee shall be void.
Correct and safe operation of the SCR - System is dependent on proper operation and maintenance procedures.

1.5 Chemicals

The SCR-System is operated with urea solution (32,5 %) as reducing agent. The instructions for handling this material are listed in the supplier's (Material safety data sheets) MSDS. Do not work on or open piping before checking the MSDS.

When handling the catalytic material, refer to the MSDS in the AeriNOx SCR-System documentation.

1.6 Important note

The tag numbers of valves, field devices… are referring to P & ID Diagram.

2 General (safety) instructions

This technical description contains introductions concerning major personal safety issues and how to prevent property damage, however, these instructions are intended to complement general CLASSIFICATION and company safety instructions only.

– To avoid damages at engine / turbo by falling parts, we strongly recommend to install applicable arrangements (e.g. protection grill / or siphon***)***

– Protect hot parts (> 50°C) against contact!

– All temperature bonded threats must be treated with adequate antiseize paste

– Avoid Temperature over 520°C for whole SCR – System, catalyst or material maybe damaged!

– Install catalysts after running in engines!

– We recommend to install catalyst only under supervision of AeriNOx expert.

– All urea contacted items / pipes shall be made of stainless steel

3 Main components of the SCR – System

The AeriNOx DENOx system cleans the exhaust gas from a gas engine. For this process the DENOx system is built with the following main components (Per Unit):

– 1 Diesel Oxidation Catalyst housing and element
– 1 Injection and mixing pipe
– 1 SCR / DPF housing and elements
– 1 Air compressor unit with automatic drain
– 1 Control cabinet including:
    - Electrical control unit (PLC)
    - NOx sensor
    - Field devices:
    - Urea dosing
    - Compressed air control
    - Thermocouple
    - Differential pressure transmitter

– Urea Tank with supply pump and level transmitter

4 Description of the process

Selective Catalytic Reduction Principle

NOx is a general term referring to Nitrogen Oxide (NO) and Nitrogen Dioxide (NO_2) gases. NOx forms at the high temperatures of a combustion process, typical of internal combustion engines. NOx is a precursor to smog and adversely effects health and the environment. As such, NOx is increasingly regulated by both the US Environmental Protection Agency and by local authorities.

NOx emissions are most efficiently removed from the exhaust by Selective Catalytic Reduction, often referred to as SCR. SCR works by promoting a chemical reaction between the NOx and ammonia gas (NH_3), which is introduced upstream of the SCR catalysts. The ammonia can come from a variety of sources, including directly as a gas (known as anhydrous ammonia), or as an aqueous ammonia solution. It is more common to use aqueous urea solution. Urea is a widespread component of fertilizer, and water-based solutions made from urea are easier to handle than ammonia compounds. Moreover, aqueous urea solutions are readily available in different storage capacities and concentrations.

Commercially, aqueous urea solutions come in two concentrations, either 32.5% or 40%. The lower concentration, 32.5%, has the lowest freezing point of 12°F (-11°C), and is therefore used in colder climates where ambient temperatures can reach this point. The 40% concentration has a higher freezing temperature of 35°F (2°C), but requires less volume of solution to achieve the same degree of NOx reduction. In either case, freezing is to be avoided since injection becomes problematic. When low temperatures are encountered in the application, it is customary to install an immersion heater in the urea storage tank, as well as heat-tracing the urea supply lines to the SCR System. This is true for both concentrations of urea solution.

When the engine is running and the catalyst has warmed up to its normal operating temperature, urea solution is injected into exhaust stream ahead of the SCR catalyst, in combination with high-pressure air, to assist in atomizing the spray. (The air also cools the urea injection nozzle and purges the injector when the engine is no longer running.) Chemically, the heat of the exhaust first vaporizes the water in the urea solution, resulting in the formation of small urea crystals. These crystals further breakdown in the exhaust stream into ammonia and carbon dioxide. Once ammonia is present, the chemical reactions shown below take place over the SCR catalyst, reducing NOx to harmless nitrogen gas and water vapor.

Once ammonia gas is present, the chemical reactions shown below take place over the SCR catalyst, reducing NOx to harmless nitrogen gas and water vapor:

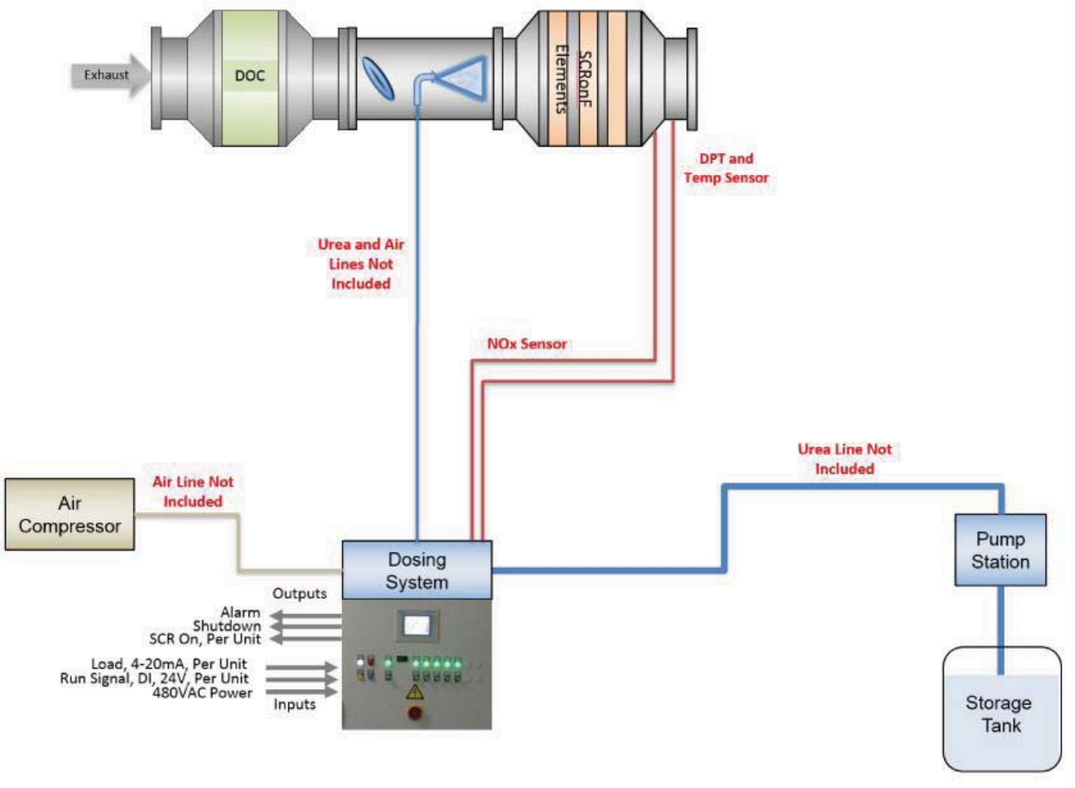
$$4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$$
$$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O$$
$$2\ NO + 2NO_2 + 4\ NH_3 \rightarrow 4\ N_2 + 6\ H_2O$$

The SCR Catalyst Technology:

SCR catalysts generally fall into two categories, a vanadia-based catalyst embedded in an extruded ceramic substrate, or a zeolite-based technology coated onto the surface of a ceramic substrate. In the former, the catalyst is actually incorporated into the ceramic structure, and as a result the catalyst is generally more robust to thermal variation. In addition, vanadia-based technologies operate over a wide temperature range, and when combined with its strength advantages and lower cost, are used in many industrial applications such as large-scale power plants and boiler systems. Vanadia-based catalysts have demonstrated NOx reduction capability of up to 98%, and can operate continuously to temperatures of 510°C (950°F).

Zeolite systems are ideal for higher temperature applications, for example above 510°C, and as such have found wide use in mobile diesel applications such as on-highway trucks. These systems have also demonstrated a capability for high NOx reduction.

The size of the SCR catalyst elements and how they are configured in a catalyst housing (e.g., number of catalyst layers) is determined by factors such as the required NOx reduction, allowable back pressure of the engine, and ammonia slip limits. High levels of NOx reduction (>80%) generally require 2-4 layers of catalyst.



Schematic of a representative AeriNOx™ Emission Control System. Urea storage not included.

Urea Injection Strategy:

Reducing NOx to N_2 with high levels of chemical conversion efficiency without introducing excess ammonia into the exhaust (known as "ammonia slip") requires precise control of the urea or ammonia injection process. The strategy for urea or ammonia injection depends on the degree of NOx reduction, and the required ammonia slip limits.

The simplest injection strategy links the engine to the SCR system through the engine load. NOx emissions are measured as a function of engine load, creating a "NOx vs. Engine Load" map. From this map, an injection algorithm determines the amount of urea or aqua ammonia necessary to reach the required NOx level, and sends this signal to the dosing control system. Because the amount of urea or ammonia injected is based on the engine load and not on a direct measurement of NOx, such an engine mapping strategy is often referred to as an "open-loop" control strategy. Such an injection strategy has been used successfully when NOx reduction requirements are generally less than 90%. Moreover the strategy has demonstrated that ammonia slip is minimal, generally far less than typical 10ppm regulatory requirements.

When higher levels of NOx reduction are necessary, it is customary to add a NOx analyzer to the SCR System to directly measure NOx after the SCR catalyst. The signal from the analyzer is then sent to the SCR dosing control system, which then "trims" the injection volume up or down to ensure the required NOx reduction level is reached, without overdosing that could lead to an increase in ammonia slip. As the NOx is measured directly with the NOx analyzer, and the signal is used to control the reagent dosing volume, this strategy is referred to as "closed-loop" control. This strategy has demonstrated up to 98% NOx reduction, with very low levels of ammonia slip (as low as 5ppm in some applications).

Role of the Oxidation Catalyst:
By incorporating an oxidation catalyst into the system, it is possible to reduce carbon monoxide (CO), many hydrocarbon species (HC), volatile organic compounds (VOC) such as formaldehyde, and particulate matter. Placement of the oxidation catalyst depends on the application requirements, such as degree of CO reduction, but also on parameters such as the degree of NOx reduction and maximum levels of ammonia slip. In many cases, the oxidation catalyst can be incorporated directly into the SCR catalyst housing, saving both space and the cost of a separate housing.

Oxidation catalysts are generally precious metals-based systems composed of platinum, or mixtures of platinum, palladium and other precious group metals (PGM). PGM catalysts are highly effective at utilizing the excess oxygen in the exhaust stream of lean-burning engines to convert CO, HC and formaldehyde to water vapor and carbon dioxide, as shown below:

$2CO + O_2 \rightarrow 2\ CO_2$
HC* $+ O_2 \rightarrow H_2O + CO_2$
$HCOH + O_2 \rightarrow H_2O + CO_2$

Oxidation catalysts can be engineered to operate at temperatures similar to SCR catalysts, allowing for reduction of several pollutant emissions within the same system. Moreover, oxidation catalysts are highly effective, reducing emissions as much as 95%.

5 Signal Exchange

The AeriNOx system functions independently to a large degree. For this automatic operation a signal exchange between the engine-management and the AeriNOx system is realized, which includes following:

Name	**Character**	**Description**	**Source**	**Destination**
Engine running	Digital	Closed when engine running	Engine management	AeriNOx DENOx System
Engine load	Analog	0…100% = 4…20 mA	Eninge management	AeriNOx DENOx System
Engine Fuel mode	Digital	Closed if engine in diesel mode	Eninge management	AeriNOx DENOx System
Alarm DENOx system	Digital	system is in alarm mode	AeriNOx DENOx System	engine management

6 Operation Modes

6.1 Operation Mode "Stand By"

System "Stand By" is the operation mode if the hand operated switch is in position "off", the remote signal "SCR - off" is active or the gas engine is not running. All components turn to the safe position.

The components are in operation states as follows:

Component	**Pos. N°**	**Operation State**	**Notes**
Urea pump	1HSJ AP010	No request	
Compressor	1HSC AN230	Normal operation	Controled by compressor internal unit – pressure related
shut-off valve atomizing air	1HSC AA010	closed	

---

* *The specific reaction depends on HC species, such as* CH_4, C_2H_6 *etc.*

shut-off valve flushing air	1HSC AA020	closed	
dosing valve reducing agent	1HSJ AA040	closed	
shut-off valve urea	1HSJ AA030	Closed	
NO_x measurement system			
Measuring gas pump	1HSA AP060	On	

6.2 Operation Mode "Start Up"

System "Start Up" is the operation mode if the hand operated switch is in position "On", the remote signal "SCR - off" is inactive or the gas engine is running. The engine load must me higher than 30% and the exhaust gas temperature after catalyst must be higher than 280°C.

The components are in operation states as follows:

Component	**Pos. N°**	**Operation State**	**Notes**
Urea pump	1HSJ AP010	Requested-On	
Compressor	1HSC AN230	Normal operation	Controled by compressor internal unit – pressure related
shut-off valve atomizing air	1HSC AA010	Open	
shut-off valve flushing air	1HSC AA020	Open	
dosing valve reducing agent	1HSJ AA040	closed	
shut-off valve urea	1HSJ AA030	Closed	
NO_x measurement system			
Measuring gas pump	1HSA AP060	On	

6.3 Operation Mode "Urea Injection"

System "Urea Injection" is the operation mode if the hand operated switch is in position "On", the remote signal "SCR - off" is inactive or the gas engine is running. The engine load must me higher than 30% and the exhaust gas temperature after catalyst must be higher than 280°C.

The components are in operation states as follows:

Component	**Pos. N°**	**Operation State**	**Notes**
Urea pump	1HSJ AP010	On	
Compressor	1HSC AN230	Normal operation	Controled by compressor internal unit – pressure related
shut-off valve atomizing air	1HSC AA010	Open	
shut-off valve flushing air	1HSC AA020	Closed	
dosing valve reducing agent	1HSJ AA040	Continuos controlling	
shut-off valve urea	1HSJ AA030	Open	

NO$_x$ measurement system			
Measuring gas pump	1HSA AP060	On	

6.4 Operation Mode "Shut Down"

System "Shut Down" is the operation mode if the hand operated switch is turned to position "Off", the remote signal "SCR - off" is changing to active or the engine is stopped. If the engine load drops below 30% or the exhaust gas temperature after catalyst drops lower than 280°C or an internal alarm occours the system will automatically go to “Shut Down” .

The components are in operation states as follows:

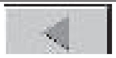
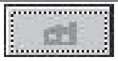
Component	**Pos. N°**	**Operation State**	**Notes**
Urea pump	1HSJ AP010	Off	
Compressor	1HSC AN230	Normal operation	Controled by compressor internal unit – pressure related
shut-off valve atomizing air	1HSC AA010	Open	
shut-off valve flushing air	1HSC AA020	Open	
dosing valve reducing agent	1HSJ AA040	Closed	
shut-off valve urea	1HSJ AA030	Closed	
NO$_x$ measurement system			
Measuring gas pump	1HSA AP060	On	

7 Manual Touch Panel:

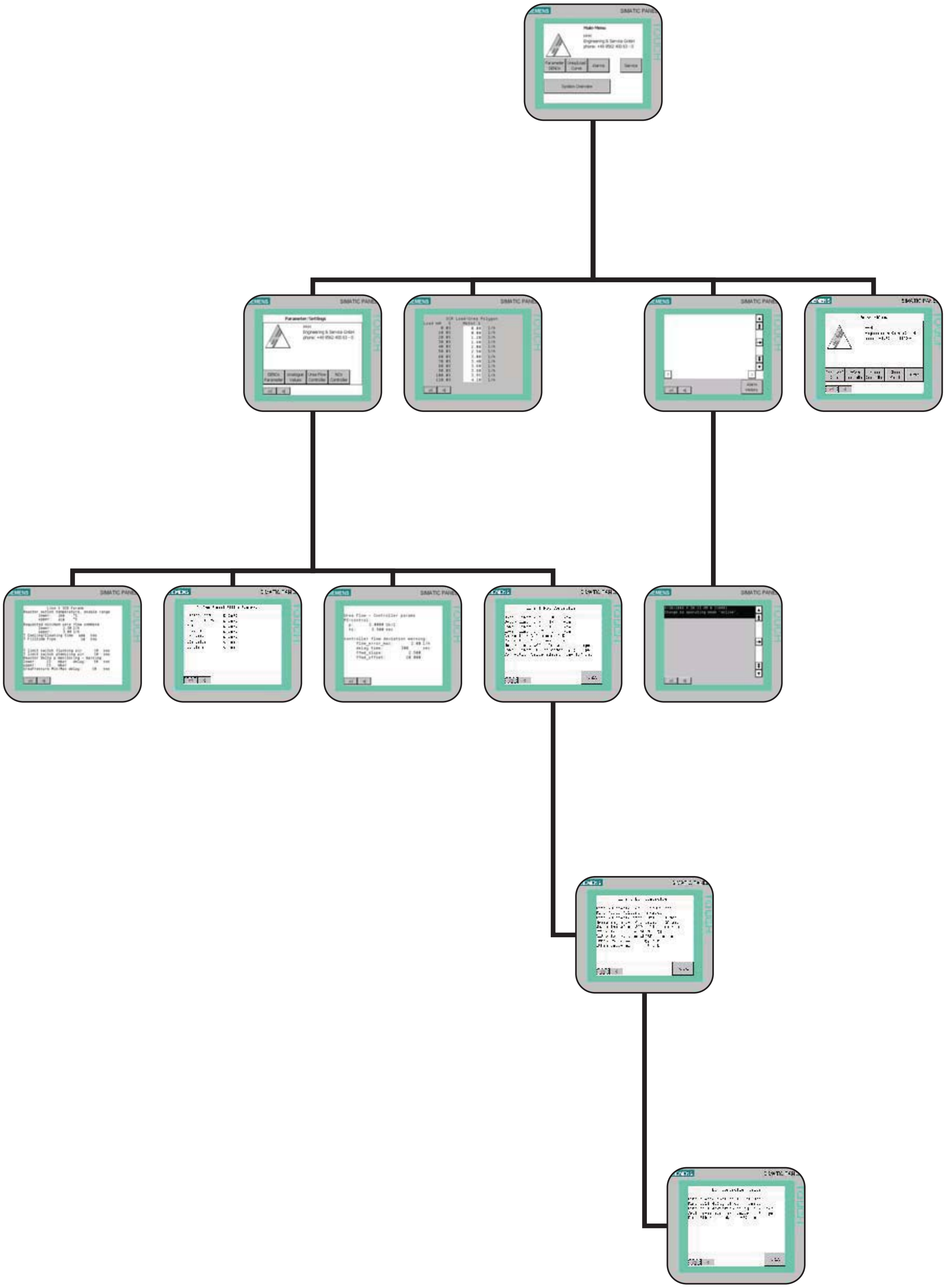
The AeriNOx DENOx system can be controlled and monitored via the integrated SIMATIC Touch Panel. This Panel is controlled via the touch screen and you will find the way through the menu via the labeled bush buttons on the screen. The menu structure is described in the following manual.

7.1 Basic functions:

On all pages you will find the following two push buttons in the left lower corner. Here in after you will have the explanation:

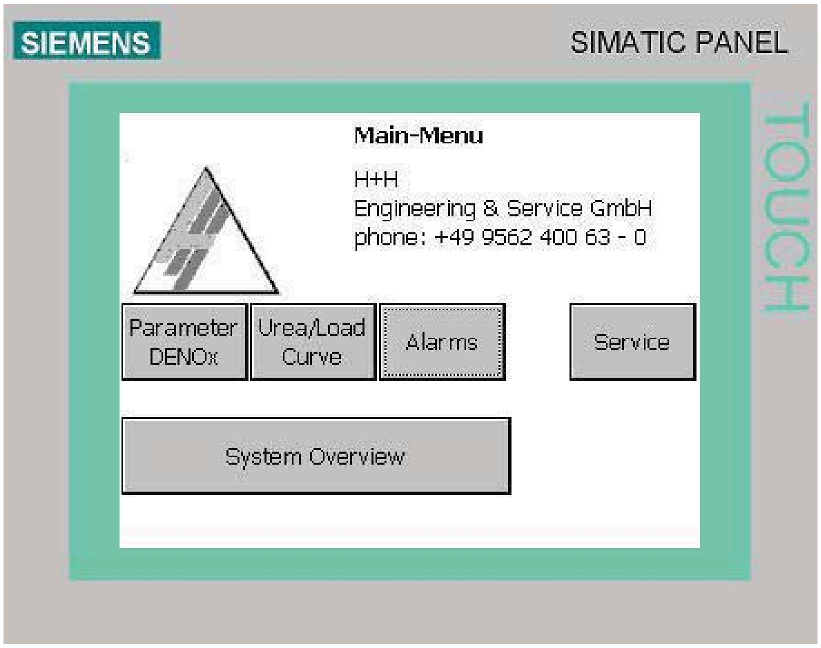
	The “BACK” – button will always go one step back, to the picture you came from.	
	The “HOME” – button will always go back to the picture “Main-Menu” (see below)	

7.2 Menu structure overview:



7.3 Detailed Menu Structure:

7.3.1 Starting Picture “Main-Menu”:



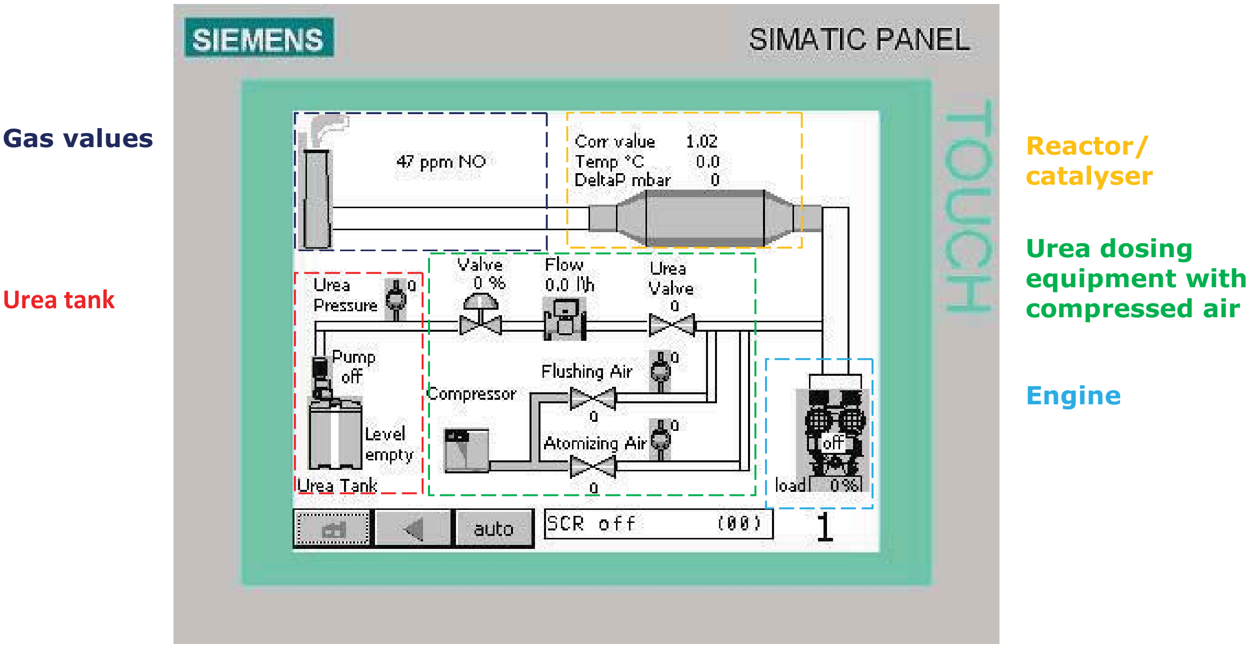
Main-Menu

H+H
Engineering & Service GmbH
phone: +49 9562 400 63 - 0

Parameter DENOx: Parameters for urea and compressed air control (see section 7.3.4 and 7.3.2)
Urea/Load Curve: The curve shows the needed urea consumption at different engine load (see section 7.3.6)
Alarms: Active alarms and access to alarm history
Service: Service menu (see Page)
System Overview: Overview of the whole system with gas values and operation states (see section 7.3.2)

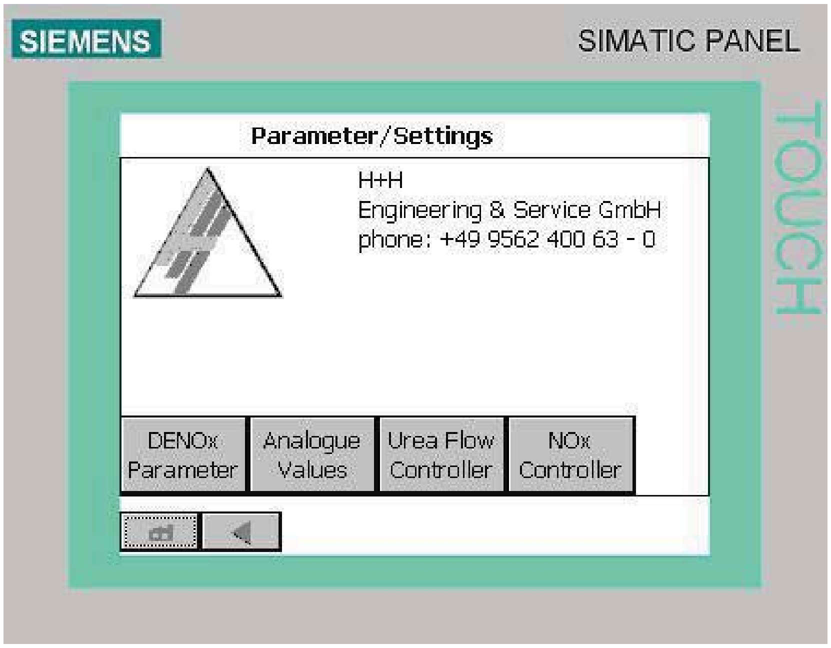
7.3.2 Picture "System Overview":

The picture shows the following main components of the system:



Urea Tank parameters:	Level:	full/empty
	Pump:	On/Off
	Urea Pressure:	0(depressureized)/1(pressurized)
Urea dosing equipment:	Valve:	actual percentage of the opening of the dosing valve
	Flow:	actual urea flow
	Urea valve:	0(closed)/1(open)
	Compressor:	On/Off
	Flushing air valve:	0(closed)/1(open)
	Flushing air pressure:	0(depressureized)/1(pressurized)
	Atomizing air valve:	0(closed)/1(open)
	Atomizing Air pressure:	0(depressureized)/1(pressurized)
Engine:	Load:	Engine load in %
	Operation status:	On/Off
Reactor/catalyser:		
	Corr value:	0,5..1,3 (actual calculated correction of the urea flow needed)
	Temp °C:	0…600 °C (Actual temperature after catalyser)
	Delta P mbar:	0…50mbar (Actual differential pressure over catalyser)

7.3.3 Picture “Parameter DENOx”:

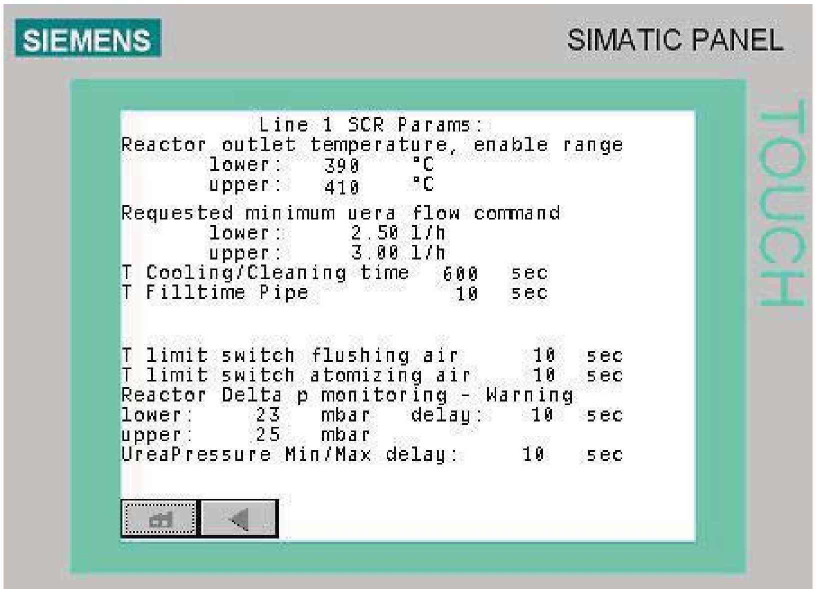


Parameter/Settings

H+H
Engineering & Service GmbH
phone: +49 9562 400 63 - 0

DENOx Parameter:	Parameters and settings for general urea and compressed air (see section 7.3.4)
Analogue Values:	Parameter for the analogue input channels - Engine load - Temperature after catalyst - Delta P (differential pressure over catalyst system) - Urea flow meter (see section 7.3.5)
Urea flow controller:	Parameter for the closed loop urea controller (see section 7.3.6)
NOx controller:	Parameter for the NOx regulation - NOx limit values

7.3.4 Picture "DENOx Parameter":



```
           Line 1 SCR Params:
Reactor outlet temperature, enable range
       lower:    390     °C
       upper:    410     °C
Requested minimum uera flow command
       lower:      2.50 l/h
       upper:      3.00 l/h
T Cooling/Cleaning time   600   sec
T Filltime Pipe            10   sec


T limit switch flushing air       10   sec
T limit switch atomizing air      10   sec
Reactor Delta p monitoring - Warning
lower:     23    mbar    delay:    10   sec
upper:     25    mbar
UreaPressure Min/Max delay:      10   sec
```

Note: All values are examples and can be different on your system – please refer to the parameter list !

Reactor outlet:

The SCR process starts at a minimum temperature of 280°C and will stop at 510°C. Both, start up and shut down, will be automatic

Requested minimum urea flow command:

The SCR process starts at a minimum request of ~1.5 l/h and will stop at ~15.0 l/h. These requested amount is related to the engine load and can be seen in the picture "Urea/Load Curve" (see section).Both, start up and shut down, will be automatic.

T Cooling/Cleaning Time:

The SCR process starts with a delay of 600sec to cool the nozzle, then the urea injection will start. When shutting down, both air valves will be open for 600 sec to clean the urea out of the piping and injection nozzle.

T filltime pipe:

Once the urea dosing is released, the dosing valve will open 100% to fill up the pipe to the nozzle as soon as possible. When the time of 10 sec is over, the dosing valve will go to normal operation mode.

T limit switch flushing (atomizing) air:

This is a delay time if the pressure transmitter gives alarm.

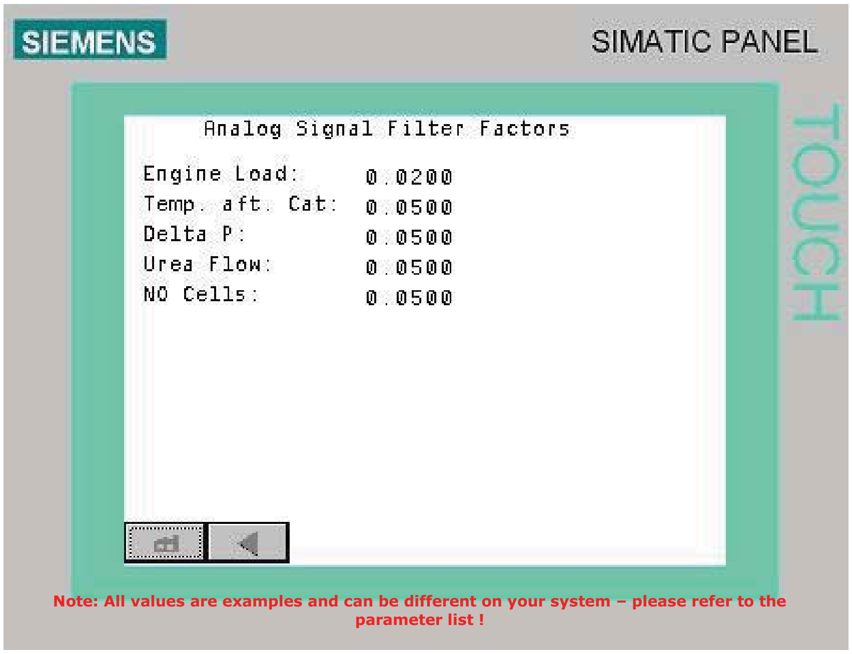
Reactor delta P warning:

A warning will be generated with 10sec delay if the back pressure exeeds 60 mbar. The warning will disappear automatic when the pressure is below 50 mbar again.

Urea pressure Min/Max delay:

This is a delay time if the pressure transmitter gives alarm.

7.3.5 Picture “Analogue Values”:



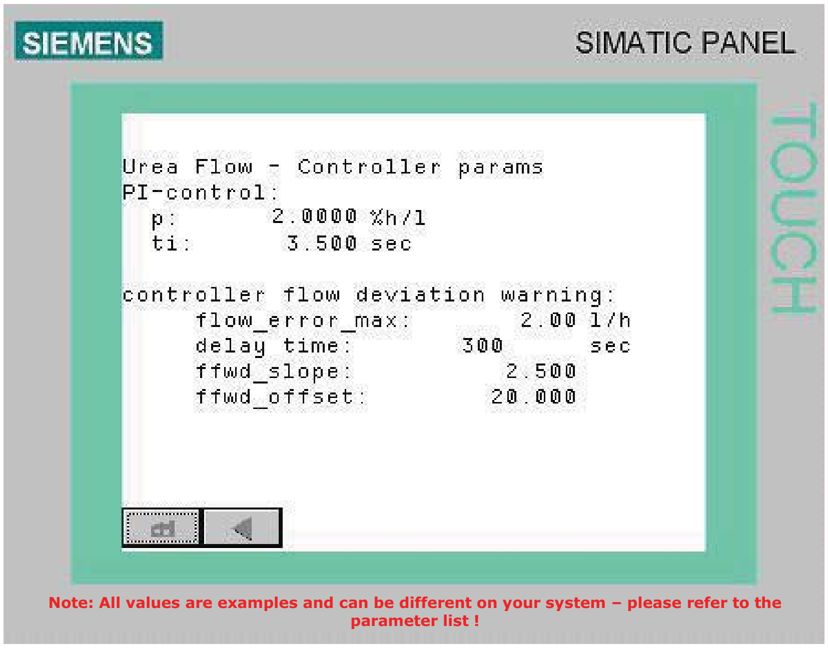
Analog Signal Filter Factors

Engine Load:	0.0200
Temp. aft. Cat:	0.0500
Delta P:	0.0500
Urea Flow:	0.0500
NO Cells:	0.0500

Note: All values are examples and can be different on your system – please refer to the parameter list !

The values show the attenuation of the input signals of the analogue values.

7.3.6 Picture “Urea Flow Controller”:



```
Urea Flow - Controller params
PI-control:
  p:        2.0000 %h/l
  ti:        3.500 sec

controller flow deviation warning:
     flow_error_max:        2.00 l/h
     delay time:        300       sec
     ffwd_slope:           2.500
     ffwd_offset:         20.000
```

Note: All values are examples and can be different on your system – please refer to the parameter list !

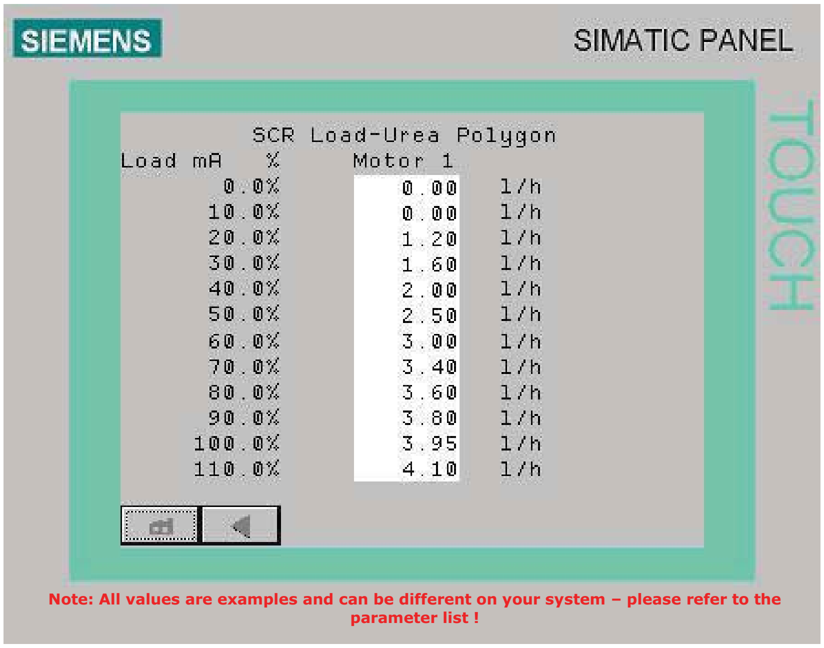
PI-Control:

This shows the amplification (P) and the integration time of the controller

Controller flow deviation warning:

Here is the max allowed deviation and the according delay time displayed and configured. Meaning when the actual flow varies from the calculated set point more than 2 l/h for more than 300 seconds the system will go to shut down and create an alarm.

7.4 Picture “Urea/Load Curve”:



SCR Load-Urea Polygon

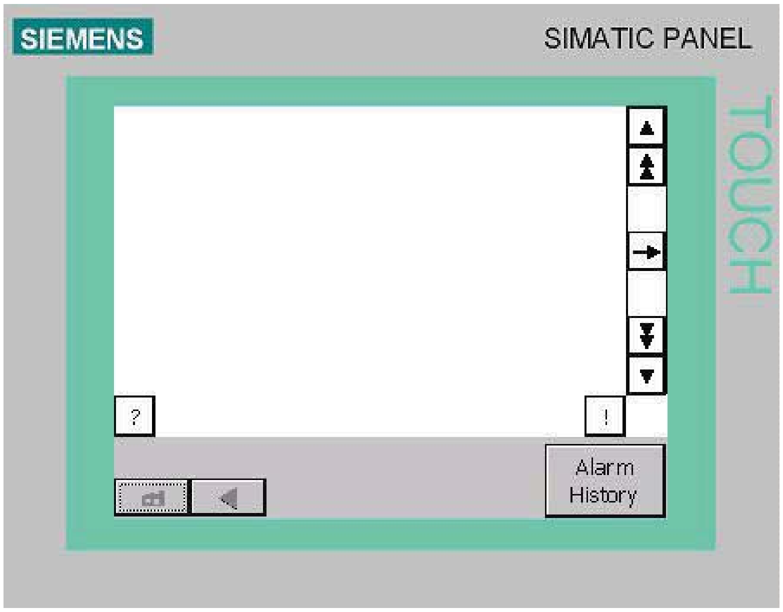
Load mA %	Motor 1	
0.0%	0.00	l/h
10.0%	0.00	l/h
20.0%	1.20	l/h
30.0%	1.60	l/h
40.0%	2.00	l/h
50.0%	2.50	l/h
60.0%	3.00	l/h
70.0%	3.40	l/h
80.0%	3.60	l/h
90.0%	3.80	l/h
100.0%	3.95	l/h
110.0%	4.10	l/h

Note: All values are examples and can be different on your system – please refer to the parameter list !

This ist the “polygon“, which calculates the values for different engine load. This curve has been configured during commissioning and gives you the needed urea amount at a certain engine load to reach the correct NOx-output. This urea values will be corrected with the “correction value” (shown in “System Overview”) to the real and actual NOx – output. The correction value compensates tolerances in the engine NOx-output, urea concentration etc.
This picture will be created for both fuel seperatly.

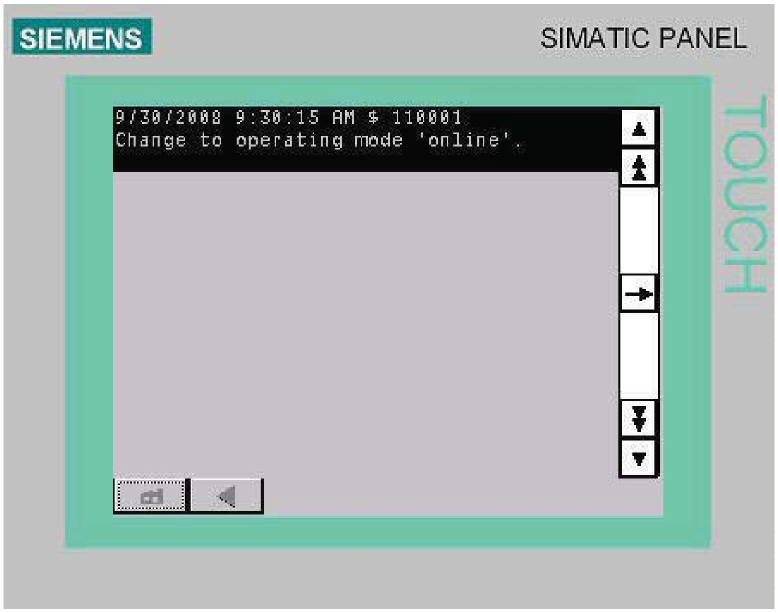
7.5 Picture “Alarms/Alarm History”:

7.5.1 Picture “Alarms”:



All active alarms will be displayed here and can be reset in this picture.

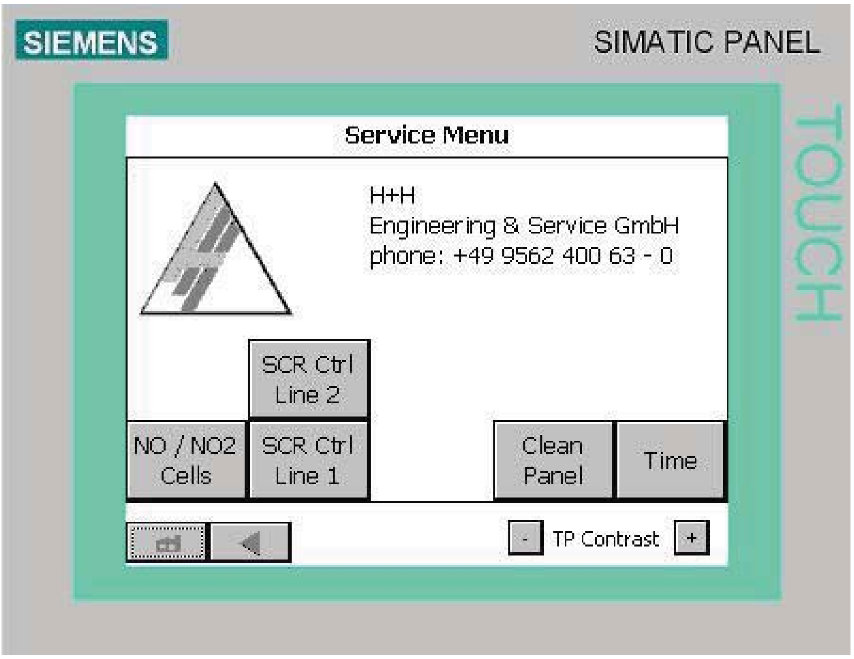
7.5.2 Picture "Alarm History":



```
9/30/2008 9:30:15 AM $ 110001
Change to operating mode 'online'.
```

This gives you an overview of all alarms in the past.

7.6 Picture "Alarms/Alarm History":



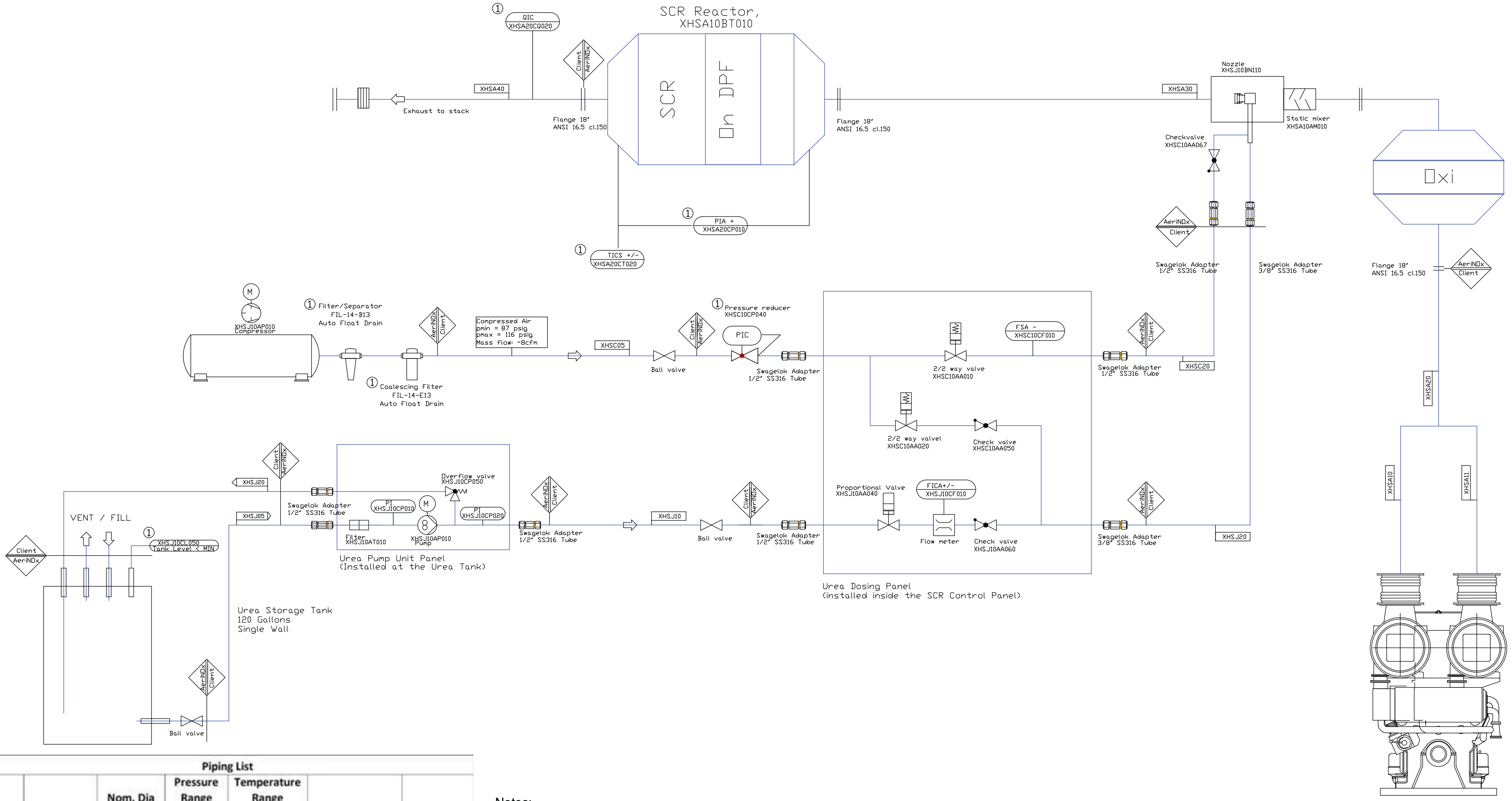
H+H
Engineering & Service GmbH
phone: +49 9562 400 63 - 0

FRONTIER POWER PRODUCTS - KOHLER 750REOZMD TIER 4 EMISSIONS PROJECT
DRAWING INDEX

Project:	Kohler 750REOZMD (3)	AeriNOx Project # 16084	Client ref:	Revision: 0	Revised By:

	Drawing			Description	Submitted		Client Approval	Comment
Pages	Title	No.	Rev.		Initials/Date		Initials/Date	
1	Drawing Index	16084-010	0		ASC	10/14/2016		
1	PID - Process Diagram	16084-100	0		ASC	10/14/2016		
1	Cable Block Diagram	16084-150	0		ASC	10/14/2016		
1	DOC, Mixer, SCR Layout	10-SCR4.9-16_E014209	0		GP	10/14/2016		
1	Installation_V04PURHS-8	CZ35270	0	Air Compressor Drawing		10/14/2016		
1	V01-V07 Technical Information Sheet	TIS_60Hz	0	Air Compressor Technical Data		10/14/2016		
1	Filter Data, FIL12-FIL20	GA23GAR-0001	0	FIL14B13AP - Filter Seperator and FIL14E13AP - Coalescing Filter		10/14/2016		
1	Urea Tank, 150 GAL	500150H	0	Urea Tank General Drawing	ASC	10/14/2016		
1	Ultrasonic Level Transmitter Data Sheet	DS204200	A.1	Ultrasonic Level Transmitter Data Sheet	ASC	10/14/2016		
1	Ultrasonic Level Transmitter Manual	MN204210	B	Ultrasonic Level Transmitter Manual	ASC	10/14/2016		
1	Urea Pump General Assembly	16084-PA2016_238LAY050	0	Urea Pump Layout, Pressure Regulator, Return Flow	ASC	10/14/2016		
	O&M Manual			After Delivery				
	Service & Maintenance Recommendations			After Commissioning				
	Commissioning Pre-Checks			After Commissioning				
	Commissioning Report			After Site Commissioning				

Drawings in Red Text are new with this revision



Piping List

Pipe #	Pipe Material	Nom. Dia (in)	Pressure Range (psig)	Temperature Range (F)	Fluid	Flow
OHSJ05	SS316L	1	3-7	5-45	32.5% Urea	0-15 gph
OHSJ20	SS316L	1	7-14	5-45	32.5% Urea	0-15 gph
1HSC05	Galv Stl	1	87	1-45	Compressed Air	24 cfm
XHSC20	SS316L	1/2	87	1-45	Compressed Air	0-8 cfm
XHSJ10	SS316L	1/4	7-130	5-45	32.5% Urea	0-5 gph
XHSJ20	SS316L	1/4	7-130	5-45	32.5% Urea	0-5 gph
XHSA20	16MO3	18	0	883	Exhaust Gas	7344 acfm
XHSA30	16MO3	18	0	883	Exhaust Gas	7344 acfm
XHSA40	Carbon Steel	18	0	883	Exhaust Gas	7344 acfm

Notes:

1. Items shipped loose.
2. Tag numbers beginning with "X" will be replaced with the unit number (1,2 or 3) for construction.
Example: XHSA20CT041 will become 1HSA20CT041 for Unit 1.

ENGINEERING APPROVALS

REV NUM.	DRAWN BY	APPROVED BY	DATE	IFC SIGNATURE

This document contains material and/or informatioin which is the property of AeriNOx Inc. and is supplied only on a confidential basis. No reproductioin, transmittal, or disclosure shall be made by any person, firm, or corporation without the prior written approval of AeriNOx Inc.

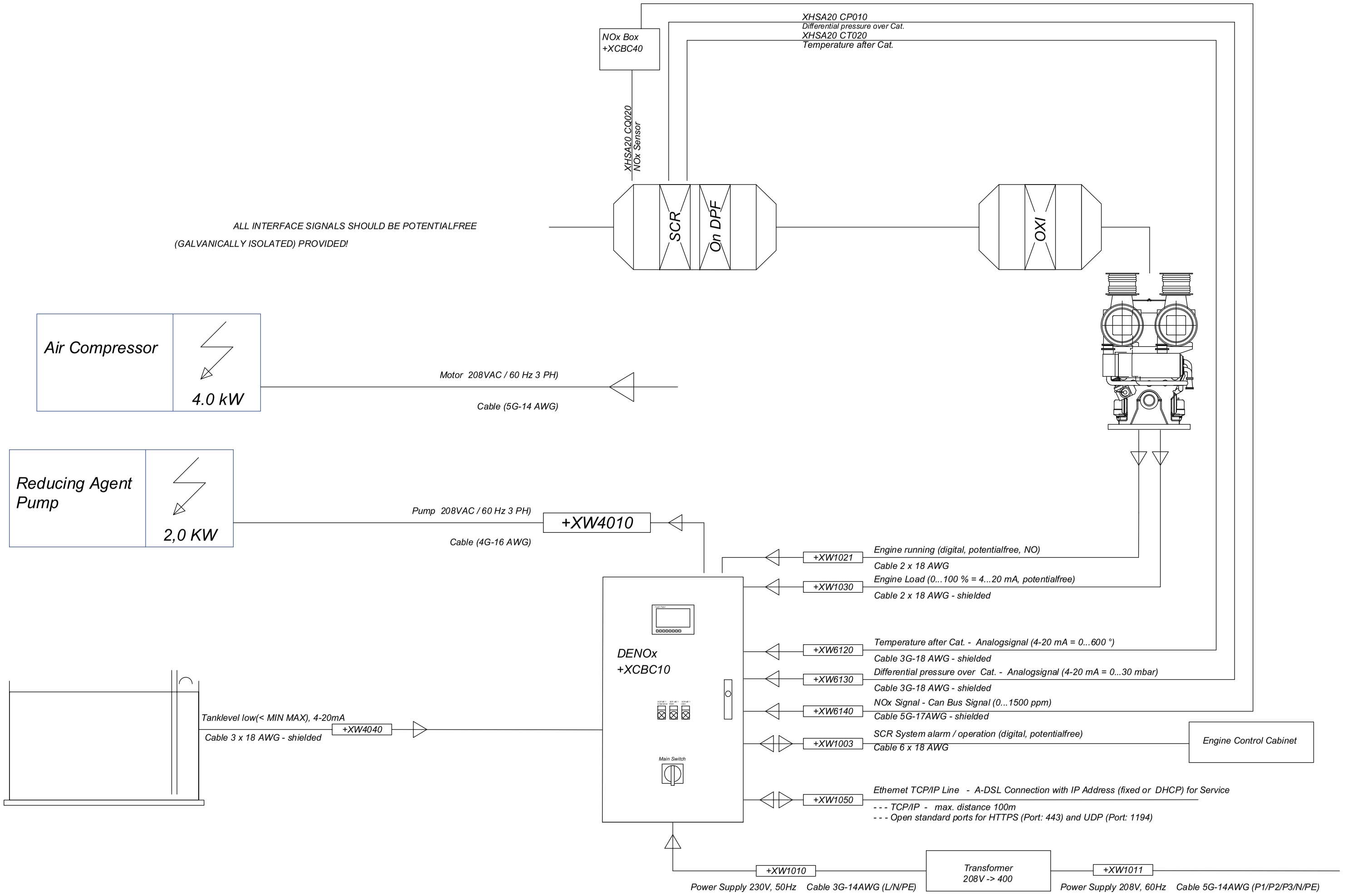
Unless Otherwise Specified:
-Dimensions are in inches.
-Dimensions shown are nominal.
For information on manufacturing tolerances contact AeriNOx Inc.

AeriNOx
A DCL and H+H Company

PO BOX 490 100 CHERRY AVE., STE 6B
EATON, CO 80615
Office: (970) 454-5639
www.AeriNOx-inc.com

		CUSTOMER	FRONTIER POWER PRODUCTS
		PROJECT	KOHLER 750REOZMD - TIER 4 EMISSIONS PROJECT
SCALE	NTS	DWG TITLE	PID SCR SYSTEM
DATE	10/13/16	DWG No.	16084-100
DWN BY	ASC	SIZE	D

REV 0 SHT 1 of 1



Notes:
1. Use shielded cables for all analog signals.
2. The "X" in the applicable tag numbers on this sheet will be replaced with the unit number (1 or 2) for construction. Example: XW4040 will be come 1W4040 for unit 1.

ENGINEERING APPROVALS

REV NUM.	DRAWN BY	APPROVED BY	DATE	IFC SIGNATURE

This document contains material and/or informatioin which is the property of AeriNOx Inc. and is supplied only on a confidential basis. No reproductioin, transmittal, or disclosure shall be made by any person, firm, or corporation without the prior written approval of AeriNOx Inc.

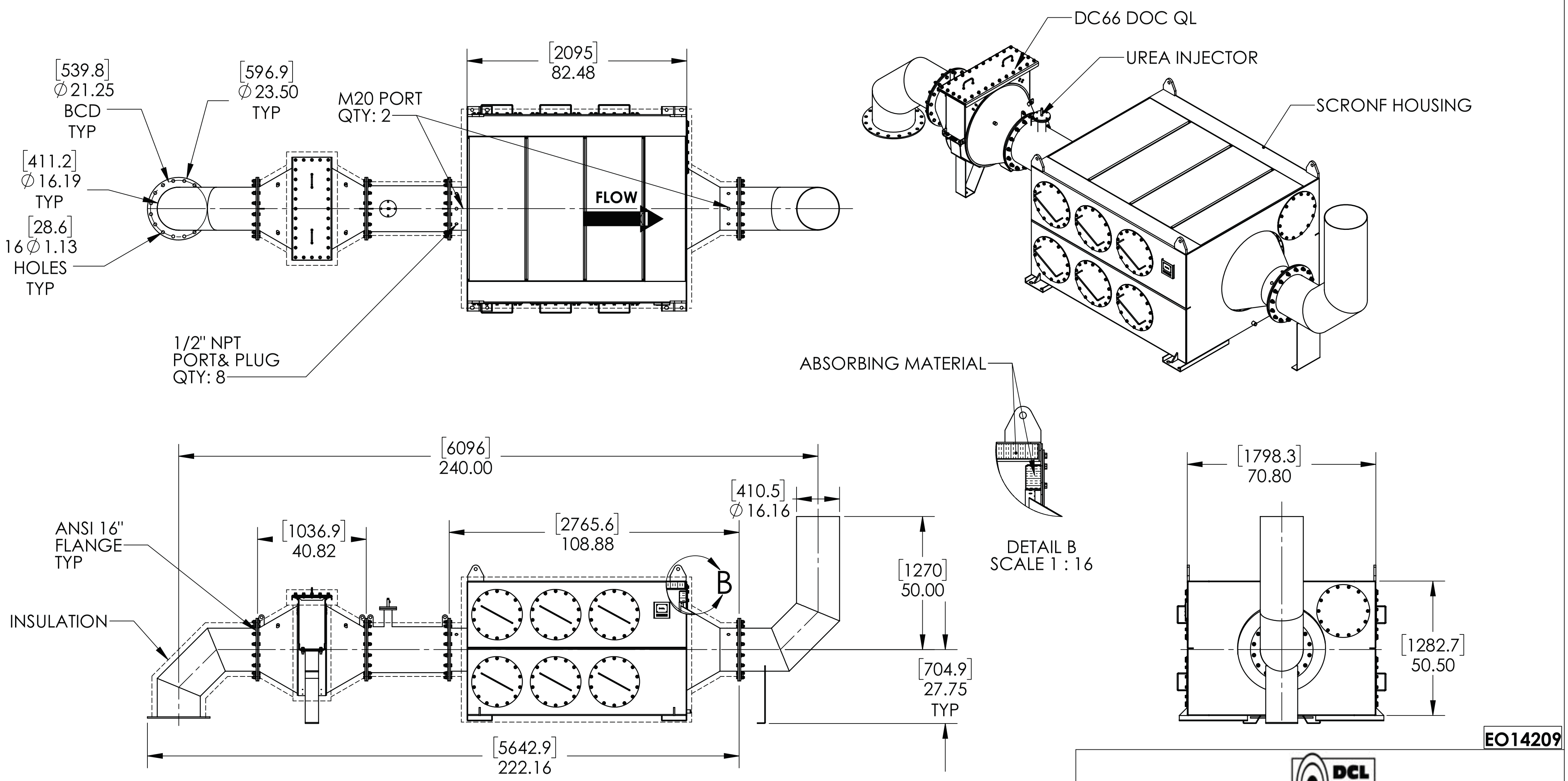
Unless Otherwise Specified:
-Dimensions are in inches.
-Dimensions shown are nominal.
For information on manufacturing tolerances contact AeriNOx Inc.

AeriNOx
A DCL and H+H Company
PO BOX 490 100 CHERRY AVE., STE 6B
EATON, CO 80615
Office: (970) 454-5639
www.AeriNOx-inc.com

		CUSTOMER	FRONTIER POWER PRODUCTS
		PROJECT	KOHLER 750REOZMD - TIER 4 EMISSIONS PROJECT
SCALE	NTS	DWG TITLE	CABLE BLOCK DIAGRAM
DATE	10/13/16	DWG No.	16084-150
DWN BY	ASC	SIZE	D

REV 0 SHT 1 of 1

PRELIMINARY CONCEPT
ALL DIMENSIONS FOR REFERENCE ONLY



MATERIAL:
1. DOC QL. INJECTOR&MIXING DUCT-STAINLESS STEEL
2. SCRonF HOUSING : 409SS
3. STACK PIPE& ALL FLANGES: CARBON STEEL
4. HARDWARE: PLATED CARBON STEEL

WELDING & ASSEMBLY PER DCL
ENGINEERING STANDARD-E101
UNLESS OTHERWISE NOTED

0	INITIAL RELEASE	CT	16/09/15	
NO	REVISION	DRAWN BY	DATE	CHK'D BY

DCL International Inc.

UNLESS OTHERWISE NOTED
1. REMOVE ALL BURRS AND SHARP EDGES
2. DIMENSIONS ARE IN INCHES
3. [ ] DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
.X ±.2 [-] ±5
.XX ±.10 [.X] ±2.5
.XXX ±.060 [.XX] ±1.50
ANGULAR TOLERANCE ±2°

THIRD ANGLE PROJECTION

DCL INTERNATIONAL INC. RESERVES PROPRIETARY RIGHTS TO THIS DRAWING AND THE DATA SHOWN THEREON AND SUBMITS IT IN CONFIDENCE ONLY. SAID DATA AND/OR DRAWING ARE NOT TO BE USED OR REPRODUCED FOR ANY PURPOSE WITHOUT THE EXPRESS CONSENT OF DCL INTERNATIONAL INC.

TITLE: **10-SCR4.9-16 ON FILTER**
ORIG. P/N:
APPLICATION: **MITSUBISHI S12A2-Y2PTAW-2(1207BHP)**
ENGINE:
DATE: **16/09/15**
DRAWN BY: **CT**
CHECKED BY:
PART NO. **10-SCF4.9-16_EO14209**
PAPER SIZE:
SCALE: **1:36**
FILE NAME: **10-SCF4.9-16_EO14209**

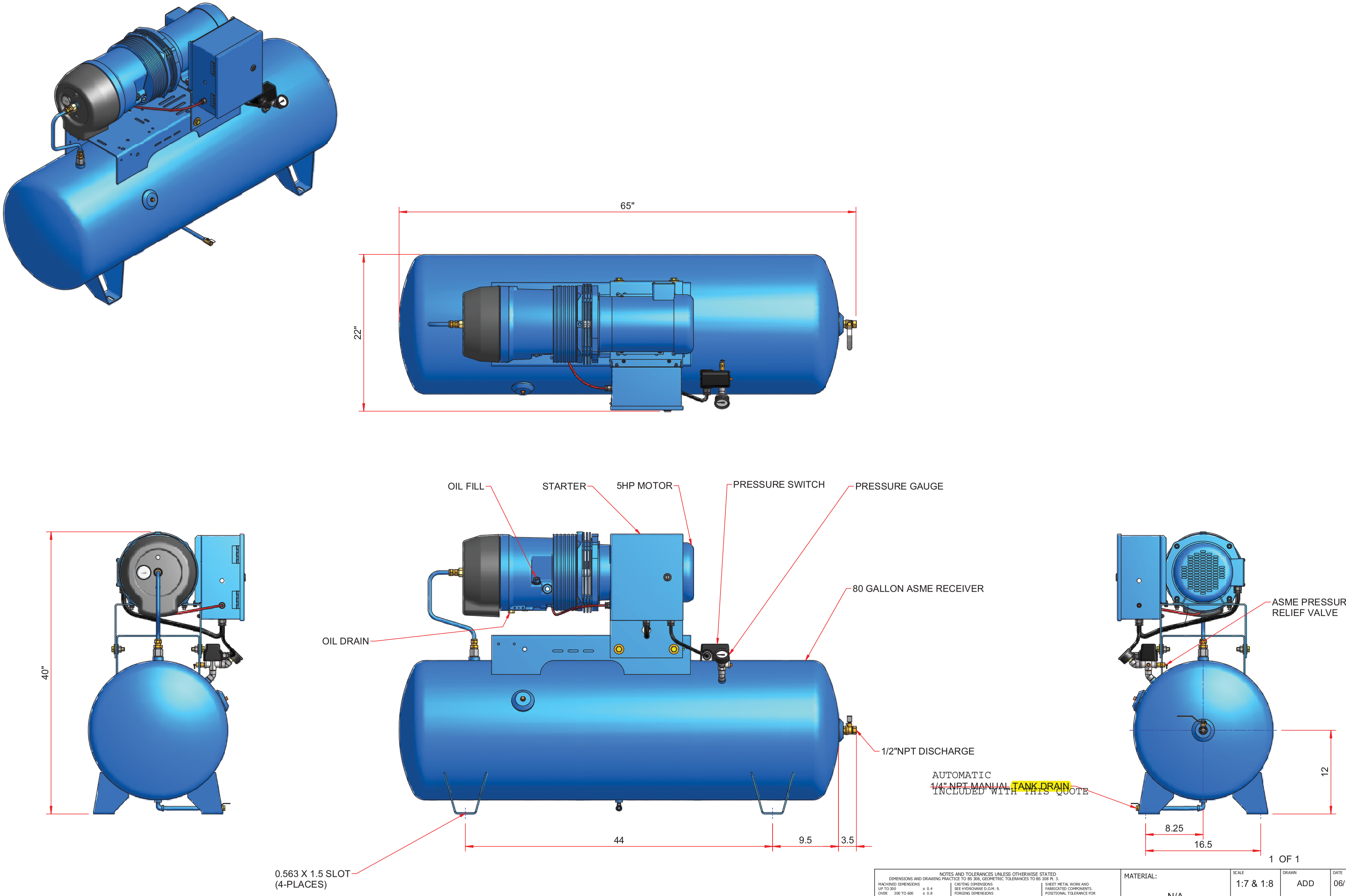
PROJECTION - THIRD ANGLE
ALL DIMENSIONS IN [redacted] INCHES

DO NOT SCALE

REMOVE ALL BURRS AND SHARP EDGES

ISSUE	A NOTE	DATE	INITIALS
A		06.11.09	ADD

MODIFICATION
INITIAL ISSUE



1 OF 1

NOTES AND TOLERANCES UNLESS OTHERWISE STATED
DIMENSIONS AND DRAWING PRACTICE TO BS 308, GEOMETRIC TOLERANCES TO BS 308 Pt. 3.

MACHINED DIMENSIONS
UP TO 300 ± 0.4
OVER 300 TO 600 ± 0.8
OVER 600 ± 1.6
POSITIONAL TOLERANCE
PLAIN HOLES Ø 0.13
TAPPED HOLES Ø 0.26
CONCENTRICITY TOLERANCE
0.13 TIR
MACHINED SURFACES
INDICATED THUS ✓
SURFACE TEXTURE TO BS 1134,
VALUES IN MICROMETRES.

CASTING DIMENSIONS
SEE HYDROVANE D.O.M. 9.
FORGING DIMENSIONS
SEE BS 4114.
ANGLES ± 1/2° (EXCEPT CHAMFERS).
METRIC THREADS
TO BS 3643 MEDIUM CLASS
EXTERNAL 6g INTERNAL 6H.
PIPE THREADS
PRESSURE TIGHT TO BS 21
FASTENING TO BS 2779.
SEE HYDROVANE D.O.M. 19.
UNIFIED THREADS TO BS 1580.

SHEET METAL WORK AND
FABRICATED COMPONENTS.
POSITIONAL TOLERANCE FOR
PLAIN & TAPPED HOLES Ø1.0
SHEET METAL WORK DIMENSIONS ± 1.0
FABRICATED PARTS DIMENSIONS ± 1.0
WELDING SYMBOLS TO BS 499.
RECEIVERS:-

MACHINING	FABRICATION
UNDER 600 ± 0.3	UNDER 100 ± 0.5
OVER 600 ± 0.8	100-300 ± 1.0
ANGLES ± 1.5°	300-600 ± 1.5
	OVER 600 ± 2.0
	ANGLES ± 1.5°

ALL DIMENSIONS ARE FINISHED DIMENSIONS

MATERIAL:
N/A

CSA COMPLIANT

SCALE
1:7 & 1:8

DRAWN
ADD

DATE
06/11/2009

TITLE
INSTALLATION_V04PURHS-8

DRAWING No.
CZ35270

hydrovane

GARDNER DENVER LTD., REDDITCH, WORCESTERSHIRE, ENGLAND OWNS THE COPYRIGHT OF THIS DRAWING WHICH IS SUPPLIED IN CONFIDENCE AND MUST NOT BE USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SUPPLIED AND MUST NOT BE REPRODUCED WITHOUT PERMISSION IN WRITING FROM THE OWNERS.

FIRST USE
V04PURHS-8

HYD.A1

hydrovane

V01 - V07 Technical Information Sheet (Air Cooled 60Hz)

TIS/60Hz/
05/2010

Performance Data	Model	V01		V04		V05		V07	
Performance	**psig**	**100**	**150**	**100**	**150**	**100**	**150**	**100**	**150**
F.A.D.	**cfm**	6.3	4.5	19.5	16	NA	22.0	NA	28.9
Total Input Power (when compressor is new)	**kW**	1.7	1.8	4.9	4.8	-	7.0	-	8.6
Total Input Power (after 500 operating hours)	**kW**	1.6	1.7	4.6	4.5	-	6.6	-	8.2
Off-Load Power	**kW**	1.7	1.8	4.9	4.8	-	7.0	-	8.6

Compressor Details		V01	V04	V05	V07
Noise level	**dB(A)**	65	72	73	73
Power	**hp (kW)**	2 (1)	5.5 (4)	7.5 (5.5)	10 (7.5)
Starter Type		Automatic Direct-On-Line			
Operating Controls		Automatic Stop/Start		Automatic Stop/Start or Continuous Run	
Air End Rotation Speed	**rpm**	1760			
Oil Capacity	**Gallons**	0.30	0.50	1.10	
Air Discharge Temperature (above ambient)	**°F**	15 - 20°F (approach temp.)			

Installation		V01	V04	V05	V07
Air Outlet Size	**NPT**	1/2			
Phase	**ph**	Single phase or Three phase			Three phase
Available Motor Voltages	**V**	208 / 230 / 460			
Ambient Temperature Range	**°F**	32 - 104°F			

Electrical Data		V01	V04	V05	V07
Starter		***Single phase - Direct-On-Line***			
Electrical Supply	**Voltage**	230V	230V	230V	n/a
Suggested Incoming Supply Cable *	**Rating**	12 AWG	8 AWG	8 AWG	n/a
110% Full Line Current	**Amps**	10.6	25.3	34.3	n/a
Motor Efficiency (at 100% Duty)	**%**	78	82.5	85.5	n/a

Electrical Data		V01	V04	V05	V07
Starter		***Three phase - Direct-On-Line***			
Electrical Supply	**Voltage**	208 - 230V	208 - 230V	208 - 230V	208 - 230V
Suggested Incoming Supply Cable *	**Rating**	14 AWG	12 AWG	8 AWG	8 AWG
110% Full Line Current	**Amps**	6.4	15	24.2	35.4
Motor Efficiency (at 100% Duty) **	**%**	84	89.5	89.5	89.5

Electrical Supply	**Voltage**	460V	460V	460V	460V
Suggested Incoming Supply Cable *	**Rating**	14 AWG	14 AWG	12 AWG	12 AWG
110% Full Line Current	**Amps**	3.1	7.15	11.1	14.85
Motor Efficiency (at 100% Duty) **	**%**	84	89.5	89.5	89.5

Motor Data		V01	V04	V05	V07
Motor Service Factor		1.15			
Standard Drive Motor Detail	**NEMA**	TEFC			

Model Dimensions	Overall Lenth (in.)	Overall Width (in.)	Overall Height (in.)	Overall Weight (lbs.)
V01PUTS	30	11	18	130
V01PURHS-3	41	19	34	240
V04PUTS	42	24	24	315
V04PURVS-8	38	26	66	570
V04PURHS-8	65	22	40	425
V05PURVS-8	39	26	69	695
V05PURHS-8	66	22	43	550
V07PURHS-8	66	22	43	670
V04PDRHS-12	72	27	48	845
V05PDRHS-12	76	27	50	1210
V07PDRHS-12	76	27	50	1325

* Based on 75°C conductor temperature rating, copper wire (insulated), and 104°F ambient. Does not account for voltage drop.

** V04PUTS 3-phase motor efficiency @ 100% duty is 87.5%.

hydrovane

FILTER TYPE		FIL12 (Grade)	FIL14 (Grade)	FIL16 (Grade)	FIL18 (Grade)	FIL20 (Grade)
REPLACEMENT ELEMENT		FIL12 (Grade)E	FIL14 (Grade)E	FIL16 (Grade)E	FIL18 (Grade)E	FIL20 (Grade)E
NOMINAL AIR FLOW	SCFM @ 100 psig (m^3/hr @ 7.0 bar)	20 (35)	35 (60)	60 (105)	100 (170)	170 (250)
IN/OUT CONNECTION	in. (NPT/BSP)	3/8, 1/2	3/8, 1/2	3/8, 1/2	3/4, 1	3/4, 1
"A"	in., (mm)	4.13, (105)	4.13, (105)	4.13, (105)	5.25, (133)	5.25, (133)
"B"	in, (mm)	7.875, (200)	10.05, (255)	12.40, (316)	13.32, (338)	17.57, (446)
"C"	in, (mm)	6.40, (163)	8.59, (219)	10.97, (285)	11.74, (298)	15.99, (406)
"D"	in, (mm)	3.00, (76)	3.00, (76)	3.00, (76)	3.50, (89)	3.50, (89)
WEIGHT	lb/(kg)	4.2/(2.9)	8.1/(3.67)	8.5/(3.86)	6.3/(2.9)	6.9/(3.1)
MWP SEE NOTES#1, 2	psig/(bar)	300/(21)	300/(21)	300/(21)	300/(21)	300/(21)
MAXIMUM OPERATING TEMP.	°F/(°C)	150/(65)	150/(65)	150/(65)	150/(65)	150/(65)
HEAD MATERIAL		ZINC	ZINC	ZINC	ALUMINUM	ALUMINUM
BOWL MATERIAL		ALUMINUM	ALUMINUM	ALUMINUM	ALUMINUM	ALUMINUM
LLI MATERIAL (OPTIONAL)		ISOPLAST	ISOPLAST	ISOPLAST	ISOPLAST	ISOPLAST

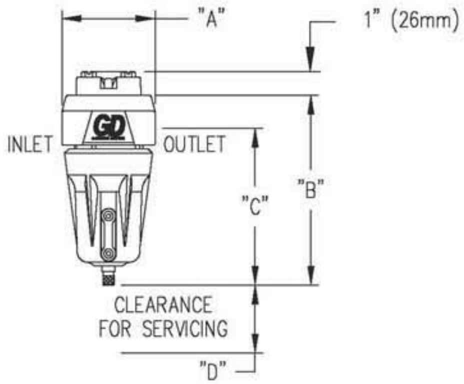
B

REVISIONS

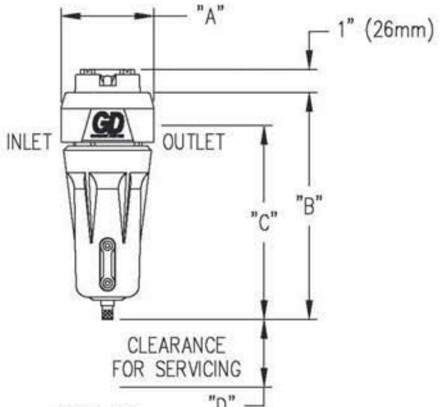
ZONE	REV	DESCRIPTION	DATE	DWN	CHK
	A	REF TO ECF-010620-DDB-01	7/6/01	RDP	DDB
	B	REF TO ECF-010816-DDB-01	8/17/01	RDP	DDB

NOTES & SPECIFICATIONS

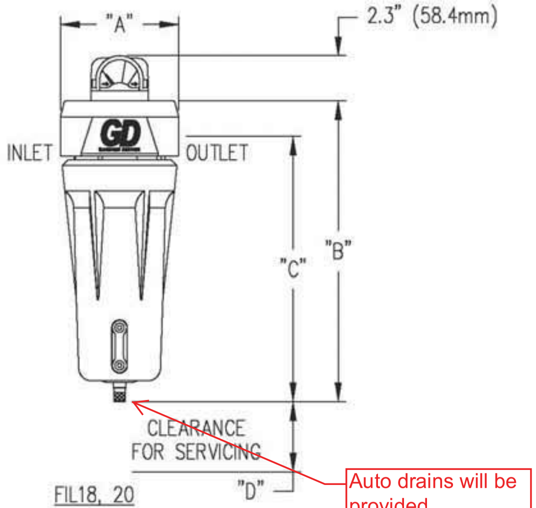
1. MWP – MAXIMUM WORKING PRESSURE.
2. FILTER ASSEMBLIES WITH AN LLI OR AN AUTOMATIC FLOAT DRAIN INSTALLED WILL HAVE A MWP OF 250 psi (17 bar).
3. CONSULT FACTORY FOR BSP TYPE INLET/OUTLET CONNECTIONS.



FIL12



FIL14, 16



FIL18, 20

Auto drains will be provided

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOL. ON FRACTIONS: ± 1/16"
TOL. ON DECIMALS: ± .03" (2 PLACE)
TOL. ON DECIMALS: ± .015" (3 PLACE)
TOL. ON ANGLES: ± .5°
THIRD ANGLE PROJECTION

ENG. REF:
DIMENSIONING AND TOLERANCES PER ASME Y14.5M–1994

HEAT TREATMENT

Gardner Denver Inc.
Quincy, Il.

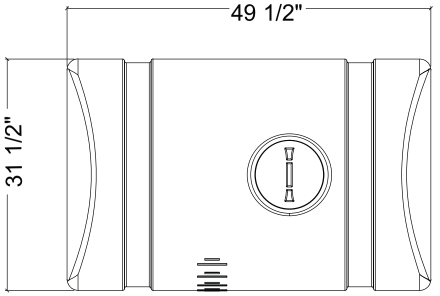
FILTER DATA
FIL12 THRU FIL20

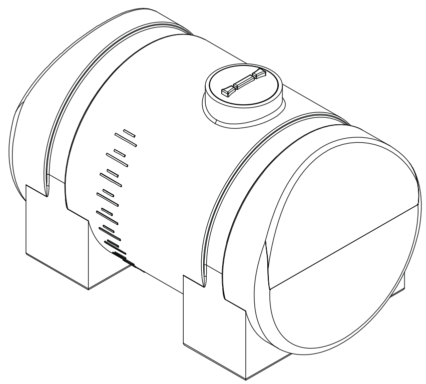
DWN BY RDP 5/10/01
CK'D BY DDB 5/10/01

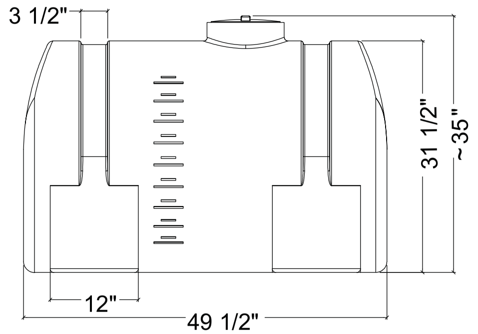
SIZE B
ENGR. APPROVAL DDB
DWG NO. GA23GAR–0001
REV B
SCALE NONE
SHEET 1 of 1

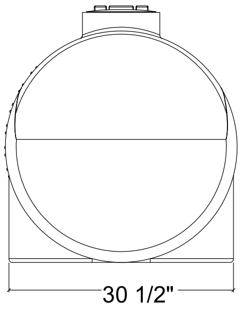
CONFIDENTIAL – THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE PROPERTY OF GARDNER DENVER, INC. IT IS NOT FOR PUBLIC DISCLOSURE. POSSESSION OF THE INFORMATION DOES NOT CONVEY ANY RIGHT TO LOAN, SELL OR DISCLOSE THE INFORMATION. UNAUTHORIZED REPRODUCTION OR USE OF THE INFORMATION IS PROHIBITED. THIS DOCUMENT IS TO BE RETURNED TO GARDNER DENVER, INC. UPON THE COMPLETION OF THE PURPOSE FOR WHICH IT IS LOANED OR UPON REQUEST. TAP DRILL DEPTHS ARE MAXIMUM. FULL THD DEPTHS ARE MINIMUM. UNLESS OTHERWISE SPECIFIED MACH. DIM ±.02
FINISH OF CHAMFERS & FILLETS TO CONFORM TO ROUGHEST ADJACENT AREA SURFACE ROUGHNESS MAX. PER ASA SPEC.

MATERIALS LIST		
ITEMS	DESCRIPTION	NOTES
1	IHFS-125	
2	8" THREADED MCPHEE LID	









NOTES:

1. TANK IS MANUFACTURED FROM HDPE. (1.5 SG)
2. TANK IS MANUFACTURED TO ASTM-D-1998 STANDARD.
3. ACO RECOMMENDS ALL FLANGE GASKETS TO BE MIN. 1/4" THICK.
4. ALL FITTING GASKETS ARE EPDM.
5. INCLUDES (4) 2 IN NPT FITTINGS LOCATIONS TBD.

ENGINEERING APPROVALS

REV NUM.	DRAWN BY	APPROVED BY	DATE	IFC SIGNATURE

This document contains material and/or informatioin which is the property of AeriNOx Inc. and is supplied only on a confidential basis. No reproductioin, transmittal, or disclosure shall be made by any person, firm, or corporation without the prior written approval of AeriNOx Inc.

Unless Otherwise Specified:
-Dimensions are in inches.
-Dimensions shown are nominal.
For information on manufacturing tolerances contact AeriNOx Inc.

AeriNOx
A DCL and H+H Company
PO BOX 490 100 CHERRY AVE., STE 6B
EATON, CO 80615
Office: (970) 454-5639
www.AeriNOx-inc.com

		CUSTOMER	FRONTIER POWER PRODUCTS
		PROJECT	KOHLER 750REOZMD - TIER 4 EMISSIONS PROJECT
SCALE	NTS	DWG TITLE	UREA TANK, 150 GAL HORIZONTAL
DATE	10/13/16	DWG No.	500150H
DWN BY	ASC	SIZE	D

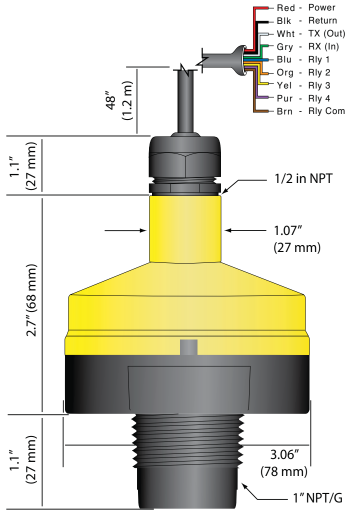
REV 0 SHT 1 of 1

EchoPod®

2.5m Ultrasonic Level Switch, Controller and Transmitter

Introducing EchoPod

The general purpose, ultrasonic sensor provides non-contact level detection up to 98.4” (2.5m) with 4 SPST 60 VA 1A relays and a two-wire 4-20 mA level measurement output. Each relay can be configured on a single set point alarm or latched on two sets for automatic fill or empty in simplex or duplex control modes with fail-safe logic. The embedded controller can replace external control hardware. The sensor is well suited for a wide range of corrosive, sticky or dirty type media. EchoPod is broadly selected for day tanks, sumps, IBC totes, lift stations and mini-bulk storage applications. To configure EchoPod, download our free WebCal software and purchase one USB interface tool.



U.S. Patent #: 7,098,669

Specifications

Range:	98.4” (2.5 m)
Accuracy:	+/- 0.2 % range
Resolution:	0.019" (0.5 mm)
Beam width:	2" (5 cm)
Dead band:	4" (10 cm)
Supply voltage:	24 VDC (loop)
Loop resistance:	400Ω max
Consumption:	0.5W
Signal output:	4-20 mA , two-wire (when loop powered)
Contact type:	(4) SPST relays 1A
Loop fail-safety:	4 mA, 20 mA, 21 mA, 22 mA or hold last
Relay fail-safety:	Power loss: Hold last Echo loss: Open, close or hold last
Hysteresis:	Selectable
Configuration:	WebCal® PC Windows® USB 2.0
Temp. comp.:	Automatic over range
Process Temp.:	F: -20˚ to 140˚ C: -7˚ to 60˚
Pressure:	MWP = 30 PSI
Enclosure:	Type 6P encapsulated, corrosion resistant & submersible
Encl. material:	PC
Strain relief mat.:	Santoprene
Trans. material:	PVDF
Cable length:	48” (1.2 m)
Cable jacket mat.:	Polyurethane
Process mount:	1" NPT (1" G)
Mount. gasket:	Viton®
Classification:	General purpose
Approvals:	CE
Compliance:	RoHS

Features

☑ Multi-function sensor provides 4-20 mA measurement, switch and control functions Compact sensor with 2” beam width and 4” dead band optimized for small tank applications

☑ Four 1A relays programmable for switch or advanced pump or valve control and fail-safety

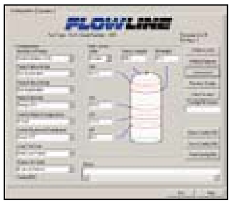
☑ Rugged PVDF transducer and polycarbonate enclosure rated 6P for corrosive applications

☑ Control / switch point functions include:

- 2 pumps with 2 alarms
- 1 pump with 3 alarms
- 2 pumps (lead-lag) with 2 alarms
- 2 pumps (duplexing) with 2 alarms
- 4 independent switch point alarms

Configuration

EchoPod is user configured via our WebCal software through the Fob USB interface tool. Configuration files can be easily created, saved, copied into one or more units, emailed or modified. Take control of your level process with WebCal’s intuitive interface, pre-programmed menus, tank set point graphics and custom wiring diagrams for each configuration. Click here to learn more about WebCal. Its level made simple.



WebCal Software

LI99-1001
Shown

EchoPod Ordering

DL24-☐☐

Process mount
0 NPT (US)
1 G (Metric)

Fob USB interface (1),(2)
0 Without Fob
1 With Fob

Ordering Notes

1) EchoPod can not be configured without the Fob USB interface tool (LI99-1001) and WebCal. One Fob will configure all EchoPods.

2) WebCal is a free download from our website at www.flowline.com/webcal (Windows® XP Compatible).

© 2009 Flowline Inc.

EchoPod
DL14, DL24 & DL34 Series
Manual
Revision A.3


DL24-00 Shown

Flowline Inc.
10500 Humbolt Street
Los Alamitos, CA 90720
Tel: (562) 598-3015
Fax: (562) 431-8507
www.flowline.com

Preface

This manual explains how to use the EchoPod DL14, DL24 and DL34 series level switch, controller and transmitter.

Warranty, Service & Repair

To register your product with the manufacturer, go to the Flowline website for on-line registration. The website address is as follows:

www.flowline.com

On-line Warranty Registration can be found on the Flowline home page.

If for some reason your product must be returned for factory service, go to the Flowline website to receive a Material Return Authorization number (MRA), providing the following information:

1. Full Part Number, Full Serial Number
2. Name and telephone number of someone who can answer technical questions related to the product and its application.
3. Return Shipping Address
4. Brief Description of the Symptom
5. Brief Description of the Application

On-line Material Return Authorization can be found under Contact Us in the Navigation Bar along the side of the home page. Click on *Return Authorization* to begin the MRA request. Once you have received a MRA number, ship the product prepaid in its original packing to:

Flowline Factory Service
MRA_____
10500 Humbolt Street
Los Alamitos, CA 90720

To avoid delays in processing your repair, write the MRA on the shipping label. Please include the information about the malfunction with your product. This information enables our service technicians to process your repair order as quickly as possible.

Warranty

Flowline warrants to the original purchaser of its products that such products will be free from defects in material and workmanship under normal use and service in accordance with instructions furnished by Flowline for a period, which is equal to the shorter of one year from the date of purchase of such products or two years from the date of manufacture of such products. Flowline's obligation under this warranty is solely and exclusively limited to the repair or replacement, at Flowline's option, of the products or components, which Flowline's examination determines to its satisfaction to be defective in material or workmanship within the warranty period. Flowline must be notified pursuant to the instructions below of any claim under this warranty within thirty (30) days of any claimed lack of conformity of the product. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original warranty period.

Returns

Products cannot be returned to Flowline without Flowline's prior authorization. To return a product that is thought to be defective, go to www.flowline.com, and submit a customer return (MRA) request form and follow the instructions therein. All warranty and non-warranty product returns to Flowline must be shipped prepaid and insured. Flowline will not be responsible for any products lost or damaged in shipment.

Limitations

This warranty does not apply to products which: 1) are beyond the warranty period or are products for which the original purchaser does not follow the warranty procedures outlined above; 2) have been subjected to electrical, mechanical or chemical damage due to improper, accidental or negligent use; 3) have been modified or altered; 4) anyone other than service personnel authorized by Flowline have attempted to repair; 5) have been involved in accidents or natural disasters; or 6) are damaged during return shipment to Flowline. Flowline reserves the right to unilaterally waive this warranty and dispose of any product returned to Flowline where: 1) there is evidence of a potentially hazardous material present with the product; or 2) the product has remained unclaimed at Flowline for more than 30 days after Flowline has dutifully requested disposition. This warranty contains the sole express warranty made by Flowline in connection with its products. ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED. The remedies of repair or replacement as stated above are the exclusive remedies for the breach of this warranty. IN NO EVENT SHALL FLOWLINE BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND INCLUDING PERSONAL OR REAL PROPERTY OR FOR INJURY TO ANY PERSON. THIS WARRANTY CONSTITUTES THE FINAL, COMPLETE AND EXCLUSIVE STATEMENT OF WARRANTY TERMS AND NO PERSON IS AUTHORIZED TO MAKE ANY OTHER WARRANTIES OR REPRESENTATIONS ON BEHALF OF FLOWLINE. This warranty will be interpreted pursuant to the laws of the State of California. If any portion of this warranty is held to be invalid or unenforceable for any reason, such finding will not invalidate any other provision of this warranty.

Introduction:

The EchoPod is a general-purpose ultrasonic level switch, controller and transmitter that provides a loop powered 4-20 mA output and 4 SPST 60 VA relays. The 4-20 mA output can be used to provide the proportional level of liquid in any tank or vessel. The 4 relays can be used to control multiple combinations of pumps, valves and/or alarms. The signal can be connected to any device that accepts a loop powered 4-20 mA signal or relay output, such as a PLC, SCADA, DCS, display, controller, etc.

New Features

- Simple configuration with WebCal software, ***no more target calibration***
- Adjustable Loop Fail-Safe, Hold Last, Empty, Full, 21 mA, 22 mA
- Easy to reverse mA output, 4-20 mA to 20-4 mA
- Adjustable start-up condition, Empty, Mid (12 mA), Full, Over range (22 mA)
- Increased output filtering

Table of Contents

About this Manual:

PLEASE READ THE ENTIRE QUICK START PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on the EchoPod series Ultrasonic Level Switch, controller and transmitter from FLOWLINE. Please refer to the part number located on the switch label to verify the exact model configuration, which you have purchased.

User's Responsibility for Safety:

FLOWLINE manufactures a broad range of level sensing technologies. While each of these sensors is designed to operate in a wide variety of applications, it is the user's responsibility to select a sensor model that is appropriate for the application, install it properly, perform tests of the installed system, and maintain all components. The failure to do so could result in property damage or serious injury.

Proper Installation and Handling:

Only professional staff should install and/or repair this product. Install the transmitter with the included Viton® gasket and never over tighten the transmitter within the fitting. Always check for leaks prior to system start-up.

Wiring and Electrical:

A supply voltage of 12 to 28 VDC is used to power the EchoPod. Electrical wiring of the transmitter should be performed in accordance with all applicable national, state, and local codes.

Material Compatibility:

The enclosure is made of Polycarbonate (PC). The transducer is made of Polyvinylidene Fluoride (PVDF). Make sure that the model, which you have selected, is chemically compatible with the application media.

Enclosure:

While the transmitter housing is liquid-resistant the EchoPod is not designed to be operational when immersed. It should be mounted in such a way that the enclosure and transducer do not come into contact with the application media under normal operational conditions.

Safety:

- Installation should be done by properly trained staff
- Supply voltage should never exceed a maximum of 28 VDC
- Make sure the sensor is chemically compatible with your application
- Design a fail-safe system that accommodates the possibility of sensor and/or power failure
- This sensor should not be used in classified hazardous environments

Make a Fail-Safe System:

Design a fail-safe system that accommodates the possibility of transmitter and/or power failure. FLOWLINE recommends the use of redundant backup systems and alarms in addition to the primary system.

Flammable, Explosive or Hazardous Applications:

EchoPod should not be used within classified hazardous environments.

Warning:

Always use the Viton® gasket when installing the EchoPod, and make sure that all electrical wiring of the switch is in accordance with applicable codes.

Components:

EchoPod is offered in two different models. Depending on the model purchased, you may or may not have been shipped all the components shown below. You do however, need an EchoPod, USB® Fob and Viton® gasket to configure, install and operate EchoPod.

- EchoPod
    - DL14-00 – 4.1’ (1.25 m) range, Type 6P encl., 1” NPT
    - DL14-01 – 4.1’ (1.25 m) range, Type 6P encl., 1” NPT w/ Fob
    - DL14-10 – 4.1’ (1.25 m) range, Type 6P encl., 1” G
    - DL14-11 – 4.1’ (1.25 m) range, Type 6P encl., 1” G w/ Fob
    - DL24-00 – 9.8’ (3.0 m) range, Type 6P encl., 1” NPT
    - DL24-01 – 9.8’ (3.0 m) range, Type 6P encl., 1” NPT w/ Fob
    - DL24-10 – 9.8’ (3.0 m) range, Type 6P encl., 1” G
    - DL24-11 – 9.8’ (3.0 m) range, Type 6P encl., 1” G w/ Fob
    - DL34-00 – 18.0’ (5.5 m) range, Type 6P encl., 2” NPT
    - DL34-01 – 18.0’ (5.5 m) range, Type 6P encl., 2” NPT w/ Fob
    - DL34-10 – 18.0’ (5.5 m) range, Type 6P encl., 2” G
    - DL34-11 – 18.0’ (5.5 m) range, Type 6P encl., 2” G w/ Fob
- Viton® Gasket
    - Part #200128 – used with DL14 series
    - Part #200129 – used with DL24 series
    - Part #204038 – used with DL34 series
- USB® Fob (DL_4-_1 only)
    - Part #LI99-1001
- Quick Start Guide

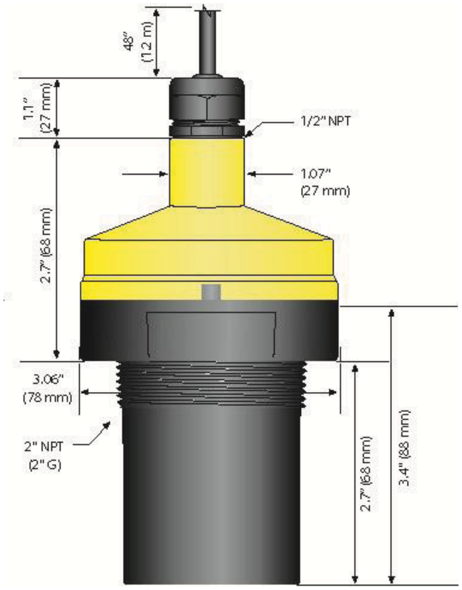
Specifications:

Range:	DL14: 2" to 4.1’ (5 cm to 1.25m) DL24: 4" to 9.8’ (10 cm to 3.0m) DL34: 8" to 18.0’ (20 cm to 5.5m)
Accuracy:	DL14: 0.125” (3mm) DL24: +/- 0.2% of range DL34: +/- 0.2% of range
Resolution:	DL14: 0.019” (0.5mm) DL24: 0.039” (1mm) DL34: 0.079” (2mm)
Beam width:	DL14/24: 2” (5cm) dia. DL34: 3” (7.6cm)
Dead band:	DL14: 2” (5 cm) DL24: 4” (10 cm) DL34: 8” (20 cm)
Memory:	Non-volatile
Supply voltage:	24 VDC (loop)
Loop resistance:	400 Ohms max
Consumption:	0.5 W
Signal output:	4-20 mA, two-wire (when loop powered)
Contact type:	(4) SPST relays 1A
Loop fail-safety:	4 mA, 20 mA, 21 mA, 22 mA or hold last

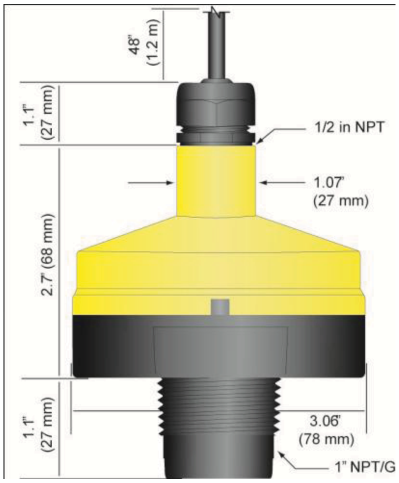
Relay fail-safety:	Power loss: Hold last Echo loss: Open, close or hold last
Hysteresis:	Selectable
Configuration:	WebCal® PC Windows® USB 2.0
Temp. comp.:	Automatic
Process temp.:	F: 20° to 140° C: -7° to 60°
Ambient temp.:	F: 31° to 140° C: -35° to 60°
Pressure:	MWP = 30 PSI
Enclosure type:	Type 6P encapsulated, corrosion resistance & submersible
Encl. material:	PC
Strain relief mat.:	Santoprene
Trans. material:	PVDF
Cable length:	48” (1.2 m)
Cable jacket mat.:	Polyurethane
Cable type:	9-cond., shielded
Process mount:	DL14/24: 1” NPT (1” G) DL34: 2” NPT (2” G)
Mount. gasket:	Viton®
Classification:	General purpose
Compliance:	RoHS
Approvals:	CE – DL14/DL24/DL34 cFMus – DL14 only

Dimensions:

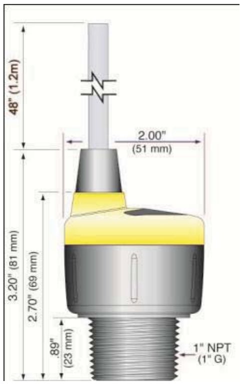
DL34 Series



DL24 Series

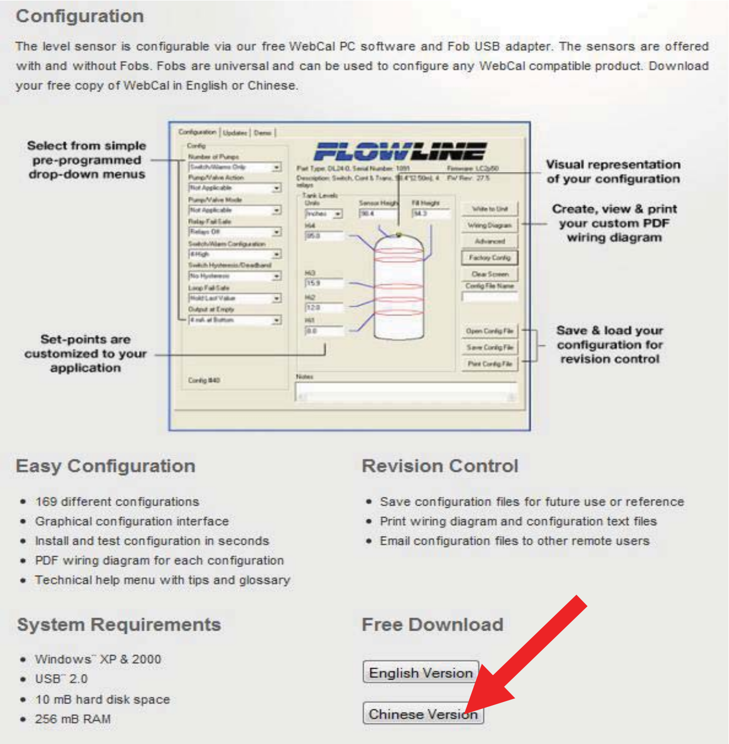


DL14 Series



Getting Started:

EchoPod is configured through WebCal, a PC software program. WebCal is a free download from Flowline's website. ***You must download and install WebCal prior to plugging in the USB® Fob.*** Please go to http://www.flowline.com, click on WebCal Software and select your language version.



Configuration

The level sensor is configurable via our free WebCal PC software and Fob USB adapter. The sensors are offered with and without Fobs. Fobs are universal and can be used to configure any WebCal compatible product. Download your free copy of WebCal in English or Chinese.

Easy Configuration

- 169 different configurations
- Graphical configuration interface
- Install and test configuration in seconds
- PDF wiring diagram for each configuration
- Technical help menu with tips and glossary

Revision Control

- Save configuration files for future use or reference
- Print wiring diagram and configuration text files
- Email configuration files to other remote users

System Requirements

- Windows™ XP & 2000
- USB™ 2.0
- 10 mB hard disk space
- 256 mB RAM

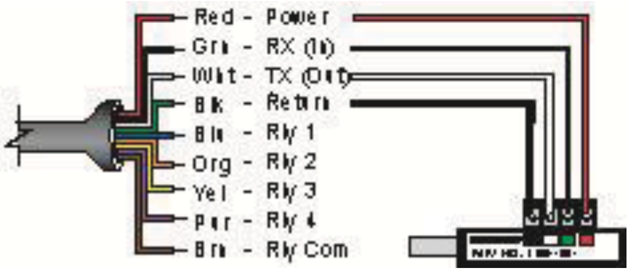
Free Download

WebCal System Requirements
Windows® XP or 2000
10 mB hard drive space
256 mB RAM
1 USB® 2.0 port
Internet connection

USB® Fob Interface

EchoSonic communicates with WebCal through a USB® interface called a Fob. Before plugging your Fob into your computer's USB® port, be sure that you have installed WebCal on your computer.

Connect the red, green, white and black wires from EchoPod into the correct terminals on the Fob. Tighten the screws on the terminals and plug your Fob into the USB® port of your computer.

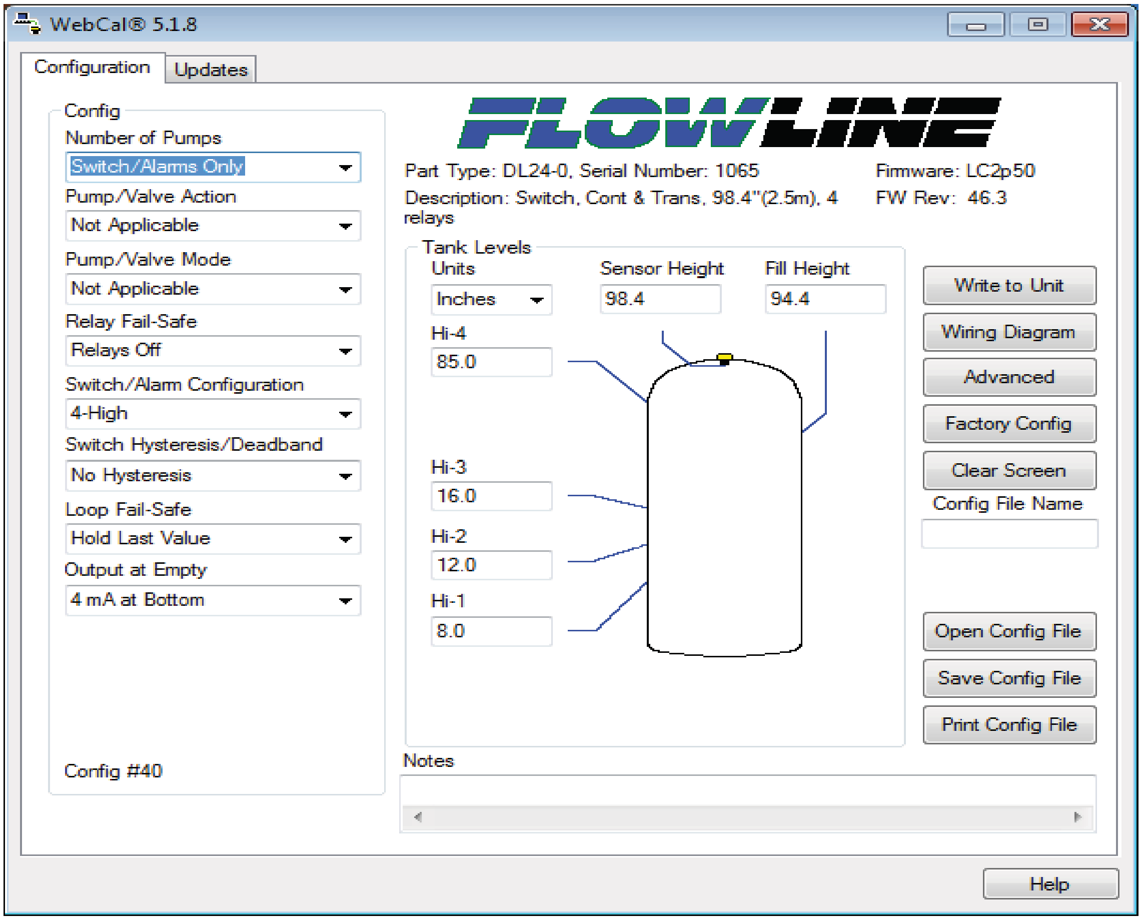


Wiring identical for all series

* Once EchoPod is configured and prior to installation, isolate the white and green wires from active power to prevent a short of the configuration circuit

WebCal

With EchoPod connected to your computer, open the WebCal software by clicking on the WebCal icon. Follow steps 1-3 to configure the transmitter. Click "Help" in the lower right hand corner and open the help menu of WebCal for additional instructions on WebCal. If you need additional assistance using WebCal, please contact a Flowline Applications engineer at (562) 598-3015



Config
Number of Pumps: Switch/Alarms Only
Pump/Valve Action: Not Applicable
Pump/Valve Mode: Not Applicable
Relay Fail-Safe: Relays Off
Switch/Alarm Configuration: 4-High
Switch Hysteresis/Deadband: No Hysteresis
Loop Fail-Safe: Hold Last Value
Output at Empty: 4 mA at Bottom
Config #40

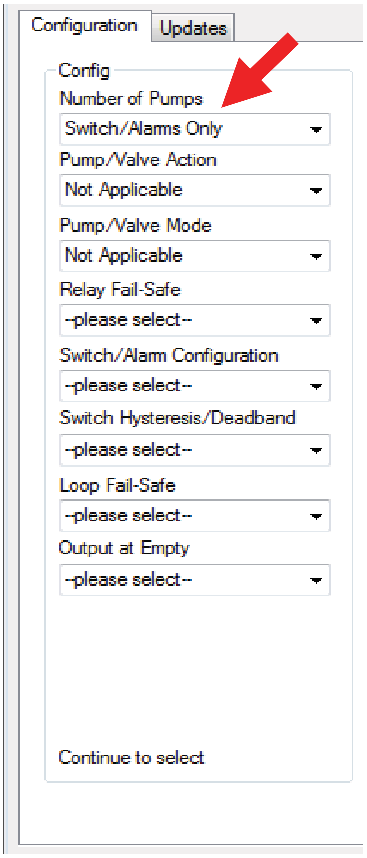
Part Type: DL24-0, Serial Number: 1065
Firmware: LC2p50
Description: Switch, Cont & Trans, 98.4"(2.5m), 4 relays
FW Rev: 46.3

Tank Levels
Units: Inches
Sensor Height: 98.4
Fill Height: 94.4
Hi-4: 85.0
Hi-3: 16.0
Hi-2: 12.0
Hi-1: 8.0

Config File Name
Notes

WebCal Step 1: Configuration

This section of WebCal is where you select the application's configuration settings. Start from the top and work to the bottom, choosing the selections that are applicable to your configuration. "***Not Applicable***" will automatically show when a selection doesn't apply to your configuration settings, and you may move on. All configuration settings must be selected or have "***Not Applicable***" before you can continue to step 2. ***Note:*** *Pressing the Clear Screen button will reset the configuration table and allow access to all of the features.*



Config

Number of Pumps: Switch/Alarms Only

Pump/Valve Action: Not Applicable

Pump/Valve Mode: Not Applicable

Relay Fail-Safe: --please select--

Switch/Alarm Configuration: --please select--

Switch Hysteresis/Deadband: --please select--

Loop Fail-Safe: --please select--

Output at Empty: --please select--

Continue to select

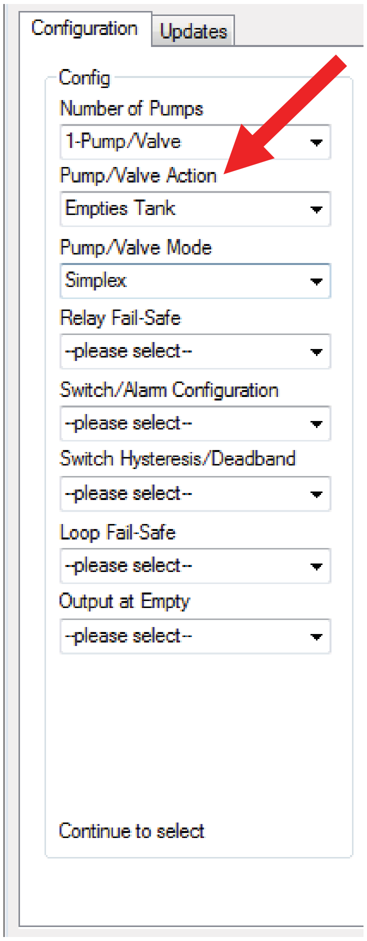
Number of Pumps

This feature allows you to select the number of pumps or valves used with EchoPod. This is the setting that activates the control capabilities of up to two relays. Control relays are often referred to as Latching relays.

- ***Switch/Alarms Only* –** The relays will be standard single point relays (High and/or Low alarms). Relays are non-latching.
- ***1- Pump/Valve*** – One relay will be configured as a control or latching relay (relay will have a start level and a separate stop level). Use this setting to control one pump or valve for automatic filling or emptying of a tank.
- ***2-Pumps/Valves*** – Two relays are configured as control or latching relays. Each relay will have a unique start level and a common stop level. Use this setting to control two pumps or valves for automatic filling or emptying of a tank.
- ***4-20mA Transmitter Only*** – This setting will disengage all of the relays. Use this function if you are not using any relays and using only the 4-20 mA current output.

Note: *Right click on any menu that you may have questions on to open the help menu.*

Note: *To reset, press the Clear Screen button.*



Config

Number of Pumps
1-Pump/Valve

Pump/Valve Action
Empties Tank

Pump/Valve Mode
Simplex

Relay Fail-Safe
--please select--

Switch/Alarm Configuration
--please select--

Switch Hysteresis/Deadband
--please select--

Loop Fail-Safe
--please select--

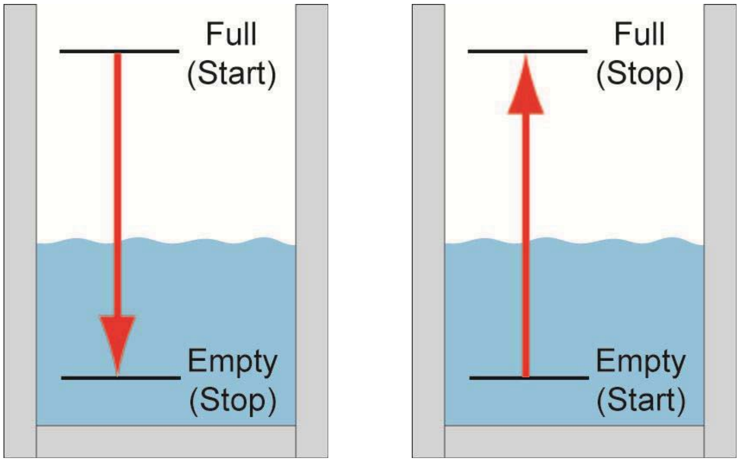
Output at Empty
--please select--

Continue to select

Pump/Valve Action

This feature allows you to select if the pumps or valves will be used to automatically fill or empty the tank. For 2-Pump/Valve mode, both devices must be the same (automatic fill or empty). You cannot set one relay for fill and the other for empty.

- ***Empties Tank*** **–** Will set relay(s) to automatically empty a tank. Start level will be above the Stop level for each relay.
- ***Fills Tank*** **–** Will set relay(s) to automatically fill a tank. Start level will be below the Stop level for each relay.
- ***Not Applicable*** **–** Appears when this function is not available (such as when ***Switch/Alarms Only*** or ***4-20mA Transmitters Only*** are selected).

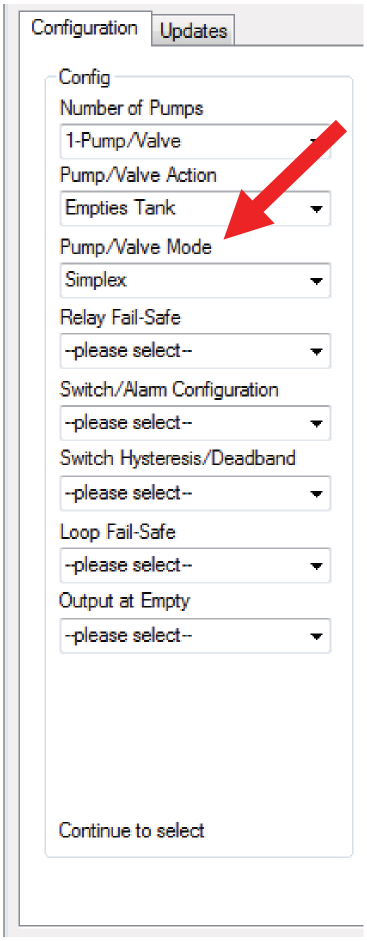


Empties Tank
(Auto Empty)

Fills Tank
(Auto Fill)

Note: *Right click on any menu that you may have questions on to open the help menu.*

Note: *To reset, press the Clear Screen button.*



Number of Pumps: 1-Pump/Valve

Pump/Valve Action: Empties Tank

Pump/Valve Mode: Simplex

Relay Fail-Safe: --please select--

Switch/Alarm Configuration: --please select--

Switch Hysteresis/Deadband: --please select--

Loop Fail-Safe: --please select--

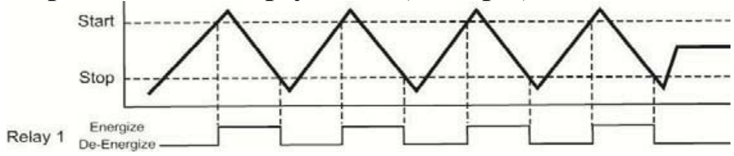
Output at Empty: --please select--

Continue to select

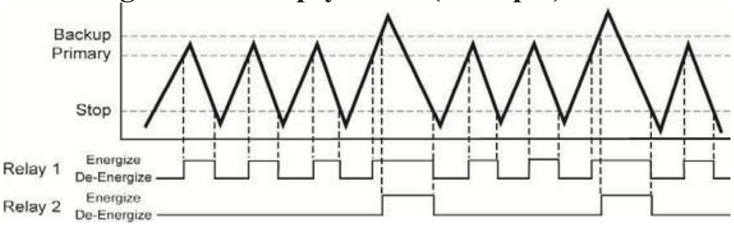
Pump/Valve Mode

This feature allows you to select the mode for a control or latching relay. Pump/Valve mode is not active for Switch/Alarms Only or 4-20 mA Transmitter Only.

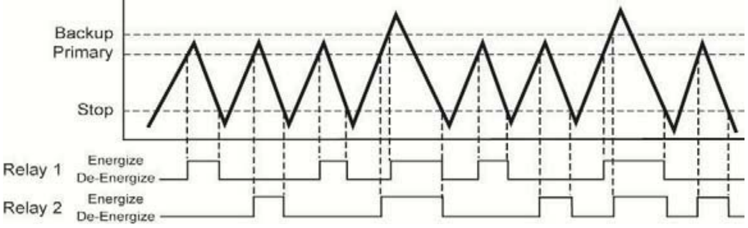
- ***Simplex*** **–** Allows for the relay to be used as an automatic fill or empty. This is the default and only configuration when ***1-Pump/Valve*** is selected.
- **Simplex used to Empty Tank (example)**



- ***Lead/Lag*** – Allows for the two relays to have unique start levels and a common stop level. The first relay will be identified as the lead relay and the second relay as the lag. Each time the lead level is reached, the first relay will always start. The lag relay will only start when the lag level is reached. All relays will stop at the common off level.
- **Lead/Lag used to Empty Tank (example)**



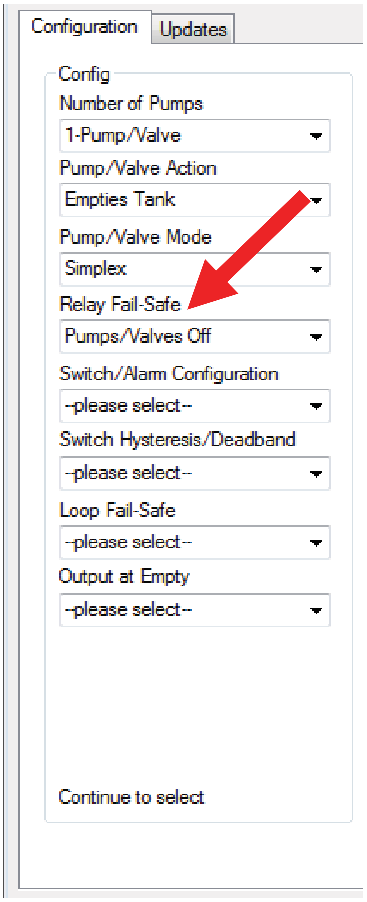
- ***Duplex*** - Allows for the two relays to have two different start levels, a common stop level and will alternate the relays when the first start level is reached. The two relays will alternate each time the lead level is reached and the remaining relay will start when the lag level is reached. All relays will stop at the common off level.
- **Duplex used to Empty Tank (example)**



- ***Not Applicable*** **–** Appears when this function is not available (such as when ***Switch/Alarms Only*** or ***4-20mA Transmitters Only*** are selected).

Note: *Right click on any menu that you may have questions on to open the help menu.*

Note: *To reset, press the Clear Screen button.*



Config

Number of Pumps: 1-Pump/Valve

Pump/Valve Action: Empties Tank

Pump/Valve Mode: Simplex

Relay Fail-Safe: Pumps/Valves Off

Switch/Alarm Configuration: --please select--

Switch Hysteresis/Deadband: --please select--

Loop Fail-Safe: --please select--

Output at Empty: --please select--

Continue to select

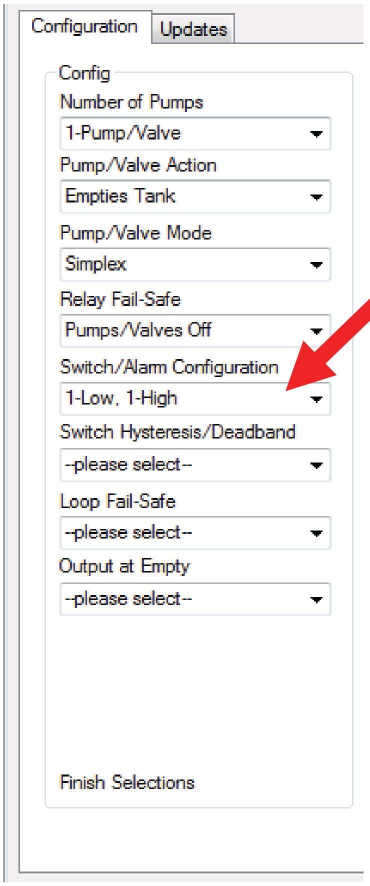
Relay Fail-Safe

This feature allows you to select the fail-safe state for the relays. When the sensor regains signal, the output current will revert back to the current level condition.

- ***Relays Off*** - The relays will revert to the OFF state. Appears when ***Switch/Alarms Only*** is selected.
- ***Relays On*** - The relays will revert to the ON state. Appears when ***Switch/Alarms Only*** is selected.
- ***Hold State* -** The relay(s) will remain in the same state as the last echo detected. When the sensor regains signal, the relays will revert to the level when the signal was regain.
- ***Pump/Valves Off*** - The relays will revert to the OFF state. Appears when ***1-Pump/Valve*** or ***2-Pumps/Valves*** are selected.
- ***Pump/Valves On*** - The relays will revert to the ON state. Appears when ***1-Pump/Valve*** or ***2-Pumps/Valves*** are selected.
- ***Not Applicable* –** Appears when this function is not available (such as when ***Transmitters Only*** are selected).

Note: *Right click on any menu that you may have questions on to open the help menu.*

Note: *To reset, press the Clear Screen button.*



Config

Number of Pumps: 1-Pump/Valve

Pump/Valve Action: Empties Tank

Pump/Valve Mode: Simplex

Relay Fail-Safe: Pumps/Valves Off

Switch/Alarm Configuration: 1-Low, 1-High

Switch Hysteresis/Deadband: --please select--

Loop Fail-Safe: --please select--

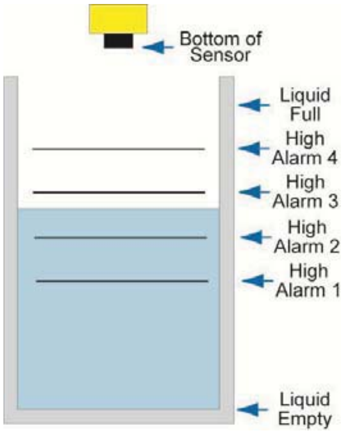
Output at Empty: --please select--

Finish Selections

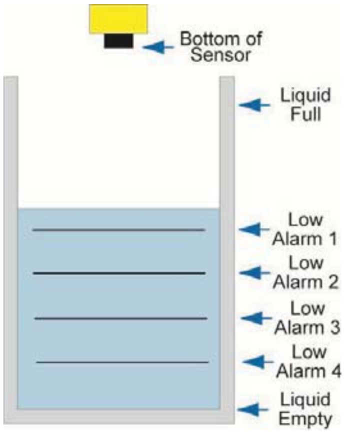
Switch/Alarm Configuration

This feature allows you to select the operation for the switches / alarms (used as a high or low alarm). This setting adjusts the number of available relays based upon the previous settings.

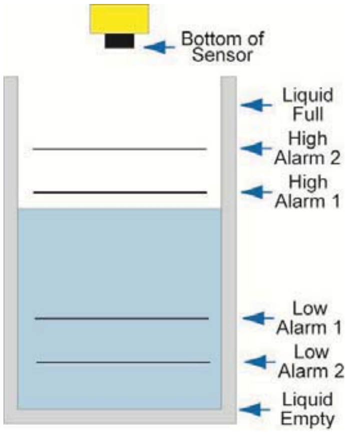
- ***No Alarm*** – Turns off all of the remaining relays.
- ***High Alarm Options*** – Set from 1 to 4 High Alarm (***1-High***, ***2-High***, ***3-High***, ***4-High***).
- ***Low Alarm Options*** – Set from 1 to 4 Low Alarms (***1-Low***, ***2-Low***, ***3-Low***, ***4-Low***).
- ***Combination Alarms*** – Set a combination of High and Low Alarms (***1-Low 1-High***, ***1-Low 2-High***, ***2-Low 1-High***, ***2-Low 2-High***, ***1-Low 3-High***, ***3-Low 1-High***).
- ***Not Applicable*** – Appears when this function is not available (such as when ***Transmitters Only*** is selected).



High Alarm Options (4 High)



Low Alarms Options (4 Low)



Combination Alarms (2 High and 2 Low)

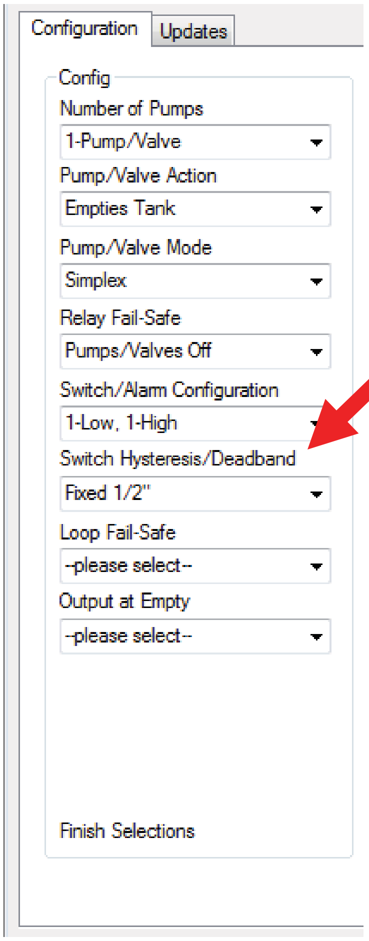
Note: *Right click on any menu that you may have questions on to open the help menu.*

Note: *To reset, press the Clear Screen button.*

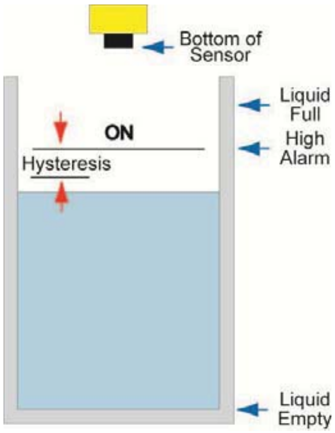
Switch Hysteresis/Dead band

This feature allows you to select a hysteresis or dead band for the remaining high and/or low alarms.

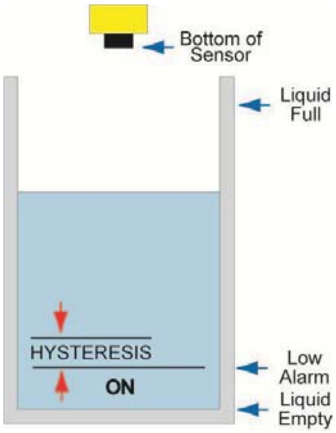
- ***Options for Hysteresis/Dead band*** – ***No Hysteresis***, *¼”*, ***½”***, ***1”***, ***2”***, ***½ cm***, **1cm**, ***2 cm***, ***5 cm*** or ***Not Applicable***.
- ***High Alarms*** – Relay activates above set point. Relay will deactivate when level goes below the set point plus the value of the hysteresis.
- ***Low Alarms*** – Relay activates below set point. Relay will deactivate when level goes above the set point plus the value of the hysteresis.



Number of Pumps: 1-Pump/Valve
Pump/Valve Action: Empties Tank
Pump/Valve Mode: Simplex
Relay Fail-Safe: Pumps/Valves Off
Switch/Alarm Configuration: 1-Low, 1-High
Switch Hysteresis/Deadband: Fixed 1/2"
Loop Fail-Safe: --please select--
Output at Empty: --please select--



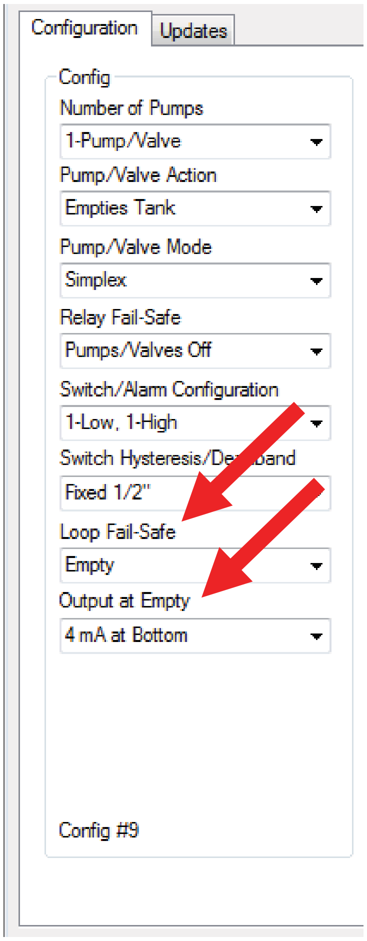
High Alarm w/ Hysteresis



Low Alarm w/ Hysteresis

Note: *Right click on any menu that you may have questions on to open the help menu.*

Note: *To reset, press the Clear Screen button.*



Number of Pumps: 1-Pump/Valve
Pump/Valve Action: Empties Tank
Pump/Valve Mode: Simplex
Relay Fail-Safe: Pumps/Valves Off
Switch/Alarm Configuration: 1-Low, 1-High
Switch Hysteresis/Deadband: Fixed 1/2"
Loop Fail-Safe: Empty
Output at Empty: 4 mA at Bottom
Config #9

Loop Fail-Safe

This feature allows you to select the fail-safe current output if the sensor fails to detect a return signal. When the sensor regains signal, the output current will revert back to the current level condition.

- ***Hold Last Value* -** The output will remain in the same state as the last echo detected. Example: If the output was 6.7 mA just prior to the lost signal, the device will continue to output 6.7 mA. Sensor will indicate the level when signal was regain.
- ***Empty*** - The output will revert to the current value for an empty condition. When ***4 mA at Bottom*** is selected, the sensor will output 4 mA when a fail-safe condition occurs. If ***20 mA at Bottom*** is selected, the sensor will output 20 mA when a fail-safe condition occurs.
- ***Full*** - The output will revert to the current value for a full condition. When ***4 mA at Bottom*** is selected, the sensor will output 20 mA when a fail-safe condition occurs. If ***20 mA at Bottom*** is selected, the sensor will output 4 mA when a fail-safe condition occurs.
- ***Overfill (21mA)*** - The output current will go to 21mA when the return signal is lost.
- ***Overfill (22mA)*** - The output current will go to 22mA when the return signal is lost.

Output at Empty

This feature allows you to select the orientation of the 4 to 20mA output (4 to 20 mA or 20 to 4 mA). Choose which output setting best fits the application. Typical installations are set with ***4 mA at Bottom***. This will not affect the performance of the sensor other than the output of the EchoPod. WebCal's factory default is 4mA at bottom and 20mA at top. *When connecting your sensor to a display, you must account for your output settings.*

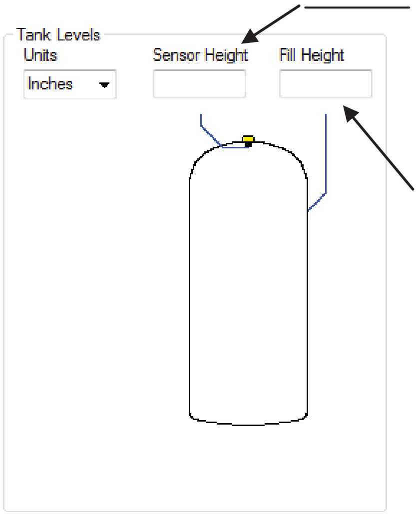
- ***4mA at Bottom* -** The output current will be 4mA when the sensor measures an empty tank and 20mA when the sensor measures a full tank.
- ***20mA at Bottom* -** The output current will be 20mA when the sensor measures an empty tank and 4mA when the sensor measures a full tank.

Note: *Right click on any menu that you may have questions on to open the help menu.*

Note: *To reset, press the Clear Screen button.*

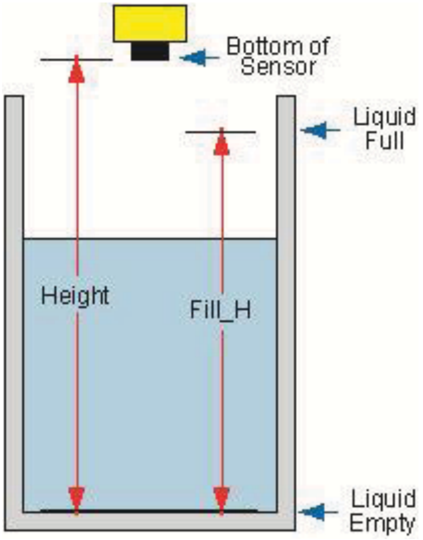
WebCal Step 2: Tank Levels

This section of WebCal is where you enter application measurement values. All values must be filled in before moving to step 3.



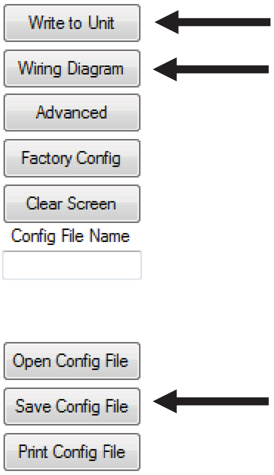
Sensor Height: Distance from the bottom of the tank to the bottom of the transducer.

Fill Height: Distance from the bottom of the tank to the maximum liquid height.



WebCal Step 3: Write to Unit

After you have entered configurations and tank values, click “**Write to Unit**” and send the configuration to your EchoPod. Now use WebCal’s file management features to save your configuration by clicking “**Save Config File**” and print your wiring diagram by clicking “**Wiring Diagram**.”



Write to Unit

Wiring diagram

Save Config File

Wiring EchoPod

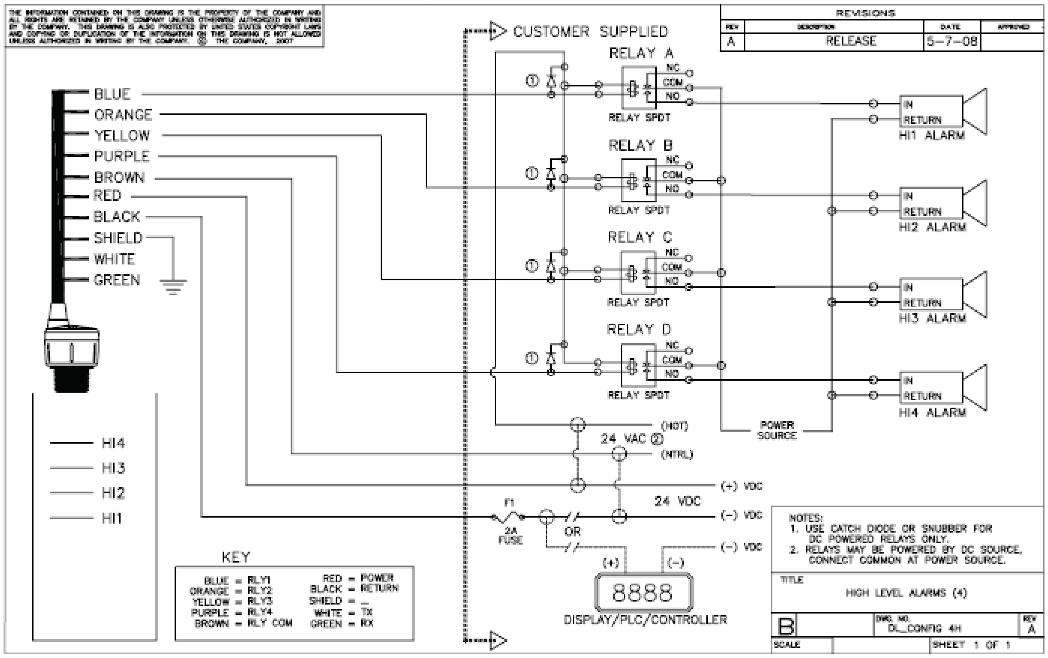
After you have finished positioning and mounting EchoPod, follow WebCal's wiring diagram to wire the sensor. A typical wiring diagram is shown above. Flowline recommends using a qualified licensed electrician to wire EchoPod and your application's components.

Note: *Do not extend the White & Green wires beyond 15'.*

Note: *Configure your EchoPod with WebCal and use the wiring diagram button to view the appropriate diagram. Each configuration will have its own unique diagram. The diagram above is only a sample and should not be used as a wiring diagram.*

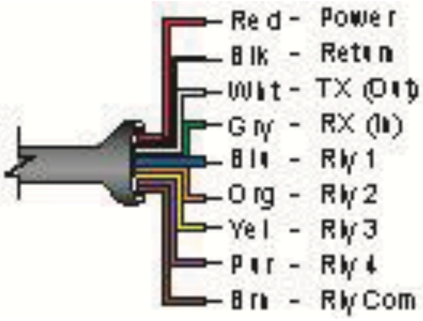
Note: Once EchoPod is configured, isolate the white and green wires from active power to prevent a short of the configuration circuit.

Wiring Diagram



Sample Wiring Diagram – Use WebCal to view appropriate wiring diagram

Wire Connections:



Red & Black

Red and Black leads are for connection to a 24 VDC power supply or to a 4-20 mA loop power source. The red and black wires can be extended up to 1,000 feet using a 22 gauge or larger wire, however do not extend the green and white wires.

White & Green

White and Green leads are reserved for use with WebCal and should not be connected during usage in the application. These wires should not be connected to WebCal while power is supplied from any source other than the LI99 series Fob.

Never allow the white or green wires to touch any power supply.

Blue, Orange, Yellow & Purple

Blue, Orange, Yellow & Purple wires are the relay contacts (normally open) from each of the relays respectively. Relay selection is determined by the configuration in WebCal.

Brown

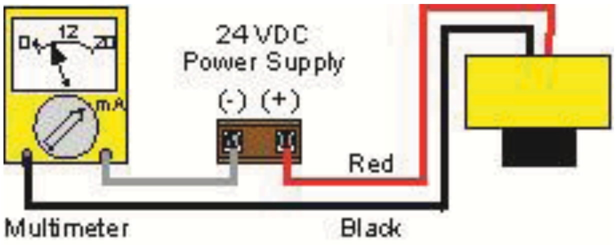
The Brown wire is the common for all the relays.

General notes for electrical connections, usage and safety:

- Where personal safety or significant property damage can occur due to a spill, the installation must have a redundant backup safety system installed.
- Wiring should always be completed by a licensed electrician.
- Supply voltage should never exceed 28 VDC.
- Always use stepper relays between the sensor and external loads. For DC circuits use a catch diode such as 1N4148, shown on previous page.
- Protect the sensor from excessive electrical spikes by isolating the power, whenever possible.
- The sensor materials must be Chemically compatible with the liquids to be measured.
- Design a fail-safe system for possible sensor and/or power failure.
- Never use the sensor in environments classified as **Hazardous**.

4-20 mA output only

EchoPod can be used as a loop powered 4-20 mA only device (refer to the wiring diagram below). When using WebCal, under ***Number of Pumps***, select ***4-20mA Transmitter Only*** to simplify the configuration in WebCal.

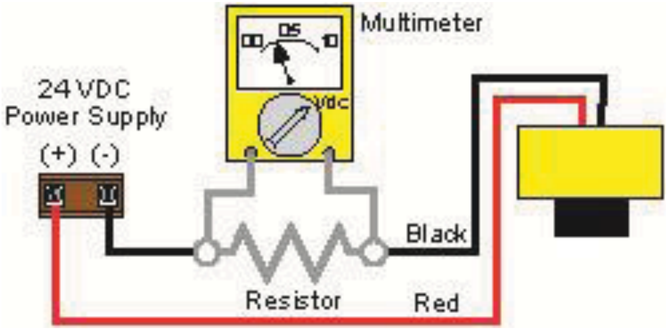


Voltage Output

EchoPod can be used as a 0 to 5 or 0 to 10 VDC output device. A resistor will need to be added to the circuit to enable a voltage output (refer to the wiring diagram below).

- 0-5 VDC output
  - Add a 250 Ohm resistor
  - Actual output will be 0.8 to 5 VDC
- 0-10 VDC output
  - Add a 500 Ohm resistor
  - Actual output will be 2 to 10 VDC

When using WebCal, under ***Number of Pumps***, select ***4-20mA Transmitter Only*** to simplify the configuration in WebCal.

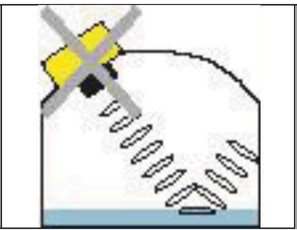
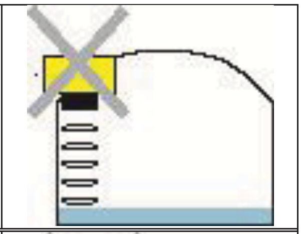
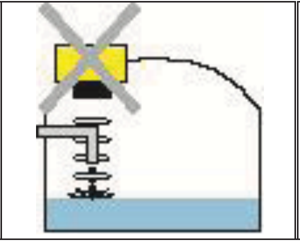
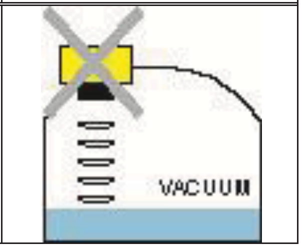


Installation

The EchoPod should always be mounted perpendicular to the liquid surface and installed using the provided Viton mounting gasket. Make sure that the fitting and transmitter threads are not damaged or worn. Always *hand-tighten* the transmitter within the fitting. Perform an installed leak test under normal process conditions prior to system start up. ***Note:*** *The preferred mounting fitting for the DL14 and DL24 series is the LM52-1400 (2" thread x 1" thread) reducer bushing.*

Mounting Guide

1. Do not mount at an angle
2. Liquid should never enter the dead band
3. Side Wall:
   a. For DL14 & DL24 Series - mount at least 2" from the side wall
   b. For DL34 Series - mount at least 3" from the side wall
4. Do not mount where obstacles will intrude on sensor's beam width
   a. See Specifications on page 8
5. Do not mount in a vacuum
6. Avoid mounting in the center of a dome top tank.
7. In cone bottom tank, position the sensor over the deepest part of the tank.

Do not install at angle relative to the liquid.		*Do not install within 3" of tank sidewall. (2" for DL14 and DL24 series)*	
Do not install with objects in the beam.		*Do not install in applications with vacuum.*	

Installation in existing fittings

If the existing fitting is larger than the threads of the EchoPod, select a reducer bushing such as the LM52-1400 (2" thread x 1" thread) or LM52-2400 (3" thread x 2" thread).

Metal Tanks (DL14 & DL24 series)

Flowline ultrasonic transmitters have been optimized for use in non-metallic fittings.

1. For best performance, avoid the use of metallic fittings.
    a. Use a plastic 2" x 1" reducer bushing, such as the LM52-1400 or a plastic 1" flange, such as the LM52-1850 for metallic tanks.
2. While installations directly into a 1" metal fitting are not recommended, acceptable results may be obtained if the 1" fitting is a half coupling in form and the outer diameter of the coupling is tightly wrapped in vinyl tape to dampen vibrations.

Fitting Selection: Check the part number to determine the required fitting mount size and thread type. EchoPod is commonly installed in tank adapters, flanges, brackets or standpipes. Note: Always include the gasket when installing the EchoPod.

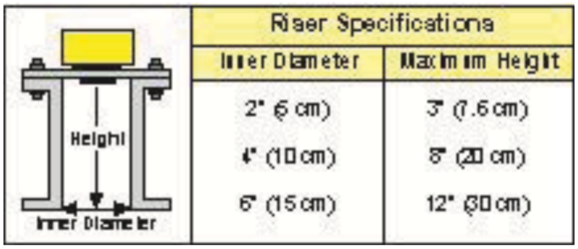
1. **Tank Adapter:** Select a tank adapter fitting, such as the LM52-1890 for the DL14 & DL24 series or the LM52-2890 for the DL34 series.
    a. *For best results, select a 2" tank adapter and add a reducer bushing such as the LM52-1400, thread x thread, reducer bushing.*
    b. Avoid tank adapter (thread x thread) styles and/or pipe stops forward of the installed transducer.

Tank Adapter
w/ 2”x1” Reducer Bushing

Tank Adapter
Thread x Thread

Do not use thread x thread

2. **Riser:** Installations with tall, narrow risers can impede the acoustic signal.
    a. **DL34 Series:** 2” (5 cm) diameter risers should be no taller than 5” (12.7 cm). Larger diameter risers should be no taller than 12” (30.5 cm).
    b. **DL14 & DL24 Series:**



Riser Specifications	
Inner Diameter	Maximum Height
2" (5 cm)	3" (7.6 cm)
4" (10 cm)	8" (20 cm)
6" (15 cm)	12" (30 cm)

***Note:** Do not exceed the dimensions listed above*

3. **Flange (DL14 & DL24 series):**

   If installing on a flange, select a flange with a thread that is above the plane of the flange, such as the LM52-1850.

    a. *The DL34 series works well with Flange installations.*
    b. Avoid the use of blind flanges with tapped threads or flanges where the threads are even with the plane of the flange, such as the Banjo 1" Poly ANSI Flange (series AF100).
    c. Use a flange with a 2” thread and add a 2” to 1” reducer bushing to complete the installation.

1” Flange w/
thread in plane

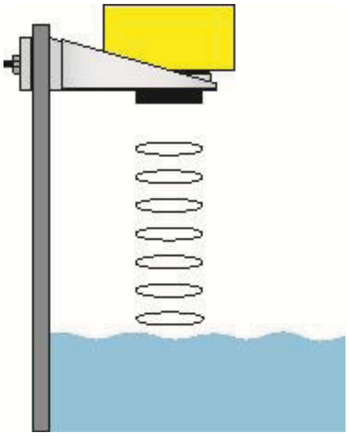
Do not use thread in plane

2” Flange w/
reducer bushing

4. **Side Mount Bracket:**

   For installations in open tanks and sumps, use the LM50 series side mount bracket.

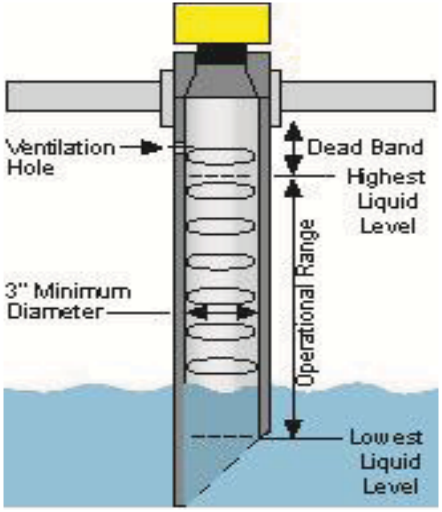
   a. For the DL14 & DL14 series, order the LM50-1001-1, which includes a 2”x 1” Reducer Bushing.
   b. For the DL34 series, order the LM50-1001 side mount bracket.



5. **Stand Pipe:**

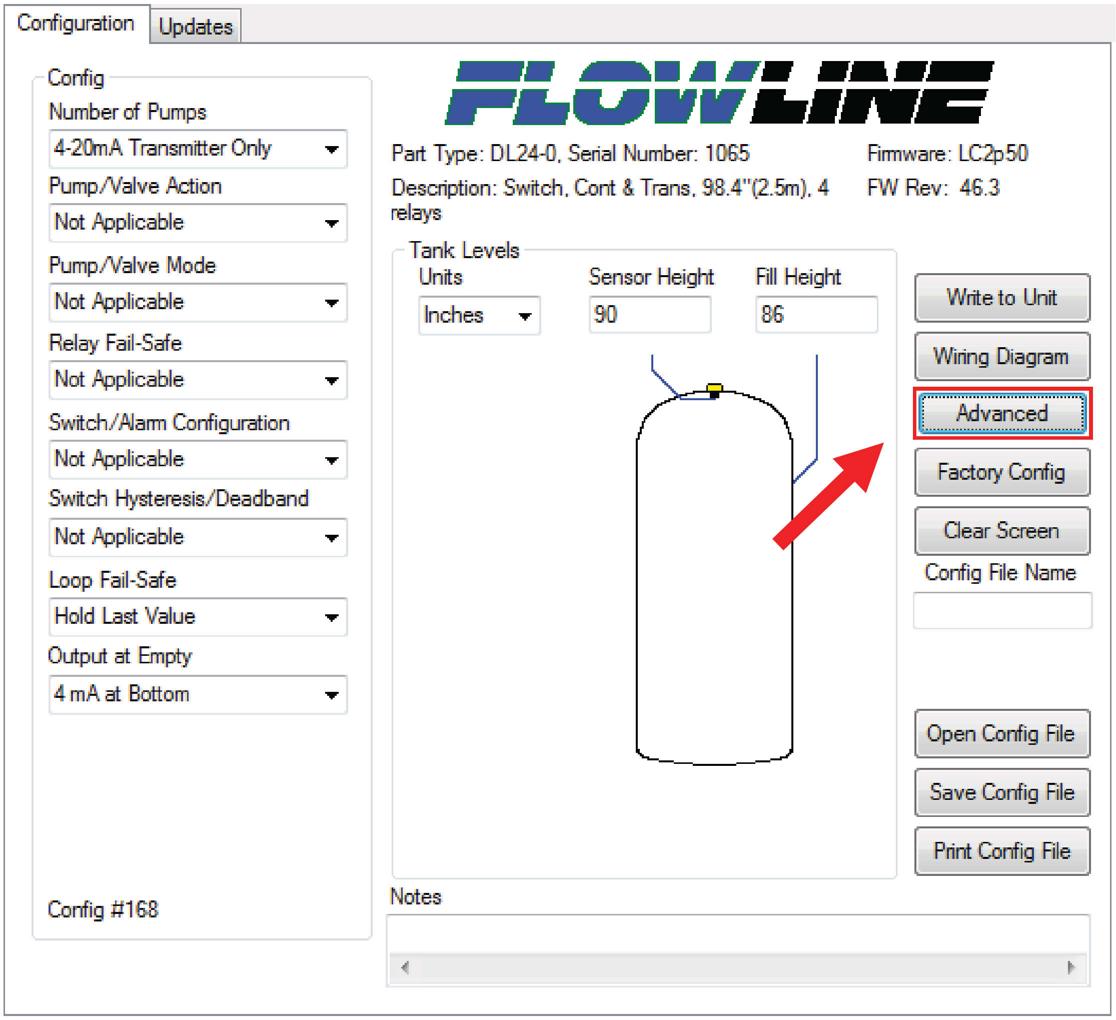
   A standpipe maybe used to dampen turbulence or when foam is present in the application.

   a. Pipe can be made of any material.
   b. Select a minimum 3” ID pipe for the stand pipe.
      i. A 2” pipe is usable with the DL14 and DL24 series, but is the minimum.
      ii. Pipes larger than 3” can also be used.
   c. Use a coupling and reducer bushing to attach the EchoPod to the pipe.
      i. With the DL14 & DL24 series, be sure to use a plastic reducing bushing such as LM52-1400 2” T x 1” T fitting or the LM52-1410 2” S x 1” T fitting.
   d. The pipe length should run the measurement span and the bottom of the pipe should remain submerged at all times to prevent foam from entering the pipe.
   e. Cut a 45°notch at the bottom of the pipe and drill a 1/4”pressure equalization hole in the dead band.
   f. The pumps should not drive liquid past the open end of the stand pipe which causes the liquid in the pipe to oscillate.



Advanced Features

This tool is designed to help solve operational issues. Changing these setting will alter the performance of your unit. Please read through this HELP file to assist you in making adjustments or if still unclear about a specific issue, please contact FLOWLINE, Applications Engineering.



Config

Number of Pumps: 4-20mA Transmitter Only

Pump/Valve Action: Not Applicable

Pump/Valve Mode: Not Applicable

Relay Fail-Safe: Not Applicable

Switch/Alarm Configuration: Not Applicable

Switch Hysteresis/Deadband: Not Applicable

Loop Fail-Safe: Hold Last Value

Output at Empty: 4 mA at Bottom

Config #168

Part Type: DL24-0, Serial Number: 1065

Firmware: LC2p50

Description: Switch, Cont & Trans, 98.4"(2.5m), 4 relays

FW Rev: 46.3

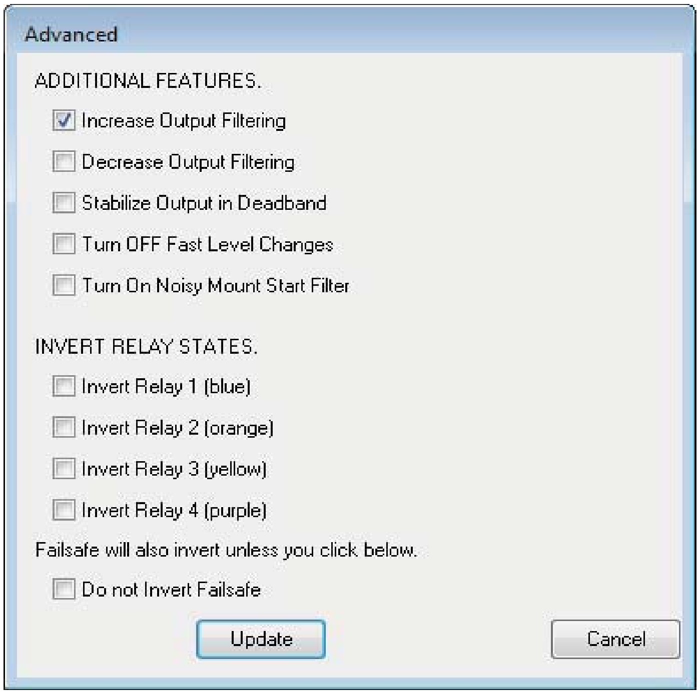
Tank Levels

Units	Sensor Height	Fill Height
Inches	90	86

Config File Name

Notes

Note: When the Advanced Button is highlighted with a RED border, this indicates you have selected an advanced feature.



Advanced

ADDITIONAL FEATURES.

☑ Increase Output Filtering
☐ Decrease Output Filtering
☐ Stabilize Output in Deadband
☐ Turn OFF Fast Level Changes
☐ Turn On Noisy Mount Start Filter

INVERT RELAY STATES.

☐ Invert Relay 1 (blue)
☐ Invert Relay 2 (orange)
☐ Invert Relay 3 (yellow)
☐ Invert Relay 4 (purple)

Failsafe will also invert unless you click below.

☐ Do not Invert Failsafe

- ***Increase Output Filtering**: Placing a check mark in the box will increase the filtering (averaging) of the analog output. Use this filter if the 4 to 20 mA output requires a smooth output for the application such as open channel flow measurement.*
- ***Decrease Output Filtering**: Placing a check mark in the box will eliminate all filtering (averaging) of the analog output. Enables a pulse by pulse level reading. Use this filter to see changes in level after every sound pulse.*

***Note:** Never check increase output filtering and decrease output filtering at the same time.*

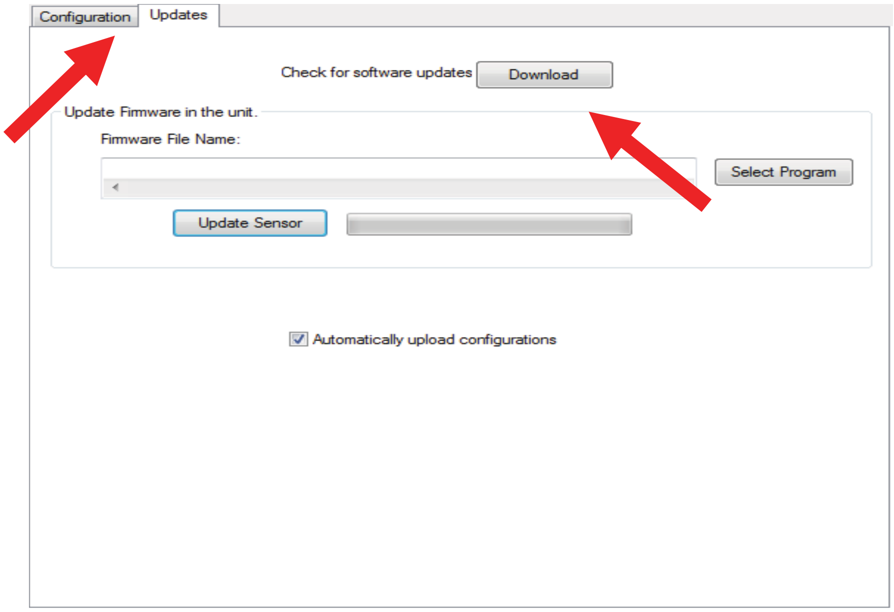
- ***Stabilize Output in Deadband***: Placing a check mark in the box will activate a filter to hold the output at Full if the level enters the dead band of the EchoPod. This filter requires the level to leave the dead band at a smooth and steady rate.
- ***Turn OFF Fast Level Changes***: Placing a check mark in the box will turn off the filter enabling fast level changes. Use this filter if your application has very smooth, slow and steady level changes. The filter instructs EchoPod to look only for small incremental changes in level.
- ***Turn ON Noisy Mount Start Filter***: Placing a check mark in the box will activate a filter that reduces sound interference from the installation mount. Use this filter if the EchoPod will not go to full range in the installation.
- ***Invert Relay States***: Placing a check mark in any of the four boxes will reverse the state of that relay. For example, if relay 4 is a high alarm that energizes above 50.0" of liquid, checking the invert box will reverse so the relay will energize when it is below 50" of liquid. Inverting the relay will also invert the fail-safe of the relay. If the relay is fail-safe On, Inverting the relay will make it fail-safe Off.
- ***Fail-Safe will also invert unless you check below:*** This button will not invert the fail-safe when a relay is inverted.

Appendix

Updating WebCal Software

WebCal software can be updated directly from the software. Simply click on the **Updates** Tab at the top of the window and press the **Download** button. Make sure that your computer has access to the Internet. If not, an error window will appear.

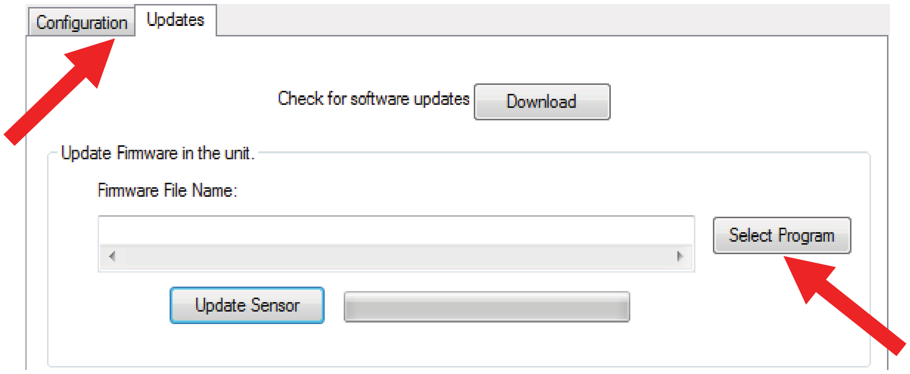
When the **Download** button is pressed, the software will check the version of software you are using with the most recent version at Flowline. If the versions are similar, a window indicating that the most recent version is installed. If not, then a window will appear asking to download the latest version. Follow the instructions for installing the latest version.



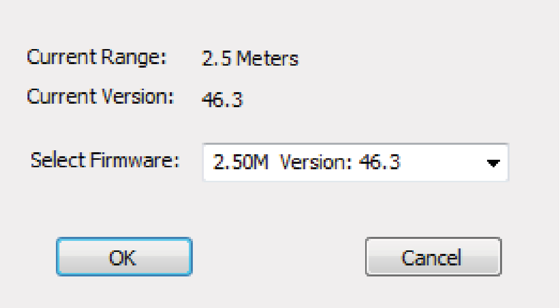
☑ Automatically upload configurations

Updating Transmitter Firmware

WebCal software can also be used to update firmware inside the EchoPod transmitter. This feature allows the transmitter to be updated when new features are added. First open WebCal with an EchoPod transmitter connected and the latest version of WebCal installed to your PC.



Click on the **Updates** Tab and then click on **Select Program** to select the firmware update.

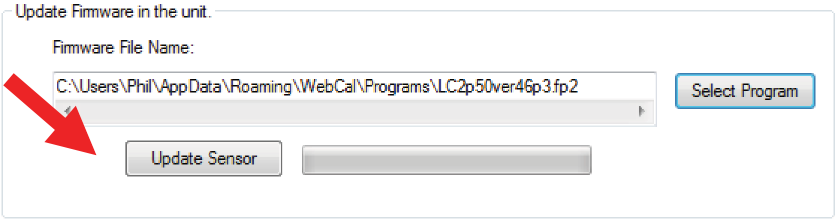


Current Range: 2.5 Meters

Current Version: 46.3

Select Firmware: 2.50M Version: 46.3

Select the latest version of the firmware file and click on OK.



Update Firmware in the unit

Firmware File Name: C:\Users\Phil\AppData\Roaming\WebCal\Programs\LC2p50ver46p3.fp2

Confirm that the address is correct and then click on **Update Sensor** to begin the firmware update. This step should take less than 1 minute. You can follow the progress with the status bar to the right of the Update Sensor button. When completed, click on the Configuration tab to configure the transmitter. *Remember, when the firmware has been updated, the unit will return to its original factory settings.*

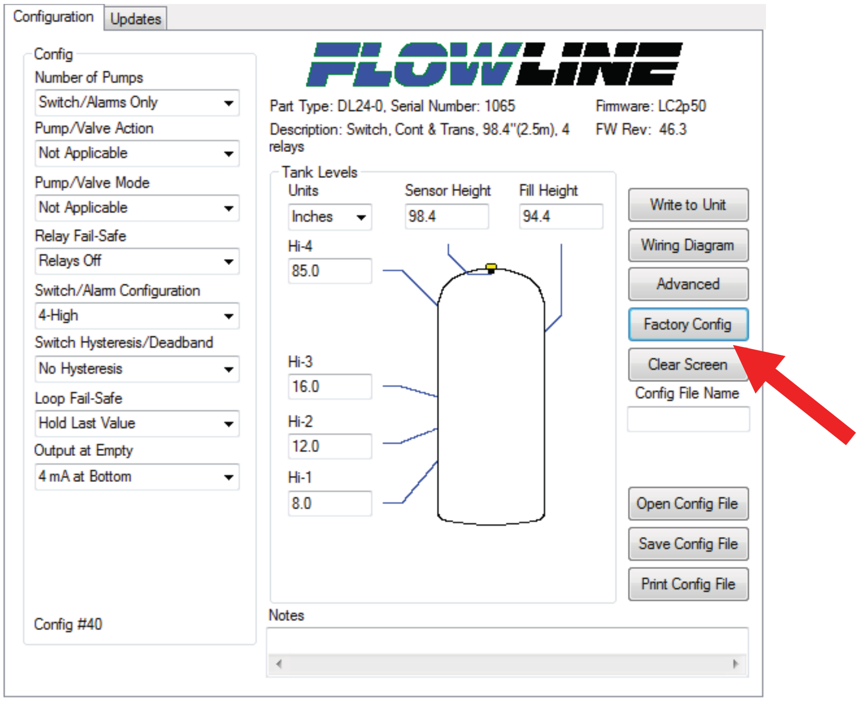
- If there is a communication interruption during the update, the process will stop. It is OK to click on Update Sensor again to start the process over again.

Factory Default

Pressing the **Factory Config** button in the Configuration menu will return the screen to the following settings. Out of the box, the EchoPod will output a 4-20 mA output that is maximized for its operational range.

- **DL14 Series** – 4mA @ 4.1' (1.25m) away and 20 mA @ 2" (5cm) away from sensor.
- **DL24 Series** – 4mA @ 8.2' (2.5m) away and 20 mA @ 4" (10cm) away from sensor.
- **DL14 Series** – 4mA @ 18.0' (5.5m) away and 20 mA @ 8" (20cm) away from sensor.

Factory Defaults Table



Config

Number of Pumps: Switch/Alarms Only

Pump/Valve Action: Not Applicable

Pump/Valve Mode: Not Applicable

Relay Fail-Safe: Relays Off

Switch/Alarm Configuration: 4-High

Switch Hysteresis/Deadband: No Hysteresis

Loop Fail-Safe: Hold Last Value

Output at Empty: 4 mA at Bottom

Config #40

Part Type: DL24-0, Serial Number: 1065

Description: Switch, Cont & Trans, 98.4"(2.5m), 4 relays

Firmware: LC2p50

FW Rev: 46.3

Tank Levels

Units: Inches

Sensor Height: 98.4

Fill Height: 94.4

Hi-4: 85.0

Hi-3: 16.0

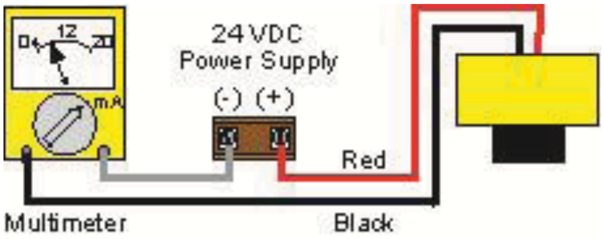
Hi-2: 12.0

Hi-1: 8.0

Config File Name

Notes

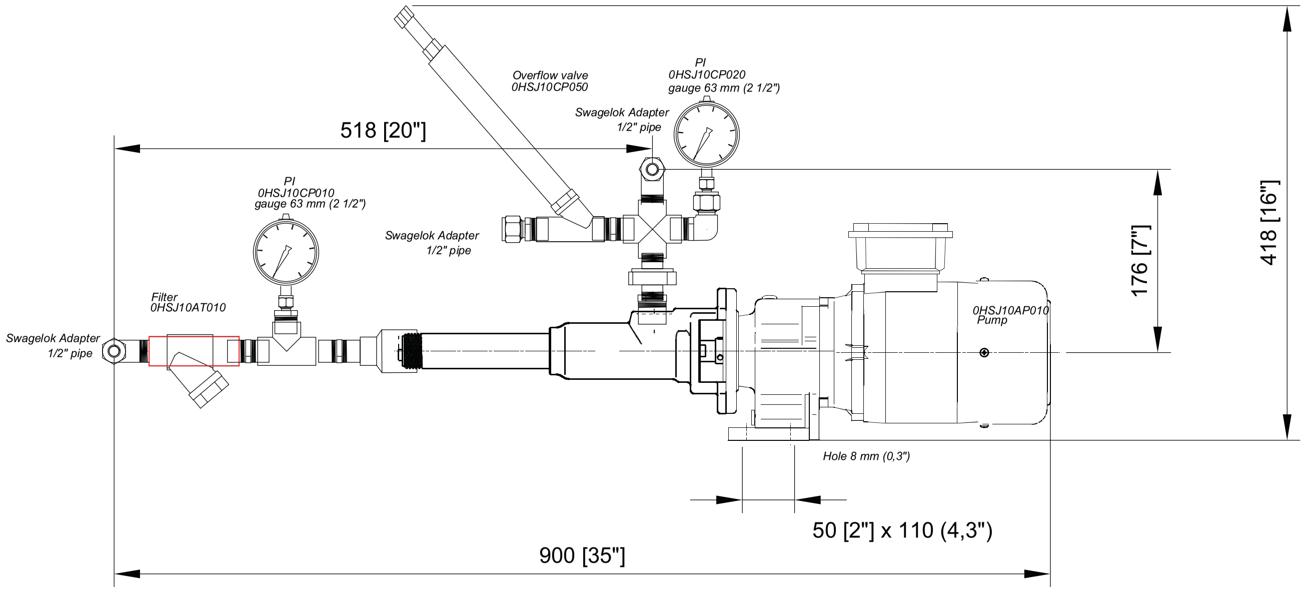
Testing the Transmitter



1. Connect a multimeter in series with the black wire to read the current output.
2. Verify that the current increases (tank filling) and decreases (tank emptying) appropriately in the calibrated span.
3. If not, carefully observe and attempt to correlate any installation, level or application event for more specific troubleshooting direction.

Troubleshooting

PROBLEM	SOLUTION
Transmitter indicates a current of 0 mA	Check the wiring for an open circuit. An open circuit is the most common issue with a 0 mA signal.
Transmitter jumps to a current reading between 19 and 20 mA	Check the installation of the transmitter. Bad installation fittings will cause false signals near the top of the tank, which typically translates to a signal between 19 and 20 mA. Also look for interference just below the transmitter. If the transmitter is installed in a metal fitting, switch to a plastic fitting.
Transmitter indicates a current over 23 mA	Immediately check the wiring for a short circuit. The EchoPod is current limited to 22 mA. Anything above 23 mA indicates a short circuit.
Transmitter always jumps to the LOST condition	Check the dimensional configuration (**Height** and **Fill-H**) of the EchoPod. Make sure that the **Fill-H** setting corresponds to the full level of liquid (from the bottom up) and not the distance from the transmitter to the liquid (top down).
Output of transmitter is opposite of the level of liquid	Check the **Output at Empty** Setting. Make sure the setting is correct (***4mA at bottom*** or ***20 mA at bottom***).
No Unit Detected in WebCal	WebCal cannot detect an EchoPod connected to the computer. • Check that the Fob is connected to the USB port. • Check that all four wires (Red, Black, White and Green) are securely attached to the Fob. • Check in Device Manager that both drivers (WebCal Configuration & EchoFob) are present.
Internet error. The server name or address could not be resolved.	This is a warning indicating the computer configuring EchoPod is not connected to the internet. Click **OK** to continue. Flowline recommends being connecting to the internet for all configurations. Not being connected to the internet will not prevent the EchoPod from being configured.
Cannot access some of the features in Configuration	As choices are made in Configuration, WebCal will begin to eliminate functions that are no longer active. To reset Configuration or get access to all the features, click on the **Clear Screen** button.
Relay closes, but does not open again	An inductive kick may be holding the relay closed. If switching 24 VDC, make sure a diode has been installed to act as a snubber (see page 21 and 22).
Relay chatters on and off repeatedly	Most likely the turbulence in the tank is causing the chatter. Increase the Hysteresis setting to correct.



ENGINEERING APPROVALS

REV NUM.	DRAWN BY	APPROVED BY	DATE	IFC SIGNATURE

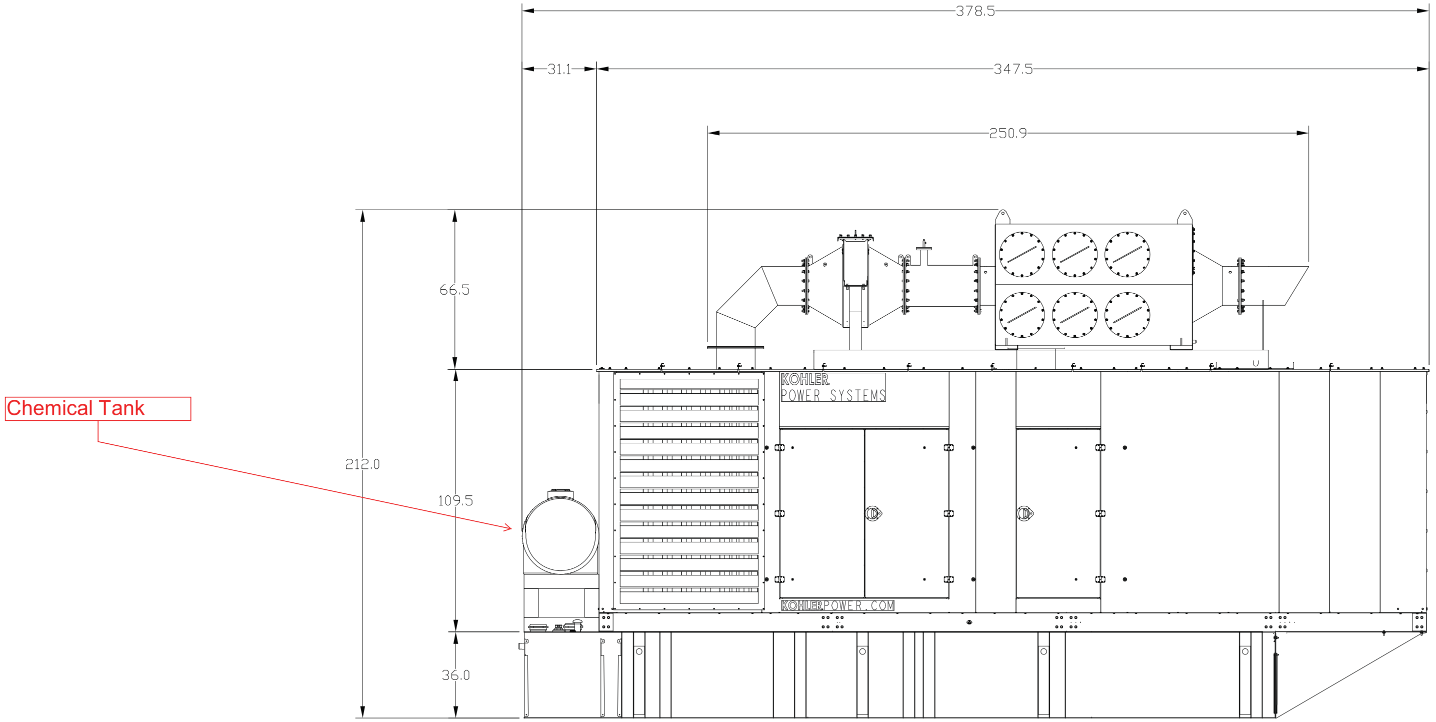
This document contains material and/or informatioin which is the property of AeriNOx Inc. and is supplied only on a confidential basis. No reproductioin, transmittal, or disclosure shall be made by any person, firm, or corporation without the prior written approval of AeriNOx Inc.

Unless Otherwise Specified:
-Dimensions are in inches.
-Dimensions shown are nominal.
For information on manufacturing tolerances contact AeriNOx Inc.

AeriNOx
A DCL and H+H Company

PO BOX 490 100 CHERRY AVE., STE 6B
EATON, CO 80615
Office: (970) 454-5639
www.AeriNOx-inc.com

CUSTOMER	FRONTIER POWER PRODUCTS
PROJECT	KOHLER 750REOZMD - TIER 4 EMISSIONS PROJECT
DWG TITLE	UREA PUMP GENERAL ASSEMBLY
DWG No.	16084-PA2016_238LAY050
SIZE	D
REV	0
SHT	1 of 1
SCALE	NTS
DATE	10/13/16
DWN BY	ASC



TANK INFORMATION				
LITERS [GALLONS] MIN HOURS	GENSETS	DIM A MM [INCH]	DIM B MM [INCH]	TANK WEIGHT KG [LBS] (NO FUEL)
LIFT BASE ONLY	700-1000REOZDE / MD	254 [10.0]	8773 [345.4]	934 [2060]
3682 [973] 12 HOURS	700-1000REOZDE / MD	304.8 [12.0]	7967 [313.6]	3512 [7743]
6679 [1791] 24 HOURS	700-1000REOZDE / 750-800REOZMD	508.0 [20.0]	7967 [313.6]	3938 [8681]
8215 [2170] 24 HOURS	900-1000REOZMD	609.6 [24.0]	7967 [313.6]	4139 [9125]
8215 [2170] 36 HOURS	700-800REOZDE	609.6 [24.0]	7967 [313.6]	4139 [9125]
10824 [2859] 36 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4500 [9920]
10824 [2859] 48 HOURS	700-800REOZDE	914.4 [36.0]	7967 [313.6]	4500 [9920]
13970 [3690] 48 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4832 [10653]
16193 [4278] 72 HOURS	700-800REOZDE	914.4 [36.0]	9567 [376.6]	5498 [12120]
20914 [5525] 72 HOURS	900-1000REOZDE / 750-1000REOZMD	914.6 [36.0]	11430 [450.0]	6322 [13938]

TANK/LIFT BASE WEIGHT
+ENCLOSURE WEIGHT
=TOTAL WEIGHT

700-1000 KW SOUND ENCLOSURE
WITH SUB BASE TANK
OR LIFTING BASE OPTION

NOTE: DIMENSIONS IN INCHES, DIMENSIONS AND FEATURES ARE SUBJECT TO CHANGE WITHOUT NOTICE

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
E	03-19-14	SEE SHEET 4 [CT75098]	SSH
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT85282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 1 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 3 OF 6. (D-6) VIEW OF E-VENTS UPDATED. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH ✓ MAX.

THIRD ANGLE PROJECTION

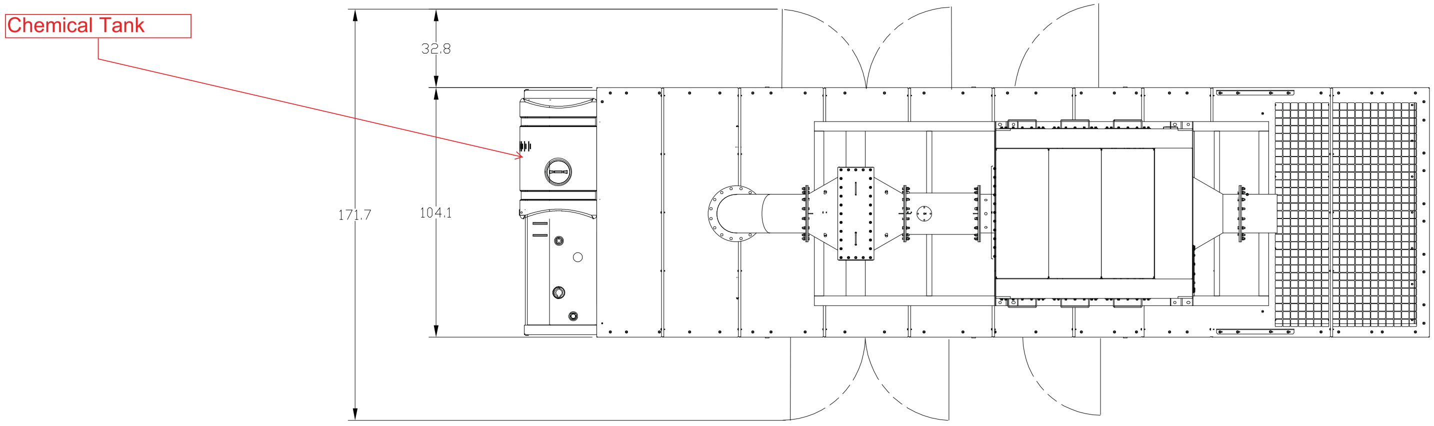
APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

KOHLER CO.
METRIC | PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

SCALE 0.04
CAD NO.
SHEET 2 of 6
DWG NO. ADV-8249
D


Chemical Tank

TANK INFORMATION				
LITERS [GALLONS] MIN HOURS	GENSETS	DIM A MM [INCH]	DIM B MM [INCH]	TANK WEIGHT KG [LBS] (NO FUEL)
LIFT BASE ONLY	700-1000REOZDE / MD	254 [10.0]	8773 [345.4]	934 [2060]
3682 [973] 12 HOURS	700-1000REOZDE / MD	304.8 [12.0]	7967 [313.6]	3512 [7743]
6679 [1791] 24 HOURS	700-1000REOZDE / 750-800REOZMD	508.0 [20.0]	7967 [313.6]	3938 [8681]
8215 [2170] 24 HOURS	900-1000REOZMD	609.6 [24.0]	7967 [313.6]	4139 [9125]
8215 [2170] 36 HOURS	700-800REOZDE	609.6 [24.0]	7967 [313.6]	4139 [9125]
10824 [2859] 36 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4500 [9920]
10824 [2859] 48 HOURS	700-800REOZDE	914.4 [36.0]	7967 [313.6]	4500 [9920]
13970 [3690] 48 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4832 [10653]
16193 [4278] 72 HOURS	700-800REOZDE	914.4 [36.0]	9567 [376.6]	5498 [12120]
20914 [5525] 72 HOURS	900-1000REOZDE / 750-1000REOZMD	914.6 [36.0]	11430 [450.0]	6322 [13938]

TANK/LIFT BASE WEIGHT
+ENCLOSURE WEIGHT
=TOTAL WEIGHT

700-1000 KW SOUND ENCLOSURE
WITH SUB BASE TANK
OR LIFTING BASE OPTION

NOTE: DIMENSIONS IN INCHES, DIMENSIONS AND FEATURES ARE SUBJECT TO CHANGE WITHOUT NOTICE

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
E	03-19-14	SEE SHEET 4 [CT75098]	SSH
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT85282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 1 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 3 OF 6. (D-6) VIEW OF E-VENTS UPDATED. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH
MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE
DIMENSION PRINT

SCALE 0.04
CAD NO.
SHEET 2 of 6
DWG NO. ADV-8249
D

W P

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Sep 2, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 020

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – 75KW Towable Genset rev 2**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**Atlas Copco QAS 90 (27pgs)**	RAN

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 32 10 item 2.1

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

AES Review Comments

Confirm that the ULS fuel required is #2, with 15PPM sulphur. <Gord> only ULS Fuel is provided in Canada

-Cable stowage container to be provided as indicated on drawings. This can be by ANY of the bidders sub-trades/suppliers, it is not required to come from the generator supplier but this was in the drawings and is part of the contract documents. Confirm this will be done by someone under WPE's contract.<Gord> Completed by WPE

Confirm Voltage selector switch cannot be actuated while the generator is operating.

AES ENGINEERING LTD.
REVIEWED ONLY
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. APPROVAL OF DIMENSIONS AND OTHER GENERAL CONSTRUCTION FEATURES IS NOT IMPLIED.
☐ REVIEWED ☐ REVISE AND RESUBMIT
☒ REVIEWED AS MODIFIED ☐ NOT REVIEWED
Project Number: 1-16-008 Date: 2016-09-21
Reviewed By: Jacob Bieling

	Requirements	Compliant		Comments
Part 2	**Generation Plant**	**Yes**	**No**	
2.1.4	75KW 94KV .8PF 347/600VAC 3phase 4w	Yes		
	cooling 30c 50/50 glycol/water	Yes		
2.1.5	CSA approved	Yes		
2.2.1	4cycle 1800RPM	Yes		
2.2.3	#2 Diesel fuel	Yes	~~no~~	requires Low Sulfur for Tier 4 rating
2.2.4	Tier 4 EPA Compliant	Yes		requires Low Sulfur for Tier 4 rating
2.2.6	Performance	Yes		
2.2.7	AC Generator	Yes		
2.2.8	Engine Control	Yes		
2.2.9	Engine	Yes		
2.2.10	Battery & Starting	Yes		
2.2.11	Base	Yes		Acceptable
2.2.12	Aux Equipment & Accessories		No	68DBA at 7m Frontier to provide field fit additional attenuation to attain 67dba Eluminated control panel no exterior flood lights (DC)
Part 2.3	**Subbase Tank**			
	24hr capacity		No	471 Lt capacity at 20.3 /hr = 23.2hrs coverage
	dual wall interstitial sensor	Yes		Acceptable
	Fuel sensing	Yes		generator control panel
	service loop	Yes		
	Fuel tank construction			UN31A - Canadian Standard for mobile EQ
	Fill location	Yes		
	Over Fill Visual / Audible	Yes		generator control panel
	Vent Pipes	Yes		UN31A - Canadian Standard for mobile EQ
	Fuel Polishing pipe connections			Not known
	Environmental Lable	Yes		to be provided by the Deparmental Representative
Part 2.4	**Spill Response Kit**			
	350Lts	Yes		
Part 2.5	**Generator Control Panel**			
	control panel	Yes		
Part 2.6	**Meters**			
	AC Voltmeter/ Ammeter / Frequency	Yes		
Part 2.7	**Battery Charger**			
	Float charge	Yes		
Part 2.8	**Enclosure**			
	Marine Grade Alum	Yes		Frontier will Upgrade to Alum c/w gutters and non higed doors additional 12wk delivery time
Part 2.9	**Genset noise**			
	67DBA	Yes		68DBA at 7m Frontier to provide field fit additional attenuation to attain 67dba
Part 2.10	**Signs**			
	Name Plate	Yes		Owner to provide Equipment Number
	Warning signage			to be confirmed
	WP Cabinet for Emergency Response			to be confirmed

Frontier
POWER PRODUCTS
7983 Progress Way | Delta, BC V4G 1A3
Phone: 604-946-5531 | Fax: 604-946-8524
www.frontierpower.com

Submittal Package

Job Name: Esquimault Graving Dock towable REV2 August 31/2016 revision

Quote: 0026255960

Proposal: GD7736

We are pleased to offer the following submittal for your consideration.

Thank you,
CRAIG EINARSON, FRONTIER POWER

Generator

Atlas Copco Model: QAS90JD MVT iT4

This generator set equipped with a alternator operating at 600 volts is rated for 75kW/90 kVA. Output amperage: 90.

Qty	Description
	QAS90 Generator System
1	Generator Set Lit Kit, General
1	Maint.

Include the following:

Literature Languages	English
Approvals and Listings	CSA Listing
Engine	QAS 90 Towable, 12V, 60Hz
Nameplate Rating	Standby 150C Rise (25C Amb.)
Voltage	60Hz, 347/600V, Wye, 3Ph, 4W
Alternator	LSA 600V
Cooling System	Unit Mounted Radiator, 45C
Skid and Mounting	Skid/Tank, Mobile
Air Intake	Heavy Duty
Controller	Deep Sea added detail
Connection Options	Camlock Load Connectors
Trailer	Installed to Generator Set
Enclosure Type	Sound 68DBA @ 7 m
Enclosure Material	Steel
Starting Aids, Installed	Cold Weather Package Battery
Electrical Accy.,Installed	Charger, Float, 6A
Fuel System Acc.,Installed	Coolant in Genset
Miscellaneous Accy,Installed	Standard 1 year
Warranty	

- Enclosure says 69dB, submittal says 68. 67dB required.

We will provide additional attenuation to attain a 67dba noise level. This will be in a free field test only, additional site ambient noise can contribute to a higher noise level, we will not be responsible for additional site related noise.

- Provide gen set controller as per spec.

Our control details are provided in the submittal on page 14, we have included further details spec sheets to confirm as to the spec:
Item2.2.8
1-Pushbutton start button is provided
2-OS,LOP,HET, are provided.
-Reset button is provided
-DIGITAL DISPLAY PROVIDED< NO LAMPS

-OS provided

-LOP provided
-HET provided
-LOP Prealram provided
-LCT provided
-LOW FUEL ALARM provided
-RUN, provided
-2 x AUX provided

.1 All engine gages are digital

.2 Voltage adjust rheostat is via digital control screen

.3.1 Digital metering only, single scale only. 0.5 % accuracy

.3.2 Voltage phase selector switch is provided

.4 Unit controller is solid state, please confirm your test device and we will confirm if compatible.

- Enclosure to be aluminum (5000 series) or stainless steel

We will upgrade the enclosure to aluminum on a custom design, it will have overhangs and bolt on doors, custom design additional leadtime of 6 weeks, new leadtime is 18 weeks from full approval.

- Confirm the following: the roof shall have a minimum 25 mm overhang and provide rain gutters over all doors and openings. All hinges shall be internally mounted and concealed, with grease fittings as required. External hinges will not be accepted.

See above, overhangs provided and non-hinged doors will be provided

- Provide breaker details to match spec

Please review the design of this unit under Power Distribution section, the unit has multi voltage outputs from 120-600 volts, each output is protected by its own breaker. This design is beneficial as it can be used in several different outputs as opposed to dedicated 600 volts, this exceeds spec items 2.2.2.12.5.2 and.3

- Provide details on tank to spec,Construction standard, fuel tank Pipe open-ings, fill connections, vent pipes, fuel polishing suction/return pipes

All the available tank details are provided, the tank is Canadian mobile standard built to UN31A

- Interstitial fuel sensor required

Provided

- Service loop in wiring allowing tank sensors to removed and examined/main-tained without sensor disconnection.

Provided

- Confirm spill kit is 350l as speced.

We can provide 350l spill kit

- Spare Tire

Provided

- CABLE STOWAGE BOX FOR 16m 5x200A DLO CABLE C/W CAMLOCK CONNECTOR TO MATCH EXISTING EGD GENERATOR CONNECTION POINTS, as per Drawing 8427

Not provided

Spec Sheets

QAS 70/90/120 JD iT4 MVT

Mobile Generator

Standard Scope of Supply

The Atlas Copco **QAS 70, QAS 90 & QAS 120 JD iT4** generators are prime power, multi-voltage, sound attenuated, mobile generators. They are powered by a John Deere iT4 liquid-cooled, four cylinder diesel engine.

The units consist of an alternator, diesel engine, cooling system, electrical distribution and control systems - all enclosed within a sound attenuated enclosure fabricated from powder coated galvanealed steel.

A broad range of undercarriage formats and options are available.

Special attention has been given to the overall product quality, user friendliness, ease of serviceability, and economical operation to ensure best in class total cost of ownership.

Available Models

QAS 70 JD	Multiple voltage – 70kVA prime power – John Deere engine
QAS 90 JD	Multiple voltage – 94kVA prime power – John Deere engine
QAS 120 JD	Multiple voltage – 120 kVA prime power – John Deere engine

Standard Features	Benefits
Compact, sound attenuated, corrosion resistant, with single point lifting and 110% fluid containment	Extremely durable and environmentally sensitive, designed to be used for everything from the oil patch to special event power
Available as a skid mounted unit with forklift pockets, or on a dual axle trailer	Versatility, giving you the flexibility to match your machine to the correct application
Heavy Duty alternator with AREP excitation and marine grade protection	Start-up power for the most demanding sites with 300% over load starting capabilities
Single side service with long run filters and 500 hour service intervals	Heavy duty oil, air and fuel filters extend the maintenance interval to 500 hours for reduced total cost of ownership Reduces maintenance costs with long intervals easy access for mechanics
Extremely reliable and durable John Deere 4045 iT4 engine	Proven engine platform with high reliability
Identical enclosures and maintenance points between all three models	Reduces stock of service kits and inventory of parts with rental ROI kept in mind
Emergency Stop	External, recessed emergency stop for increased safety
Remote Start / Stop	Allows connection as a critical back-up unit via a 2 wire dry contact connection in the distribution panel

Technical Data

Performance data [1]		QAS 70 Jd iT4	QAS 90 Jd iT4	QAS 120 Jd iT4
Rated frequency	Hz	60	60	60
Rated prime power (PRP) 3Ø	kVA / kW	70 / 56	90 / 72	120 / 95
Rated standby power (ESP) 3Ø	kVA / kW	77 / 62	99 / 79	133 / 106
Voltage selection (Series Start w/ Neutral) 3Ø	V	600Y/346 - 480Y/277	600Y/346 - 480Y/277	600Y/346 - 480Y/277
Voltage selection (Parallel Start w/ Neutral) 3Ø		240Y/139 - 208Y/120	240Y/139 - 208Y/120	240Y/139 - 208Y/120
Rated power factor (lagging)		0.8	0.8	0.8
Rated current (PRP) @600V	A	67	87	116
Rated current (PRP) @480V	A	84.2	113	143
Rated current (PRP) @240V	A	162	192	270
Rated current (PRP) @208V	A	188	222	312
Rated prime power (PRP) 1Ø	kVA	33.6	40	55.4
Voltage selection (Zig-Zag) 1Ø	V	240 / 120	240 / 120	240 / 120
Rated power factor		1	1	1
Rated current (PRP) @240V	A	140	166	231
Rated current (PRP) @120V	A	2 x 140	2 x 166	2 x 231
Single step load capability (G2) acc. ISO-8528/5	%	80	80	80
Max. sound pressure level (LPA) at 7m (23ft)	dB(A)	69	69	69
Power Distribution – Terminal Board		5 Wire (L1, L2, L3, N, Ground)		
Terminal Board Connections		Bare Wire Terminals		
Maximum Terminal Cable Size		350MCM		
Convenience Receptacles [2]		2 x NEMA 5-20R & 2 x 125/250V 50A CS6364		
Maximum Ambient Temperature (@ Sea Level) [3]	°F (°C)	122 (50)	122 (50)	122 (50)
Minimum Starting Temperature (Without cold weather options) [4]	°F (°C)	14 (-10)	14 (-10)	14 (-10)
Electrical System (Negative Ground)	V	12	12	12
Battery Capacity (Cold Cranking Amps)	A	725	725	725

Alternator		Leroy Somer	Leroy Somer	Leroy Somer
Model		LSA 43.2 M45	LSA 43.2 L8	LSA 44.2 VS45
Degree of protection / Insulation class		23 / H	23 / H	23 / H
Automatic Voltage Regulator (+/- 0.5%)		R438	R438	R438
Excitation system		AREP	AREP	AREP

Engine		John Deere	John Deere	John Deere
Model		4045HF2G92	4045HFG92	4045HFG93
Tier	US EPA	iT4	iT4	iT4
Rated speed	rpm	1800	1800	1800
Prime Horsepower	HP	97	121	151
Speed governor		Electronic	Electronic	Electronic
Number of cylinders		4	4	4
Swept volume	l	4.5	4.5	4.5
Coolant		Water	Water	Water
Aspiration		Turbocharged and intercooled		
Engine oil capacity [5]	US Gal (L)	5.4 (20.5)	5.4 (20.5)	5.4 (20.5)
Engine coolant capacity	US Gal (L)	122 (50)	122 (50)	122 (50)

Fuel system				
Fuel consumption @25% load (PRP)	gal / h (l / h)	1.9 (7.2)	1.9 (7.2)	2.6 (10)
Fuel consumption @50% load (PRP)	gal / h (l / h)	2.4 (9.2)	3.0 (11.4)	3.8 (14.2)
Fuel consumption @75% load (PRP)	gal / h (l / h)	3.2 (12.1)	4.0 (15.1)	5.4 (20.4)
Fuel consumption @100% load (PRP)	gal / h (l / h)	4.27 (16.1)	5.39 (20.3)	7 (26.4)
Fuel Type [6]		Ultra Low Sulfur Diesel ONLY		
Capacity fuel tank (Double wall, UN31A)	gal (l)	125 (471)	125 (471)	125 (471)
Fuel autonomy @100% load [7]	h	27	21.6	16.2

---

[1] *All ratings are at a reference condition of 0' altitude and 20°C (72°F)*

[2] *Please see receptacle voltage configuration in Power Distribution section*

[3] *Please see "Derate Table" for altitude and temperature calculations on page*

[4] *Cold start option comes with 120V block heater and 0W40 synthetic engine oil*

[5] *Engine oil to meet CJ-4 (low ash oil)*

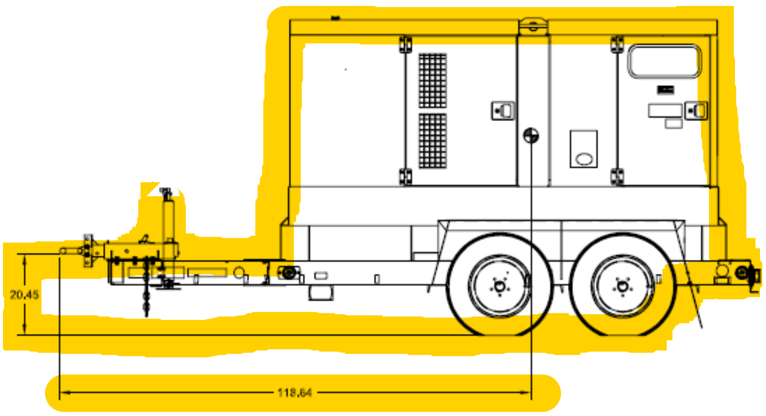
[6] *Engine and emissions require the use of Ultra Low Sulfur Diesel in accordance to ASTM-D975 Grade No.1-D S15 & No.2-D S15*

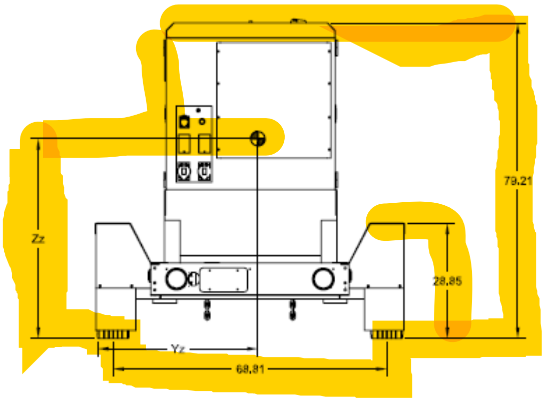
/ *Based on 90% volume of fuel tank*

Atlas Copco

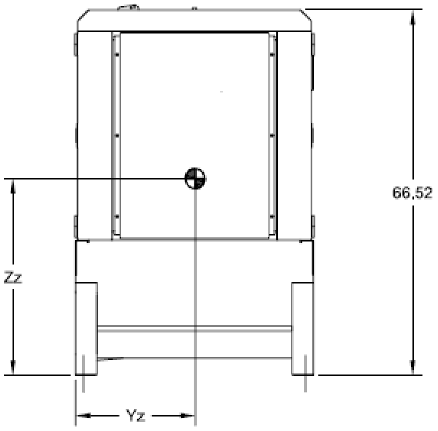
Dimensions

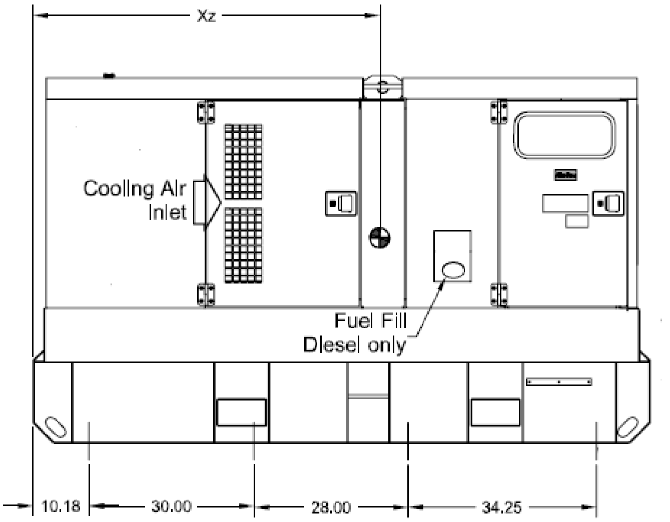
Trailer Mounted





Skid Mounted





Dimensions & weight		QAS 70 Jd iT4	QAS 90 Jd iT4	QAS 120 Jd iT4
Trailer	Inches (L x W x H)	176 x 78 x 80		
Weight (w/ trailer, wet)	lbs (kg)	6,560 (2,976)	6,560 (2,976)	6,610 (2,999)
Skid (w/Forklift pockets)	Inches (L x W x H)	112 x 44 x 67		
Weight (skid, wet)	lbs (kg)	5,310 (2,499)	5,310 (2,499)	5,360 (2,432)

Principle Data

Alternator

The Leroy Somer LSA alternators are designed for heavy duty continuous applications, with marine winding protection and Leroy Somer's AREP excitation system.

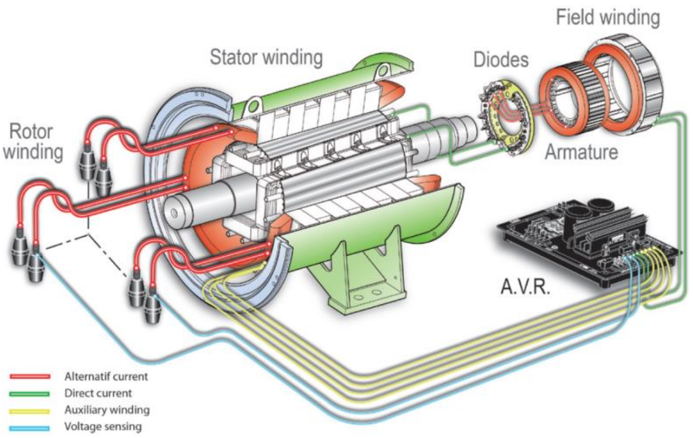
- AREP Excitation for superior motor starting capabilities
- Marine grade (relative humidity >95%) protection
- External multi-voltage selector switch (3 – position)
- 4 pole brushless design with single bearing, Class H insulation and IP23 rating
- Voltage regulation +/- 0.5%
- Full Load acceptance of prime power rating

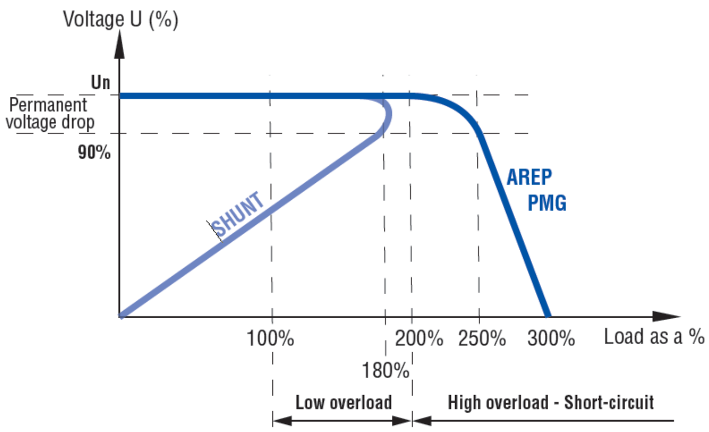
The AREP system uses 2 independent auxiliary windings located in the main stator to send supply voltage to the AVR:

- The voltage delivered by the first auxiliary winding H1 is proportional to the alternator output voltage (shunt characteristic).
- The voltage delivered by the second auxiliary winding H3 is proportional to the current drawn by the alternator and is a function of the applied load (compound characteristic – booster effect).
- The resulting phase-to-phase voltage supplies power to the AVR.

This power supply to the AVR power circuit is independent of the voltage sensing measured on the alternator output terminals. Therefore, the excitation current delivered by the AVR to the alternator exciter is independent of any voltage distortions (harmonics) due to the load.

The AREP system gives the alternator a high overload capacity (load impact or starting electric motors) and a short-circuit capability (300% - 10 s) in order to provide discriminating protection: the alternator with AREP excitation is shorter than the one with PMG excitation. It is particularly suitable for demanding applications.





Performance @ Altitude and High Ambient Conditions

When using at altitude and high ambient conditions the engine and alternator will de-rate as per chart below.

	Temperature °C (°F)										
Height m (Feet)	**0 (32)**	**5 (41)**	**10 (50)**	**15 (59)**	**20 (68)**	**25 (77)**	**30 (86)**	**35 (95)**	**40 (104)**	**45 (113)**	**50 (122)**
0	100%	100%	100%	100%	100%	100%	100%	100%	100%	97%	94%
500 (1640)	100%	100%	100%	100%	100%	100%	100%	100%	100%	97%	94%
1000 (3280)	100%	100%	100%	100%	100%	100%	100%	100%	100%	97%	94%
1500 (4921)	97%	97%	97%	97%	97%	97%	97%	97%	97%	94%	91%
2000 (6561)	94%	94%	94%	94%	94%	94%	94%	94%	94%	91%	88%
2500 (8202)	88%	88%	88%	88%	88%	88%	88%	88%	88%	85%	83%
3000 (9842)	88%	88%	88%	88%	88%	88%	88%	88%	88%	85%	83%
3500 (11,482)	82%	82%	82%	82%	82%	82%	82%	82%	82%	80%	77%
4000 (13,123)	82%	82%	82%	82%	82%	82%	82%	82%	82%	80%	77%

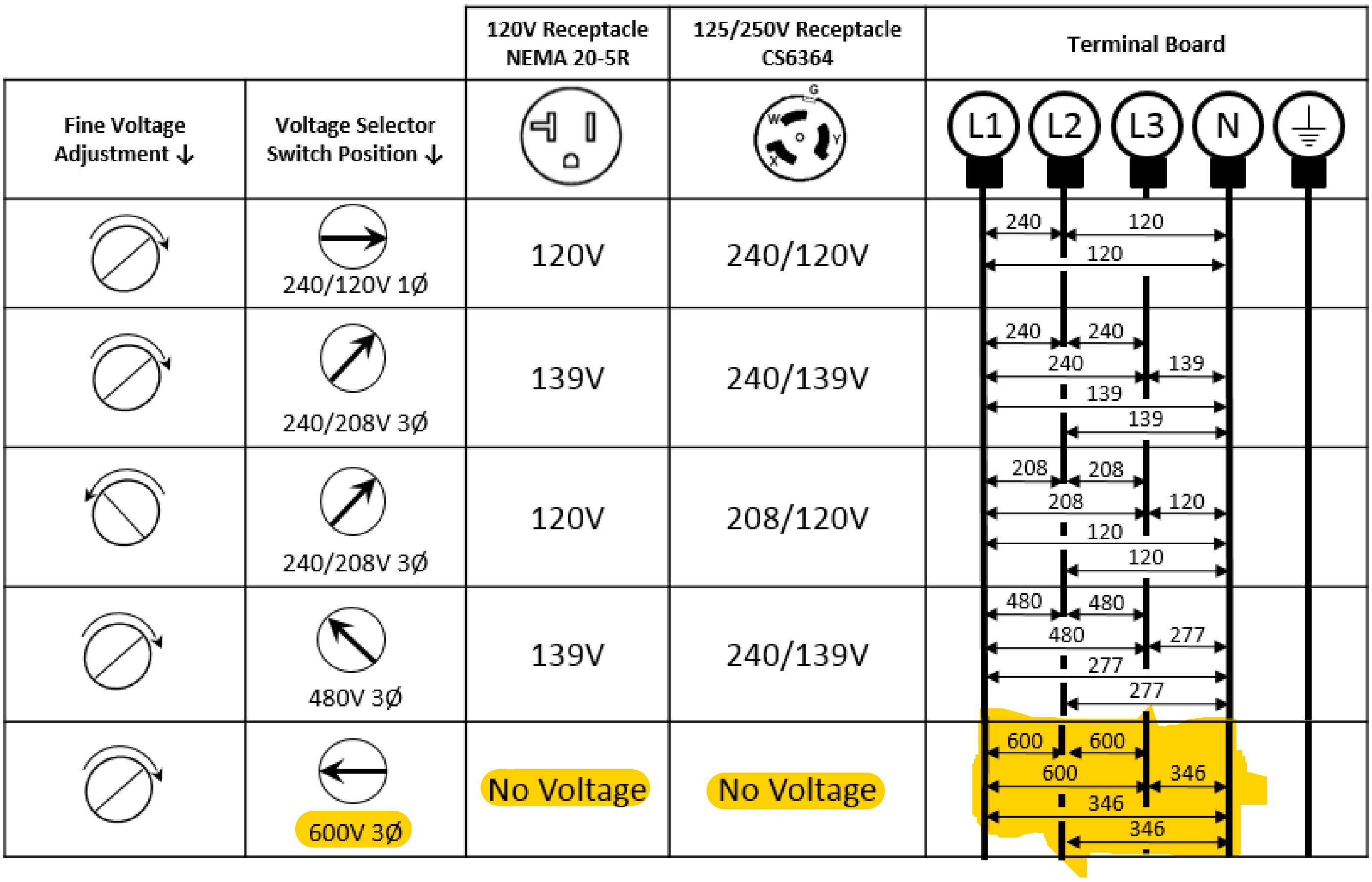
When nominal power is below 30kVA derating factor is different, check Instruction Book.

Power Distribution

The main power is connected from the alternator through a 3 position voltage selector switch to the main power cubicle. The cubicle incorporates all power distribution, controls, sensing and protection devises.

- ✓ 4 position Multi Voltage Technology Selector Switch (MVT)
- ✓ Current transformer x 3 (1 each leg)
- ✓ Single main breaker w/shunt trip
- ✓ Individual breakers for each receptacle
- ✓ Convenience receptacles located on outside of unit for easy access
- ✓ Terminal board for hard wiring
- ✓ Cam-Lock external quick connect (available as option)
- ✓ External emergency stop switch (recessed)
- ✓ Neutral bonded to Ground with a removable bonding link accessible in the control cubicle

Please refer to the chart below for power distribution and voltages. NOTE: All voltages below are subject to change, depending on set point of “Fine Voltage Adjustment” potentiometer and Voltage Selector Switch.



Fine Voltage Adjustment ↓	Voltage Selector Switch Position ↓	120V Receptacle NEMA 20-5R	125/250V Receptacle CS6364	Terminal Board L1 L2 L3 N ⏚
	240/120V 1Ø	120V	240/120V	240 120 120
	240/208V 3Ø	139V	240/139V	240 240 240 139 139 139
	240/208V 3Ø	120V	208/120V	208 208 208 120 120 120
	480V 3Ø	139V	240/139V	480 480 480 277 277 277
	600V 3Ø	No Voltage	No Voltage	600 600 600 346 346 346

- All voltages are adjustable with the “Fine Voltage Adjustment” potentiometer located on the control panel. Therefore voltage may be different then what is shown in the above table. All voltages should be verified before connection to the unit.

DSE**7310**/20

AUTO START & AUTO MAINS FAILURE CONTROL MODULES

FEATURES

■■■■■■□

The DSE7310 is an Auto Start Control Module and the DSE7320 is an Auto Mains (Utility) Failure Control Module suitable for a wide variety of single, diesel or gas, gen-set applications.

Monitoring an extensive number of engine parameters, the modules will display warnings, shutdown and engine status information on the back-lit LCD screen, illuminated LEDs, remote PC and via SMS text alerts (with external modem).

The DSE7320 will also monitor the mains (utility) supply. The modules include USB, RS232 and RS485 ports as well as dedicated DSENet® terminals for system expansion.

Both modules are compatible with electronic (CAN) and non-electronic (magnetic pick-up/alternator sensing) engines and offer an extensive number of flexible inputs, outputs and extensive engine protections so the system can be easily adapted to meet the most demanding industry requirements.

The extensive list of features includes enhanced event and performance monitoring, remote communications, PLC functionality and dual mutual standby (DSE7310 only) to reduce engine wear.

The modules can be easily configured using the DSE Configuration Suite PC software. Selected front panel editing is also available.

ENVIRONMENTAL TESTING STANDARDS

ELECTRO-MAGNETIC COMPATIBILITY
BS EN 61000-6-2
EMC Generic Immunity Standard for the Industrial Environment
BS EN 61000-6-4
EMC Generic Emission Standard for the Industrial Environment

ELECTRICAL SAFETY
BS EN 60950
Safety of Information Technology Equipment, including Electrical Business Equipment

TEMPERATURE
BS EN 60068-2-1
Ab/Ae Cold Test -30 °C
BS EN 60068-2-2
Bb/Be Dry Heat +70 °C

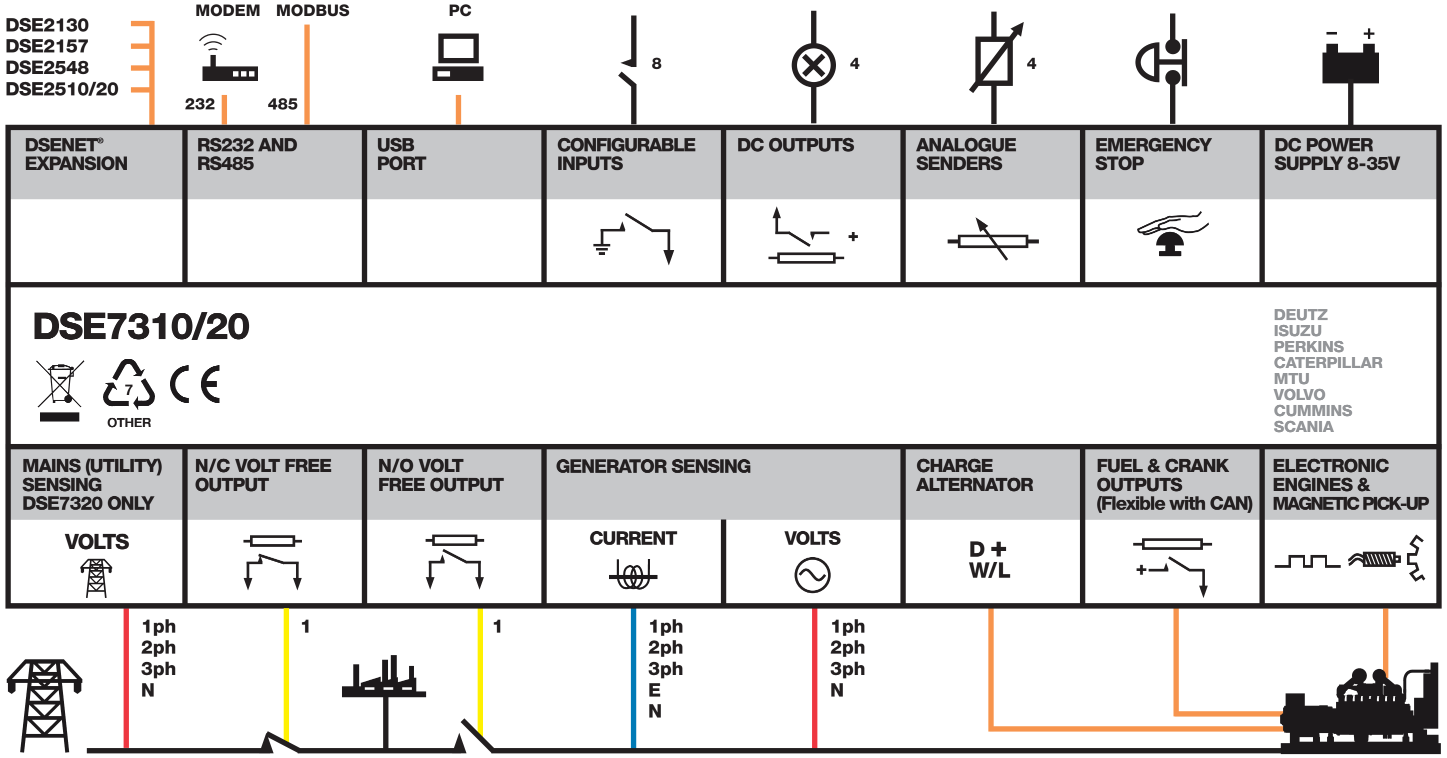
VIBRATION
BS EN 60068-2-6
Ten sweeps in each of three major axes
5 Hz to 8 Hz @ +/-7.5 mm,
8 Hz to 500 Hz @ 2 gn

HUMIDITY
BS EN 60068-2-30
Db Damp Heat Cyclic 20/55 °C
@ 95% RH 48 Hours
BS EN 60068-2-78
Cab Damp Heat Static 40 °C
@ 93% RH 48 Hours

SHOCK
BS EN 60068-2-27
Three shocks in each of three major axes
15 gn in 11 mS

DEGREES OF PROTECTION PROVIDED BY ENCLOSURES
BS EN 60529
IP65 - Front of module when installed into the control panel with the supplied sealing gasket.

COMPREHENSIVE FEATURE LIST TO SUIT A WIDE VARIETY OF GEN-SET APPLICATIONS



ISSUE 6

DSEGenset

DSE®

DSE7310/20

AUTO START & AUTO MAINS FAILURE CONTROL MODULES

FEATURES

■■■■■■□

DSE**7310**

DSE**7320**

KEY FEATURES

- 4-Line back-lit LCD text display
- Five key menu navigation
- Front panel editing with PIN protection
- Customisable status screens
- Power save mode
- Support for up to three remote display units
- 9 configurable inputs
- 8 configurable outputs
- Flexible sender inputs
- Configurable timers and alarms
- 3 configurable maintenance alarms
- Multiple date and time scheduler
- Configurable event log (250)
- CAN engine support
- Integral PLC editor
- Easy access diagnostic page
- CAN and Magnetic Pick-up/Alt. sensing
- Fuel usage monitor and low fuel alarms
- Charge alternator failure alarm
- Manual speed control (on compatible CAN engines)
- Manual fuel pump control
- Engine exerciser
- “Protections disabled” feature
- kW & kV Ar protection
- Reverse power (kW & kV Ar) protection
- LED and LCD alarm indication
- Power monitoring (kW h, kV Ar, kV A h, kV Ar h)
- Load switching (load shedding and dummy load outputs)
- Automatic load transfer (DSE7320)
- Unbalanced load protection
- Independent Earth Fault trip
- True dual mutual standby with load balancing timer (DSE7310 only)
- USB connectivity
- Backed up real time clock
- Fully configurable via DSE Configuration Suite PC software
- Configurable display languages
- Remote SCADA monitoring via DSE Configuration Suite PC software
- User selectable RS232 and RS485 communications
- Configurable Gencomm pages
- Advanced SMS messaging (additional external modem required)
- Start & stop capability via SMS messaging
- Additional display screens to help with modem diagnostics
- Idle control for starting & stopping.
- DSENet® expansion compatible
- Heated display option available

KEY BENEFITS

- 132 x 64 pixel ratio display for clarity
- Real-time clock provides accurate event logging
- Multiple date and time scheduler
- Set maintenance periods can be configured to maintain optimum engine performance
- Ethernet communications (via DSE855 module), provides advanced remote monitoring
- Modules can be integrated into building management systems (BMS)
- Increased input and output expansion capability via DSENet®
- Licence-free PC software
- IP65 rating (with supplied gasket) offers increased resistance to water ingress
- PLC editor allows user configurable functions to meet specific application requirements

SPECIFICATION

DC SUPPLY

CONTINUOUS VOLTAGE RATING
8 V to 35 V Continuous

CRANKING DROPOUTS
Able to survive 0 V for 50 mS, providing supply was at least 10 V before dropout and supply recovers to 5 V. This is achieved without the need for internal batteries. LEDs and backlight will not be maintained during cranking.

MAXIMUM OPERATING CURRENT
340 mA at 12 V, 160 mA at 24 V

MAXIMUM STANDBY CURRENT
160 mA at 12 V, 80 mA at 24 V

CHARGE FAIL/EXCITATION RANGE
0 V to 35 V

MAINS (UTILITY) DSE7320 ONLY

VOLTAGE RANGE
15 V to 415 V AC (Ph to N)
26 V to 719 V AC (Ph to Ph)

FREQUENCY RANGE
3.5 Hz to 75 Hz

OUTPUTS

OUTPUT A (FUEL)
15 A DC at supply voltage

OUTPUT B (START)
15 A DC at supply voltage

OUTPUTS C & D
8 A 250 V (Volt free)

AUXILIARY OUTPUTS E,F,G,H
2 A DC at supply voltage

GENERATOR

VOLTAGE RANGE
15 V to 415 V AC (Ph to N)
26 V to 719 V AC (Ph to Ph)

FREQUENCY RANGE
3.5 Hz to 75 Hz

MAGNETIC PICK UP

VOLTAGE RANGE
+/- 0.5 V to 70 V

FREQUENCY RANGE
10,000 Hz (max)

DIMENSIONS

OVERALL
240 mm x 181 mm x 42 mm
9.4” x 7.1” x 1.6”

PANEL CUT-OUT
220 mm x 160 mm
8.7” x 6.3”

MAXIMUM PANEL THICKNESS
8 mm
0.3”

OPERATING TEMPERATURE RANGE
-30°C to +70°C

STORAGE TEMPERATURE RANGE
-40°C to +80°C

RELATED MATERIALS

TITLE	PART NO’S
DSE7310 Installation Instructions	053-028
DSE7320 Installation Instructions	053-029
DSE7200/7300 Quick Start Guide	057-101
DSE7200/7300 Operator Manual	057-074
DSE7200/7300 Configuration Suite PC Manual	057-077

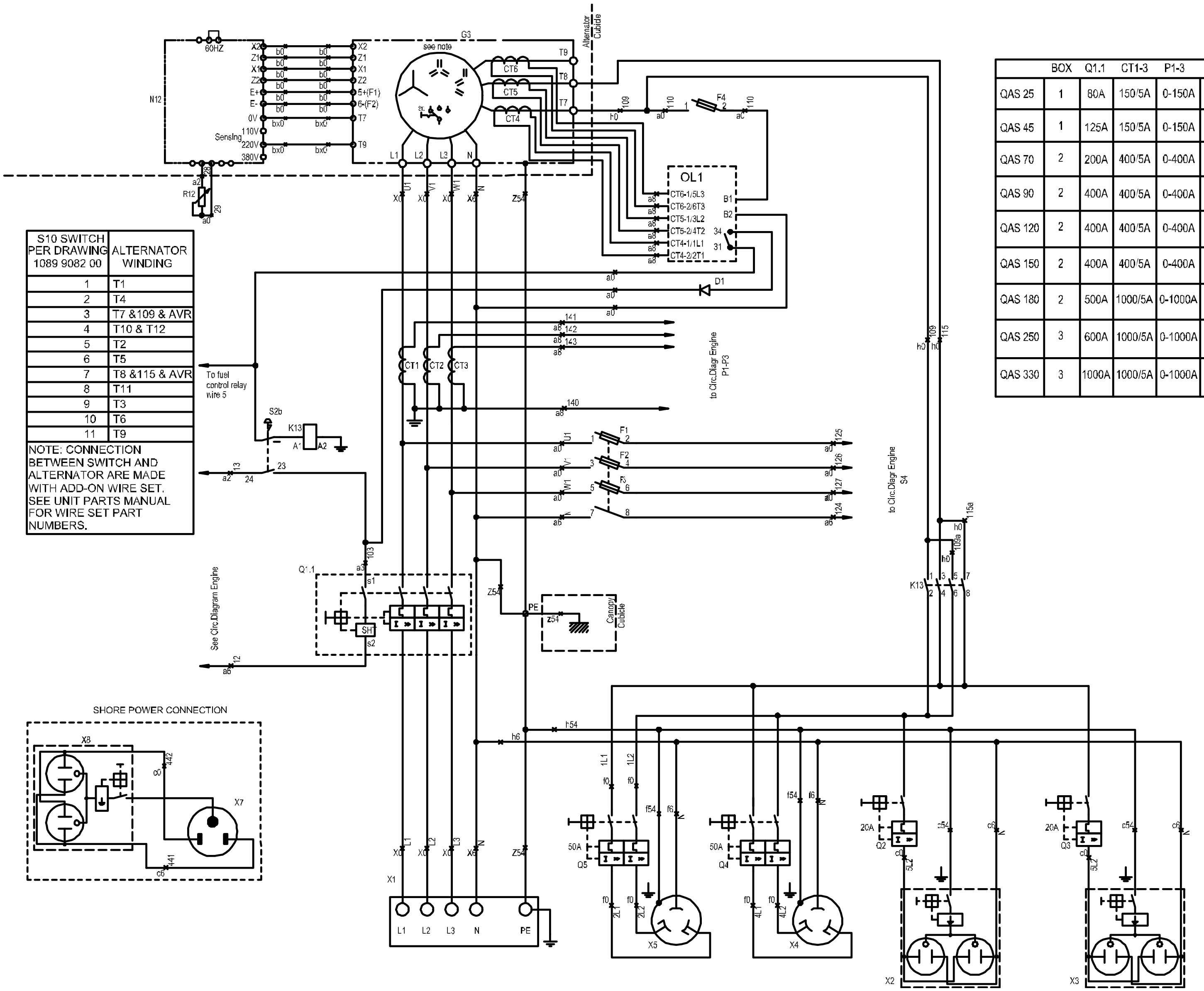
DEEP SEA ELECTRONICS PLC UK
Highfield House, Hunmanby Industrial Estate, Hunmanby YO14 0PH
TELEPHONE +44 (0) 1723 890099 **FACSIMILE** +44 (0) 1723 893303
EMAIL sales@deepseaplc.com **WEBSITE** www.deepseaplc.com

DEEP SEA ELECTRONICS INC USA
3230 Williams Avenue, Rockford, IL 61101-2668 USA
TELEPHONE +1 (815) 316 8706 **FACSIMILE** +1 (815) 316 8708
EMAIL sales@deepseausa.com **WEBSITE** www.deepseausa.com

Deep Sea Electronics Plc maintains a policy of continuous development and reserves the right to change the details shown on this data sheet without prior notice. The contents are intended for guidance only.

Registered in England & Wales No.01319649
VAT No.316923457

1310 3200 29/00
Applicable for QAS 70-90-120 John Deere - Power circuit



S10 SWITCH PER DRAWING 1089 9082 00	ALTERNATOR WINDING
1	T1
2	T4
3	T7 &109 & AVR
4	T10 & T12
5	T2
6	T5
7	T8 &115 & AVR
8	T11
9	T3
10	T6
11	T9

NOTE: CONNECTION BETWEEN SWITCH AND ALTERNATOR ARE MADE WITH ADD-ON WIRE SET. SEE UNIT PARTS MANUAL FOR WIRE SET PART NUMBERS.

	BOX	Q1.1	CT1-3	P1-3	CT4-6	OL1	Wire size
QAS 25	1	80A	150/5A	0-150A	60/5A	2.5A	X/fx Z/f
QAS 45	1	125A	150/5A	0-150A	60/5A	5.0A	X/hx Z/h
QAS 70	2	200A	400/5A	0-400A	200/5A	2.5A	X/ix Z/j
QAS 90	2	400A	400/5A	0-400A	200/5A	3.2A	X/(2)jx Z/j
QAS 120	2	400A	400/5A	0-400A	200/5A	4.2A	X/(2)jx Z/j
QAS 150	2	400A	400/5A	0-400A	200/5A	5.0A	X/(2)jx Z/j
QAS 180	2	500A	1000/5A	0-1000A	400/5A	3.1A	X/(2)jx Z/k
QAS 250	3	600A	1000/5A	0-1000A	400/5A	3.5A	X/(2)kx Z/k
QAS 330	3	1000A	1000/5A	0-1000A	400/5A	5.0A	X/(2)my Z/k

Connection Lugs for 4x 1c#3/0 CU DLO cable at 15mt each - provided by WPE

Controller

The QAS 70/90/120 come equipped with a DeepSea 7310 control module. This is a fully diagnostic ECU controller with large 3” display that is intuitive and easy to operate with all functions conveniently at your fingertips. The controller also manages the engine ECU operating system, and a number of safety warnings and shut downs on various parameters (listed below).

The controller is powered by a main On/Off switch located next to unit.

DeepSea 7310 Controller Functionality:

- Home Page (displayed while running, scrolling every 3seconds)
  - ✓ Generator voltage (ph-ph)
- Status Page
  - ✓ Generator voltage (ph-N)
  - ✓ Generator voltage (ph-ph)
  - ✓ Generator frequency
  - ✓ Generator kw
  - ✓ Generator power factor
  - ✓ Generator amperage
- Generator Page
  - ✓ Generator current (A)
  - ✓ Generator earth current
  - ✓ Generator load (kw)
  - ✓ Generator load (kVA)
  - ✓ Generator power factor
  - ✓ Generator load (kVAr)
  - ✓ Generator load (kWh, kVAh, kVArh)
  - ✓ Generator phase sequence
  - ✓ Dual mutual status
- Event Page
  - ✓ Displays the last 15 events
- Remote Start/Stop
  - ✓ Automatic start stop via 2 wire dry contact connection
- Operational Buttons
  - ✓ Start button
  - ✓ Stop button
  - ✓ Automatic mode (external remote start)
  - ✓ Up/Down arrows
- Info Page
  - ✓ Model number
  - ✓ USB identification number
  - ✓ Configured engine type
  - ✓ Module’s date and time
  - ✓ Scheduler setting
- Engine Page
  - ✓ Engine speed
  - ✓ Oil pressure
  - ✓ Coolant temperature
  - ✓ Engine Battery volts
  - ✓ Run Time
  - ✓ Oil Temperature
  - ✓ Fuel Temperature
  - ✓ Turbo Pressure
  - ✓ Fuel Pressure
  - ✓ Fuel Consumption
  - ✓ Fuel Used
  - ✓ Fuel Level
  - ✓ Auxilliary Sensors
  - ✓ Engine Maintenance Due
  - ✓ Engine ECU Link
  - ✓ DPF Soot Level
- Engine DTC Page
  - ✓ This page contains any active Diagnostic Trouble Codes that the engine ECU is currently generating. These alarms are conditions detected by the engine ECU and displayed on the DSE controller.

Engine

John Deere

John Deere Interim Tier 4, turbo charged, four-cylinder, liquid-cooled diesel engine provides ample power to operate the generator continuously at full-load.

Meets all US EPA, CARB and Environment Canada exhaust legislations with interim Tier 4 compliance. The engine utilizes a Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF) to meet interim Tier 4 emissions. All functionality of the engine is controlled automatically on the Atlas Copco controller.

The engine has the capability to start the generator at 14°F (-10°C) with standard glow-plug aid and block heater. Cold start options are available for machine starting for down to -13°F (-25°C).

Fuel tank is sufficiently sized to operate the unit at full-load condition for long run times (see chart on page 2 for specifications). And complies with the UN31A standard.

The engine operates on a 12V negative ground electrical system with a 90A charging alternator. Comes standard with 120V immersion block heater.

The cooling system is suitably designed for continuous operation in ambient conditions up to 122°F (50°C), with canopy door closed.

Fuel System

A large metal fuel tank provides safe diesel storage while eliminating tank corrosion contaminants from being introduced to your fuel system. With integrated fuel water separator and filter, the system is designed to help maintain clean and trouble free diesel supply to the engine for reliable trouble free operation.

- ✓ Lockable diesel fill cap
- ✓ Fuel / Water separator
- ✓ Inline priming pump (w/ filter)
- ✓ Fuel pre-filter
- ✓ Fuel supply pump (w/ strainer)
- ✓ Fuel level sensor
- ✓ Low fuel shut down feature (programmable level)

Scheduled maintenance

Standard equipped with filters sized and designed to allow 500 hour service intervals under normal operating conditions. Extended time between services reduces down time and total cost of ownership of the unit over its lifetime.

- 500 Hour Service Interval:
  - ✓ Air filter
  - ✓ Oil filter
  - ✓ Fuel filter
  - ✓ Fuel / water separator
- 1000 Hour Service Interval:
  - ✓ Air filter
  - ✓ Oil filter
  - ✓ Fuel filter
  - ✓ Fuel / water separator

NOTE: Site specific operating conditions such as; poor fuel quality and low load profile may require more frequent service intervals.

Enclosure & Frame

The generator enclosure is designed for extreme applications to provide superior performance and reliability.

The enclosure is fabricated from galvaneal coated steel which is powder coated for corrosion resistance. The enclosure and frame are fully sealed from the radiator to the back of the unit, providing a true 110% containment of all fluids.

- ✓ Galvanealed, powder coated enclosure
- ✓ Heavy duty base frame
- ✓ 110% fluid containment
- ✓ UN31A fuel tank fulfillment
- ✓ Superior level of rain ingress protection and design features
- ✓ Lockable doors and fuel cap
- ✓ Engine fluid plumbed to exterior of frame for ease of service
- ✓ Central lifting point
- ✓ Sound dampening material and design to allow quiet operation at 69 dB(A) at 7 meters distance

Undercarriage

The QAS 70, QAS 90 and QAS 120 are available with two undercarriage alternatives, providing utmost flexibility in installation, site handling or towing. Both the skid frame and the trailer mount the same way and can be interchanged for versatility.

- Trailer mounted:
  - ✓ Dual axle trailer
  - ✓ Available with hydraulic or electric brakes
  - ✓ DOT/Federal MVSS 49CFR571 approved light package and 7 flat blade RV style plug
  - ✓ Adjustable height pintle hitch (3” lunette)
  - ✓ 15” Rims w/ ST205/75R15 Tires for trailer use
  - ✓ Heavy Duty torsion axle rated at 3,500lbs w/ brakes
  - ✓ Safety chains
  - ✓ Screw jack leveling, with pad foot, 8,000 lbs static capacity
  - ✓ Single point lifting structure
  - ✓ D-Ring Tie down points x4

- Skid mounted:
  - ✓ Sub-frame skid with integrated forklift pockets
  - ✓ Heavy duty design for use in extreme conditions
  - ✓ Frame is ¼” wider then machine to reduce damage from forklifts
  - ✓ Built-in locations for straps or chains to secure the unit for transport
  - ✓ Single point lifting structure

Factory Options Available

- Dual axle trailer with hydraulic or electric brake package
- Heavy duty skid with forklift pockets
- 2” or 2 5/16” ball hitches (shipped loose)
- Trailer stabilizer jacks
- Trailer mounted tool box
- Trailer spare tire
- Battery charger (12V)
- Battery isolation switch (lockable)
- Cam-Lock quick connections (5 x 400A)
- External fuel quick connects (3 way valve, located inside of enclosure for spill containment and protection)
- CSA approval (Standard for Canada)

Manufacturing & Environmental Standards

The **QAS 70, QAS 90, and QAS 120 JD iT4** are manufactured following stringent ISO 9001 regulations, and by a fully implemented Environmental Management System fulfilling ISO 14001 requirements.

Attention has been given to ensure minimum negative impact to the environment.

The **QAS 70, QAS 90, and QAS 120 JDiT4** meets all current US EPA, CARB and Environment Canada exhaust and noise emission directives.

Supplied Documentation

The unit is delivered with documentation regarding:

- Hard copies of the Atlas Copco Operators Safety and Instruction Manual, Atlas Copco Parts Book, John Deere Engine Manual and Parts book, in English as well as electronic copies available on request.
- Warranty Registration card for engine and Atlas Copco Generators (Units must be registered upon receipt).

Warranty Coverage

Atlas Copco Generator: Warrantied to be free from defects with regard to material and workmanship for the period of eighteen (18) months from date of shipment from the factory, or twelve (12) months from date of initial startup, whichever occurs first, without limitation of running hours.

John Deere Engine: Warranty from John Deere. Unit must be registered directly with John Deere upon receipt to be eligible for warranty. Failure to register warranty upon initial startup may cause warranty claim delays or rejection of claim by John Deere.

John Deere Diesel Engines are warranted to be free from defects with regard to materials and workmanship for the period of twelve (12) months from the date of initial startup, without limitation in running hours, or the period of the twenty-four (24) months from the date of initial startup, prior to the accumulation of 2,000 running hours. Emission control components are warranted for 5 years or 3,000 hours.

Leroy Somer Alternator: Warrantied to be free from defects with regard to material and workmanship for the period of twenty seven (27) months from date of shipment from the factory, or twenty four (24) months from date of initial startup or 10,000 hours, whichever occurs first.

Extended Warranty Programs: Programs are available; please contact your local sales representative for more info.

KOHLER. Power Systems

Float/Equalize Battery Charger

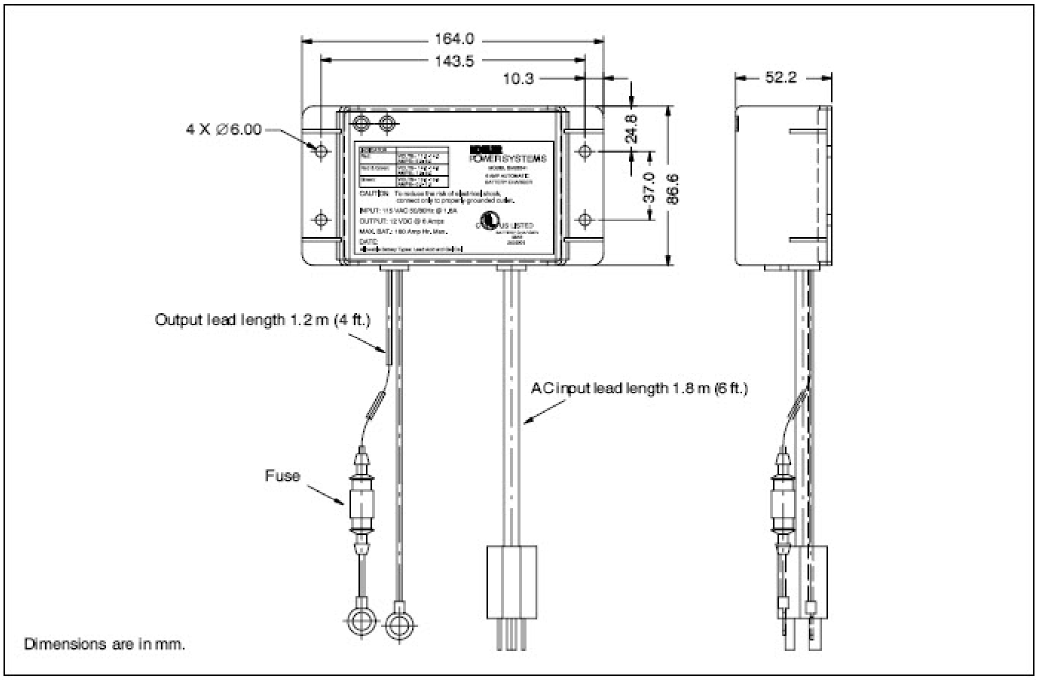
ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

Standard Features

- 12 VDC output. * Use two battery chargers for 24-volt electrical systems.
- Automatic 3-stage float/equalize battery charger
- Charges both lead-acid and gel-cell type batteries
- Indicator lamps: red and green LEDs indicate bulk charge, absorption, and float charge stages
- Durable potted assembly for full waterproofing and shockproofing
- Reverse-polarity protection
- Short-circuit protection
- UL 1236 listed
- UL 2200 compliant
- UL 991 compliant for vibration and shock
- UL listed to Canadian safety standards
- UL rated inline fuse
- FCC Class B-compliant for EMI/RFI (Date code 8/26/04 or later)
- 1-year warranty
- Easy installation:
  - o Integral mounting flanges
  - o Ring terminals for battery connection
  - o Standard US style 3-prong AC plug

Specifications

Input Voltage / Frequency	90-135 VAC / 50/60 Hz
DC Output: Bulk Absorption Float	11.8-14.0 VDC @ 5.0-6.0 amps 14.0-14.5 VDC @ 1.5-5.0 amps 13.3-14.5 VDC @ 0.1-1.5 amps
Steady Full-Load Output Current	6 amps
Current Limit	7 amps
Output Power Limit	70 +2/-5 watts
Line Regulation Across Input Voltage Range	0.01
Isolation, Input to Output	2500 V
Dimensions (L x W x D)	164 x 87 x 53 mm (6.4 x 3.5 x 2.1 in)
Weight	1.6 kg (3.5 lb.)
Temperature Range, Operating and Storage	-40°C to 70°C (-40°F to 158°F)
Humidity	0 to 100% (condensing)



Battery Connections

Lead Length 1.2 m (4 ft.)

Battery Connections 9.5 mm (3.8 in.) ring terminals

AC Power Connections

Lead Length 1.8 m (6 ft.)

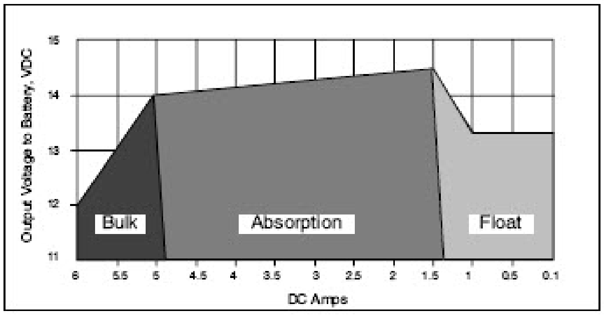
Connection Standard US style 3-prong AC plug

Shipping Information

Carton Size 254 x 152 x 89 mm (10 x 6 x 3.5 in.)

Shipping Weight 1.8 kg (4 lb.)

Charging Curves



JOHN DEERE

ENGINE PERFORMANCE CURVE

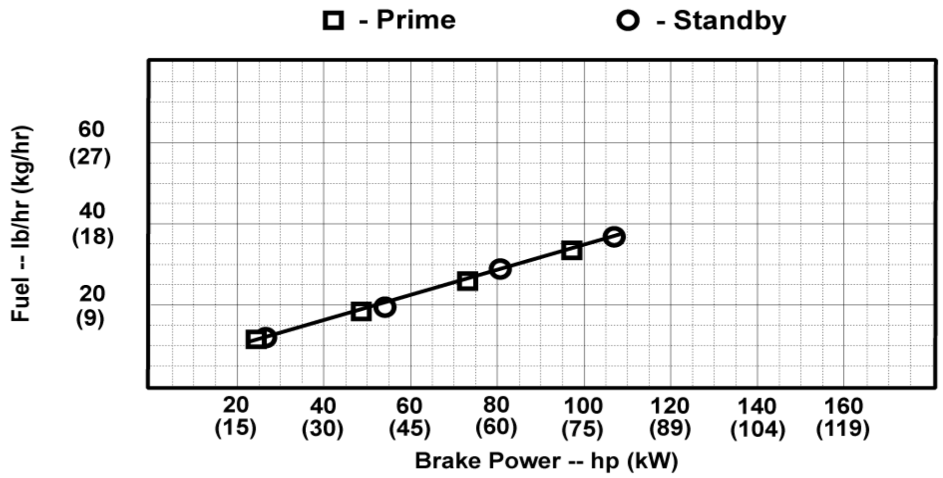
Rating: Gross Power
Application: Generator
1800 RPM (60 Hz)

PowerTech™ PWL 4.5L Engine
Model:4045HFG04
JD Electronic Control
97 hp (73 kW) Prime
107 hp (80 kW) Standby

Nominal Engine Power @ 1800 RPM			
Prime		Standby	
HP	kW	HP	kW
97	73	107	80

Generator Efficiency %	Fan Power (% of Standby)		Power Factor	Prime Rating		Standby Rating	
	hp	kW		kWe	kVA	kWe	kVA
88-92	7.5097232	5.6	0.8	60-62	74-78	65-68	82-86

Note 1: Based on nominal engine power; Fan Power is 7% of Standby Power.



STANDARD CONDITIONS

Air Intake Restriction.....................................12 in.H_2O (3 kPa)
Exhaust Back Pressure..............................30 in.H_2O (7.5 kPa)

Gross power guaranteed within + or - 5% at SAE J1995 and ISO 3046 conditions:
77 °F (25 °C) air inlet temperature
29.31 in.Hg (99 kPa) barometer
104 °F (40 °C) fuel inlet temperature
0.853 fuel specific gravity @ 60 °F (15.5 °C)
Conversion factors:
Power: kW = hp x 0.746
Fuel: 1 L = 0.85kg , 1 gal = 7.1 lb
Torque: N·m = lb-ft x 1.356
All values are from currently available data and are subje
ct to change without notice.

Notes: 1) This Performance Curve provides installation requirements necessary for the engine to emit at its certified emission levels. For additional information necessary to meet applicable regulatory requirements, refer to the John Deere Emissions-related Installation Instructions (AG01): https://power.deere.com/wps/myportal/jdps/products/engines/apguidelines. 2) A crankshaft Torsional Vibration Analysis is required on all Gen Set applications.

Designed/Calibrated to meet:	Certified by:
• CARB • EPA Tier 4 Ref: Engine Emission Label	01 Oct 2014

Performance Curve: 4045HFG04_B

Engine Installation Criteria

General Data

Model			4045HFG04	
Number of Cylinders			4	
Bore	106	mm	4.2	in.
Stroke	127	mm	5.0	in.
Displacement	4.5	L	275	in.³
Compression Ratio			17.0 : 1	
Valves per Cylinder, Intake/Exhaust			2 / 2	
Firing Order			1-3-4-2	
Combustion System			Direct Injection	
Engine Type			In-line, 4-cycle	
Aspiration			Turbocharged and air-to-air aftercooled	
Engine Crankcase Vent System			Open	

Physical Data

Length	870	mm	34.3	in.
Width	650	mm	25.6	in.
Height	1050	mm	41.3	in.
Weight, with oil &no coolant (Includes engine, flywheel housing, flywheel &electrics)	550	kg	1213	lb
Center of Gravity Location, X-axis From Rear Face of Block	265	mm	10.4	in.
Center of Gravity Location, Y-axis Right of Crankshaft	10	mm	0.4	in.
Center of Gravity Location, Z-axis Above Crankshaft	140	mm	5.5	in.
Max. Bending Moment about Main Bearings Front and Rear	480	N•m	354	lb-ft
Max. Allowable Static Bending Moment At Rear Face of Flywheel Housing with 5-G Load	814	N•m	600	lb-ft
Thrust Bearing Load Limit Forward, Intermittent	4000	N	899	lb
Thrust Bearing Load Limit Forward, Continuous	2200	N	495	lb
Thrust Bearing Load Limit Rearward, Intermittent	2000	N	450	lb
Thrust Bearing Load Limit Rearward, Continuous	1000	N	225	lb
Max. Continuous Damper Temp			NA	
Max. ECU Vibration, All Axis			6.00	gRMS
Max. Torsional Vibration, Front of Crank			0.25	DDA

Electrical System

Min. Instantaneous Cranking			50	rpm
Min. Steady State Cranking			120	rpm
Starter Rolling Current, 12V @32 °F (0 °C)			450	amps
Starter Rolling Current, 24V @32 °F (0 °C)			250	amps
Starter Rolling Current, 12V @-22 °F (-30 °C)			700	amps
Starter Rolling Current, 24V @-22 °F (-30 °C)			400	amps
Min. Voltage at ECU during Cranking, 12V			6	volts
Min. Voltage at ECU during Cranking, 24V			10	volts
Max. Voltage Drop, Battery to Starter			0.8	volts
Max. Allowable Start Circuit Resistance, 12V			0.0012	Ohm
Max. Allowable Start Circuit Resistance, 24V			0.002	Ohm
Max. Voltage From Engine to Crankshaft, 12V			15	volts
Max. Voltage From Engine to Crankshaft, 24V			30	volts
Max. ECU Temperature	105	°C	221	°F
Max. VTG Actuator Surface Temp			NA	
Max. Air Throttle Electrical Actuator Temperature			NA	
Max. Harness Temperature	125	°C	257	°F
Max. Alternator Temperature	105	°C	221	°F
Max. Starter Temperature	120	°C	248	°F
Max. Temperature, All Other Electronics	125	°C	257	°F

Performance Curve: 4045HFG04_B

Engine Installation Criteria

Charge Air Cooling System

Air-to-Air Heat Rejection	11	kW	626	BTU/min
Compressor Discharge Temperature @77°F(25°C) Ambient Air	146	°C	295	°F
Intake Manifold Pressure	122	kPa	17.7	psi
Compressor Discharge Temperature @117°F(47°C) 80 kPa Barametric pressure	186	°C	367	°F
Max. Temperature Out of Charge Air Cooler @All Ambient Conditions	88	°C	190	°F
Max. CAC System Volume	25	Liter	26	quart
Max. Pressure Drop through CAC	10	kPa	40.0	in. H_2O
Min. Pressure Drop through CAC	5	kPa	20.0	in. H_2O
Max. Temperature Out of Charge Air Cooler @77°F (25°C) Ambient Air	56	°C	133	°F
Min. Temperature Out of Charge Air Cooler @77°F (25°C) Ambient Air	44	°C	111	°F
Max. Bending Moment on Compressor Outlet	3.5	N·m	3	lb-ft
Max. Shear on Compressor Outlet	2.5	kg	6	lb

Cooling System

Engine Heat Rejection	51	kW	2903	BTU/min
Coolant Flow @10 kPa External Restriction	245	L/min	65	gal/min
Coolant Flow @40 kPa External Restriction	218	L/min	58	gal/min
Thermostat Start to Open	85	°C	185	°F
Thermostat Fully Open	97	°C	207	°F
Engine Coolant Capacity	8.5	Liter	9.0	quart
Min. Coolant Fill Rate	12	L/min	3.2	gal/min
Max. Water Pump Inlet Pressure	235	kPaa	34	psia
Min. Pump Inlet Pressure @203°F (95°C) Coolant	103	kPaa	15	psia
Min. Pump Inlet Pressure @Max. Top Tank Temperature	165	kPaa	24	psia
Max. External Coolant Restriction	40	kPa	6	psi
Max. Top Tank Temperature	113	°C	235	°F
Max. Top Tank Temperature 95% of Operating Hours	103	°C	217	°F

Exhaust System

Exhaust Flow	12.6	m^3/min	445	ft.^{3}/min
Exhaust Temperature	400	°C	752	°F
Max. Allowable Exhaust Restriction	11.5	kPa	46	in. H_2O
Max. Bending Moment on Turbo Outlet	7.4	N·m	5.5	lb-ft
Max. Shear on Turbine Outlet	2.5	kg	6	lb
Exhaust Filter Size			2 DOC \ 3 SCR	
Exhaust Filter Pressure Drop (Clean)	6.5	kPa	26	in. H_2O
Min. Mixing Length, Outlet to Exhaust Filter			NA	
Max. Bending Moment on Exhaust Filter Inlet	172	N·m	127	lb-ft
Max. Bending Moment on Exhaust Filter Outlet	85	N·m	63	lb-ft
Max. Exhaust Leakage Rate, Engine to Exhaust Filter @30kPa	5	L/min	1.3	gal/min
Max. Temperature Drop, Engine to Exhaust Filter	30	∆°C	54	∆°F

Fuel System

ECU Description			L34 Controller	
Fuel Injection Pump			Denso HP3	
Governor Type			Electronic	
Total Fuel Flow	42	kg/hr	93	lb/hr
Fuel Consumption, Prime	15.3	kg/hr	34	lb/hr
Fuel Consumption, Standby	16.8	kg/hr	37	lb/hr
Fuel Temperature Rise, Inlet to Return	30	∆°C	54	∆°F
Min. Fuel Inlet Pressure	-30	kPa	-120	in. H_2O
Max. Fuel Return Pressure	20	kPa	80	in. H_2O
Min. Fuel Return Pressure	0	kPa	0	in. H_2O
Max. Fuel Inlet Temperature	75	°C	167	°F
Fuel Filter @98% Efficiency			2	mic

Lubrication System

Oil Pressure at Rated Speed	330	kPa	48	psi
Oil Pressure at Low Idle			NA	
Max. In-Pan Oil Temperature	138	°C	280	°F
Max. Crankcase Pressure	1.0	kPa	4	in. H_2O

Performance Curve: 4045HFG04_B

Engine Installation Criteria

Air Intake System

Engine Air Flow	5.9	m³/min	208	ft.³/min
Air Mass Flow	403	kg/hr	888	lb/hr
Maximum Allowable Temperature Rise, Ambient Air to Engine Inlet	8	∆°C	15	∆°F
Max. Air Intake Restriction, Clean Air Cleaner	3.75	kPa	15.0	in. H_2O
Max. Air Intake Restriction, Dirty Air Cleaner	6.25	kPa	25.0	in. H_2O
Air Cleaner Efficiency			99.9	%

Performance Data

Rated Power, Prime	73	kW	97	HP
Rated Power, Standby	80	kW	107	HP
Rated Speed			1800	rpm
Low Idle Speed			NA	
Rated Torque, Prime	386	N•m	313	lb-ft
Rated Torque, Standby	425	N•m	313	lb-ft
BMEP, Prime	1070	kPa	313	psi
BMEP, Standby	1180	kPa	313	psi
Altitude Capability, Prime	3993	m	13100	ft
Altitude Capability, Standby	3292	m	10800	ft
Friction Power @Rated Speed	13	kW	17	HP
Air:Fuel Ratio, Prime			25.6 : 1	
Air:Fuel Ratio, Standby			24.3 : 1	
Noise @1 m Prime			89.2	dB(A)
Noise @1 m Standby			89.2	dB(A)
0-100% Standby Load Acceptance			1.78	sec
Load Acceptance, ISO 8528-5			G3	

Fuel Consumption	Prime		Standby	
	lb/hr	kg/h	lb/hr	kg/h
25 % Power	11.7	5.3	12.1	5.5
50 % Power	18.7	8.5	19.8	9.0
75 % Power	26.0	11.8	28.2	12.8
100 % Power	33.7	15.3	37.0	16.8

DEF Data

Rating	Engine Speed	DEF Consumption*		Percent of Diesel Consumption**
	RPM	g/kWh	lb/hp-hr	%
Standby	1800	11.8	0.01941	4.4
Prime	1800	11.7	0.01925	4.3

**DEF conversion factor: 1.087 kg/l (9.071 lb/gal)*

*** Percent of diesel consumption by volume at 100% power*

Performance Curve: 4045HFG04_B

KOHLER POWER SYSTEMS

Miscellaneous

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Aug 3, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 008

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – Spill Kit**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**Generator Spill Kit**	RVW

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 32 10 item 2.17 & 26 32 10.01 item 2.4

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

My Account | Contact Us | Sign In | Cart $0.00 Français

ULINE .ca 1-800-295-5510

Search GO

Products Uline Products Quick Order Catalog Request Special Offers About Us Careers

Home > All Products > Janitorial Supplies > Sorbents and Spill Control > Universal 95 Gallon Drum Spill Kit

UNIVERSAL 95 GALLON DRUM SPILL KIT

Fast response for emergency oil, water-based and chemical liquid spills.

- For large spills in factories and manufacturing plants.
- UN and DOT approved 95-gallon drum with screw-top lid.
- Includes:

(110) 15 x 19" Pads	(12) 3" x 4' Sorbent Socks
(8) 3" x 12' Sorbent Socks	(8) 18 x 18" Pillows
(1) pair Nitrile Gloves	Emergency Handbook
Goggles	(10) Disposal Bags

MODEL NO.	SPILL KIT	ABSORPTION CAPACITY	PRICE EACH		ADD TO CART
			1	3+	
S-18304	95-Gallon Drum	350 liter			1 ADD

(76 gallon)

SHIPS VIA MOTOR FREIGHT

Applied Engineering Solutions Ltd.
3rd Floor, 1815 Blanshard Street
Victoria, BC V8T 5A4

☒ Reviewed
☐ Revise and Resubmit
☐ Reviewed as Modified
☐ Not Reviewed

This review is only for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on shop drawings during this review do not relieve the contractor from compliance with the requirement of the plans and specifications. Review of the specific item shall not include review of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades; and for performing all Work in a safe and satisfactory manner.

Project No.: 16-008
Date: August 12, 2016
By: Iain Barnes

4 Total Required
3x 750KW Generator
1x 75KW Generator

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: 3 Aug, 2016
REVIEWED by _GW_

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
☒ SUBMITTAL

FOR:
☒ APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Nov 16, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 041

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – Generator Control Switchboard rev 2**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**W-095112 Generator Control Panel rev 2 (47 pgs)**	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

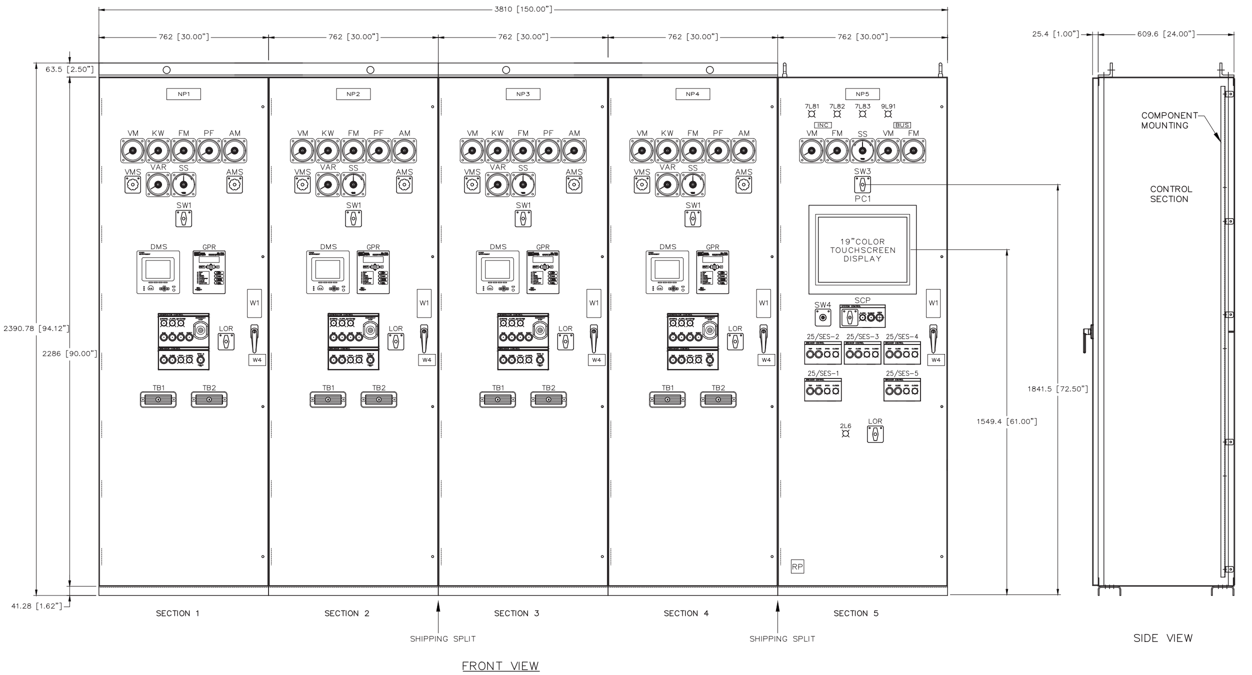
COMMENTS:
Reference Specification Section – 26 36 01 sec 1.5
Updated dwg information for review.

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax ☒ Email



DEVICE LEGEND

AM	AC AMMETER
AMS	AMMETER SELECTOR SWITCH
DMS	DIGITAL METERING SYSTEM (ION-7650)
FM	FREQUENCY METER
GPR	GENERATOR PROTECTION RELAY (SEL-700G)
HRN	HORN
KW	KILOWATT METER
L1	BREAKER OPEN LIGHT
L2	BREAKER CLOSED LIGHT
L3	GENERATOR RUNNING LIGHT
L4	GENERATOR COMMON ALARM LIGHT
L5	GENERATOR COMMON SHUTDOWN LIGHT
L6	BREAKER TRIPPED LIGHT
L7	GENERATOR IN AUTO LIGHT
7L81, 7L82, 7L83	UTILITY AVAILABLE LIGHT
9L91	EMERGENCY AVAILABLE LIGHT
8L10	SYSTEM COMMON ALARM LIGHT
LOR	LOCKOUT RELAY
OIT	OPERATOR INTERFACE TERMINAL DISPLAY
PB1	GENERATOR BREAKER TRIP PUSHBUTTON
PB2	GENERATOR BREAKER CLOSE PUSHBUTTON
PB3	ENGINE STOP PUSHBUTTON
PB4	ENGINE START PUSHBUTTON
PB5	EMERGENCY STOP PUSHBUTTON

DEVICE LEGEND

PB6	BREAKER SYNC & CLOSE PUSHBUTTON
PB7	ALARM SILENCE PUSHBUTTON
PF	POWER FACTOR METER
RP	RATING PLATE
SS	SYNCHROSCOPE
SW1	SYNC SWITCH (ON-OFF)
SW2	SYSTEM MODE (MAN-AUTO-START-TEST)
SW3	SYNC SELECTOR SWITCH (OFF-GENMAIN, DND, BCH-1, BCH-2)
SW4	TRANSITION MODE SWITCH (OPEN-CLOSED)
TB1, TB2	TEST BLOCK
VAR	VAR METER
VM	AC VOLTMETER
VMS	VOLTMETER SELECTOR SWITCH
W1,W3	WARNING LABELS

DRAWING LEGEND

10A	PHYSICAL LAYOUT
10B	SECTIONAL LAYOUT
20A	NAME PLATE DETAILS
30A	OVERALL SINGLE LINE DIAGRAM
30B	SINGLE LINE DIAGRAM
30C	SINGLE LINE DIAGRAM
30D	FIELD COMMUNICATION BLOCK DIAGRAM
30E	FIELD CONNECTION BLOCK DIAGRAM
40A	COMMON 24VDC SUPPLY SCHEMATIC
50A	COMMON PLC SCHEMATIC
50B	COMMON PLC SCHEMATIC
50C	COMMON PLC SCHEMATIC
50D	COMMON PLC SCHEMATIC
50E	COMMON PLC SCHEMATIC
50F	COMMON PLC SCHEMATIC
50G	COMMON PLC SCHEMATIC
61A	DND UTILITY 1 AC SCHEMATIC
61B	DND UTILITY 1 DC CONTROL SCHEMATIC
62A	BCH1 UTILITY 2 AC SCHEMATIC
62B	BCH1 UTILITY 2 DC CONTROL SCHEMATIC
63A	BCH2 UTILITY 3 AC SCHEMATIC
63B	BCH2 UTILITY 3 DC CONTROL SCHEMATIC
70A	TIE BREAKER AC & DC SCHEMATIC
80A	SYNC SCHEMATIC
91A	GENERATOR 1 AC SCHEMATIC
91B	GENERATOR 1 DC SCHEMATIC
91C	GENERATOR 1 DC SCHEMATIC
91D	GENERATOR 1 DC SCHEMATIC
91E	GENERATOR 1 DC SCHEMATIC

DRAWING LEGEND

92A	GENERATOR 2 AC SCHEMATIC
92B	GENERATOR 2 DC SCHEMATIC
92C	GENERATOR 2 DC SCHEMATIC
92D	GENERATOR 2 DC SCHEMATIC
92E	GENERATOR 2 DC SCHEMATIC
93A	GENERATOR 3 AC SCHEMATIC
93B	GENERATOR 3 DC SCHEMATIC
93C	GENERATOR 3 DC SCHEMATIC
93D	GENERATOR 3 DC SCHEMATIC
93E	GENERATOR 3 DC SCHEMATIC
94A	GENERATOR 4 AC SCHEMATIC
94B	GENERATOR 4 DC SCHEMATIC
94C	GENERATOR 4 DC SCHEMATIC
94D	GENERATOR 4 DC SCHEMATIC
94E	GENERATOR 4 DC SCHEMATIC
100A	GENERATOR MAIN AC SCHEMATIC
100B	GENERATOR MAIN DC CONTROL SCHEMATIC
110A	OUTDOOR TRANSFORMER AC & DC SCHEMATIC

NOTES

1	FREE STANDING ENCLOSURE : METAL ENCLOSED, NEMA 1.
2	CERTIFIED TO : CSA 22.2 NO. 14.
3	FRONT & REAR ACCESS REQUIRED.
4	ENCLOSURE COLOUR : ASA #61 GREY. INTERIOR MOUNTING PANS PAINTED WHITE.
5	COLOR CODE: BLUE – DC CONTROL, RED – AC CONTROL, BLACK – PT SECONDARY, ORANGE – CT SECONDARY, GREEN – GROUND.
6	WIRE TYPE : ALL CONNECTIONS TO BE #14AWG TEW. CT SECONDARY #10 AWG TEW. WIRING THAT IS TO BE PROVIDED AS A PART OF OR IN AN INTEGRAL PART OF SUPERVISORY CONTROL EQUIPMENT SHALL BE #14 AWG TEW. EXCEPT, PLC DIGITAL & ANALOG I/O WIRING #18 AWG TEW.
7	WIRE MARKERS : HEAT SHRINK TYPE C/W INDELIBLE INK MARKING.
8	WIRE NUMBERS TO MATCH TERMINAL NUMBERS, UNLESS NOTED.
9	ASSEMBLY FOR INDOOR USE.
10	SWITCHBOARD SUITABLE FOR MOUNTING ON NON-COMBUSTIBLE SURFACE ONLY.
11	ALL DIMENSIONS ARE TYPICAL AND SHOWN IN MM[INCHES].

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS

PROJECT: SSES Standby Power
WPE# C847
Date: 16 Nov, 2016

REVIEWED by _GW_

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

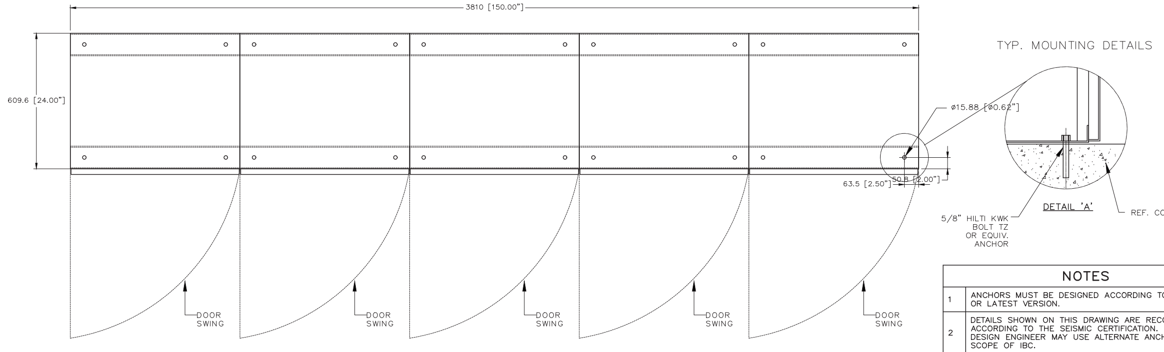
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
PHYSICAL LAYOUT
ESQUIMALT GRAVING DOCK

CUSTOMER	WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107	WORK ORDER No. W–095112
DRAWN BY SD	AUTH BY SS
DATE 16–08–11	REV 2
DRAWING/FILE No. W–095112–010A	SHEET

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



TYP. MOUNTING DETAILS

BASE LAYOUT

NOTES

1	ANCHORS MUST BE DESIGNED ACCORDING TO IBC 2006 OR LATEST VERSION.
2	DETAILS SHOWN ON THIS DRAWING ARE RECOMMENDED ACCORDING TO THE SEISMIC CERTIFICATION. DESIGN ENGINEER MAY USE ALTERNATE ANCHORS WITHIN SCOPE OF IBC.
3	FLOOR ANCHORS MAY BE INSTALLED AS SHOWN IN DETAIL.

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C – C – 1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

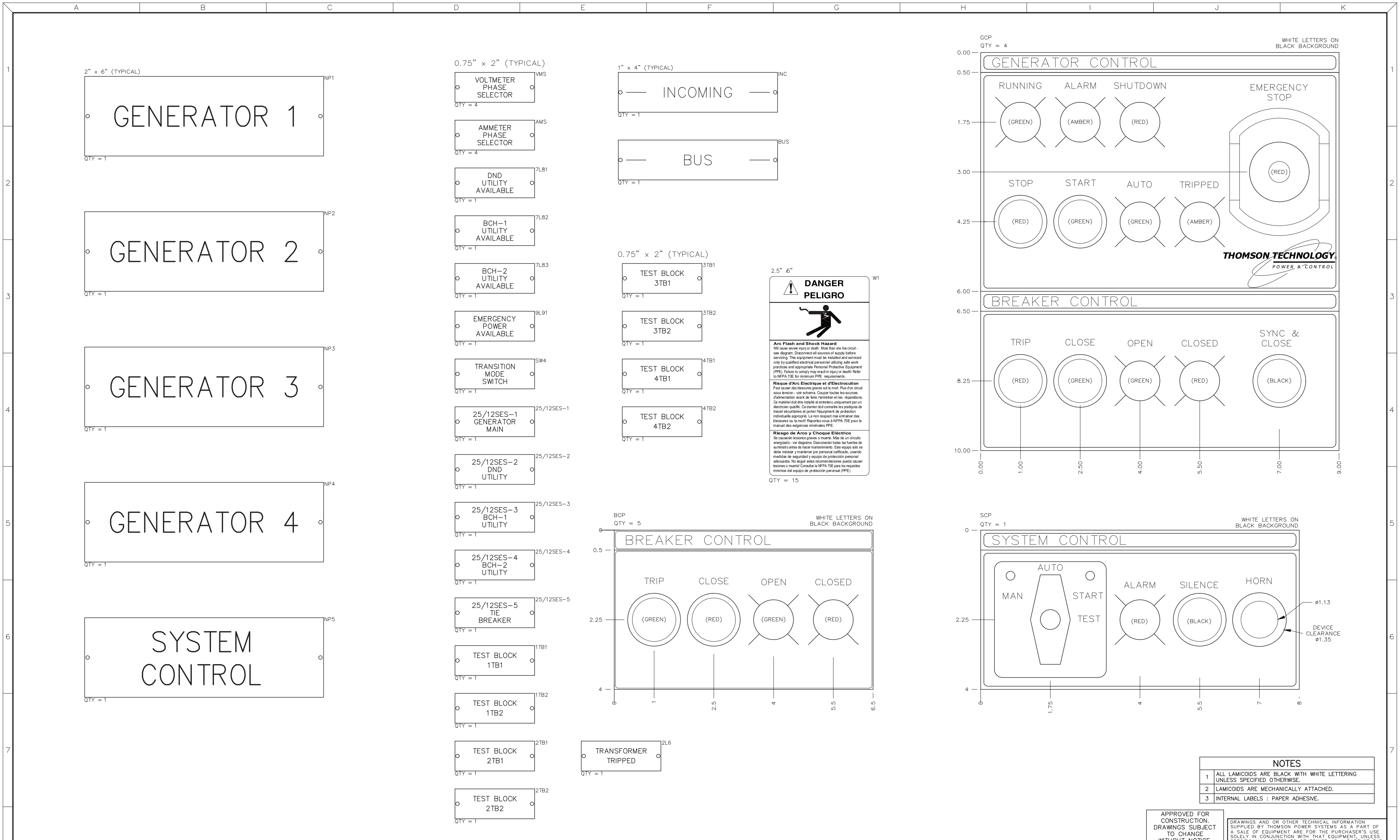
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
SECTIONAL LAYOUT
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.	WORK ORDER No.		
C–054107	W–095112		
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16–08–11	2
DRAWING/FILE No.		SHEET	
W–095112–010B		10B	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



Arc Flash and Shock Hazard
Will cause severe injury or death. More than one live circuit - see diagram. Disconnect all sources of supply before servicing. This equipment must be installed and serviced only by qualified electrical personnel utilizing safe work practices and appropriate Personal Protective Equipment (PPE). Failure to comply may result in injury or death! Refer to NFPA 70E for minimum PPE requirements.

Risque d'Arc Electrique et d'Electrocution
Peut causer des blessures graves out la mort. Plus d'un circuit sous tension - voir schema. Couper toutes les sources d'alimentation avant de faire l'entretien et les réparations. Ce matériel doit étre installé et entretenu uniquement par un électricien qualifié. Ce dernier doit connaitre les pratiques de travail sécuritaires et porter l'équipment de protection individuelle approprié. Le non respect mai entrainer des blessures ou la mort! Reportez-vous à NFPA 70E pour le manuel des exigences minimales PPE.

Riesgo de Arco y Choque Eléctrico
Se causarán lesiones graves o muerte. Màs de un circuito energizado - ver diagrama. Desconectar todas las fuentes de suministro antes de hacer mantenimiento. Este equipo solo se debe instalar y mantener por personal calificado, usando medidas de seguridad y equipo de protección personal adecuados. No seguir estas recomendaciones puede causar lesiones o muerte! Consultar la NFPA 70E para los requisitos minimos del equipo de protección peronsal (PPE)

NOTES

1	ALL LAMICOIDS ARE BLACK WITH WHITE LETTERING UNLESS SPECIFIED OTHERWISE.
2	LAMICOIDS ARE MECHANICALLY ATTACHED.
3	INTERNAL LABELS : PAPER ADHESIVE.

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

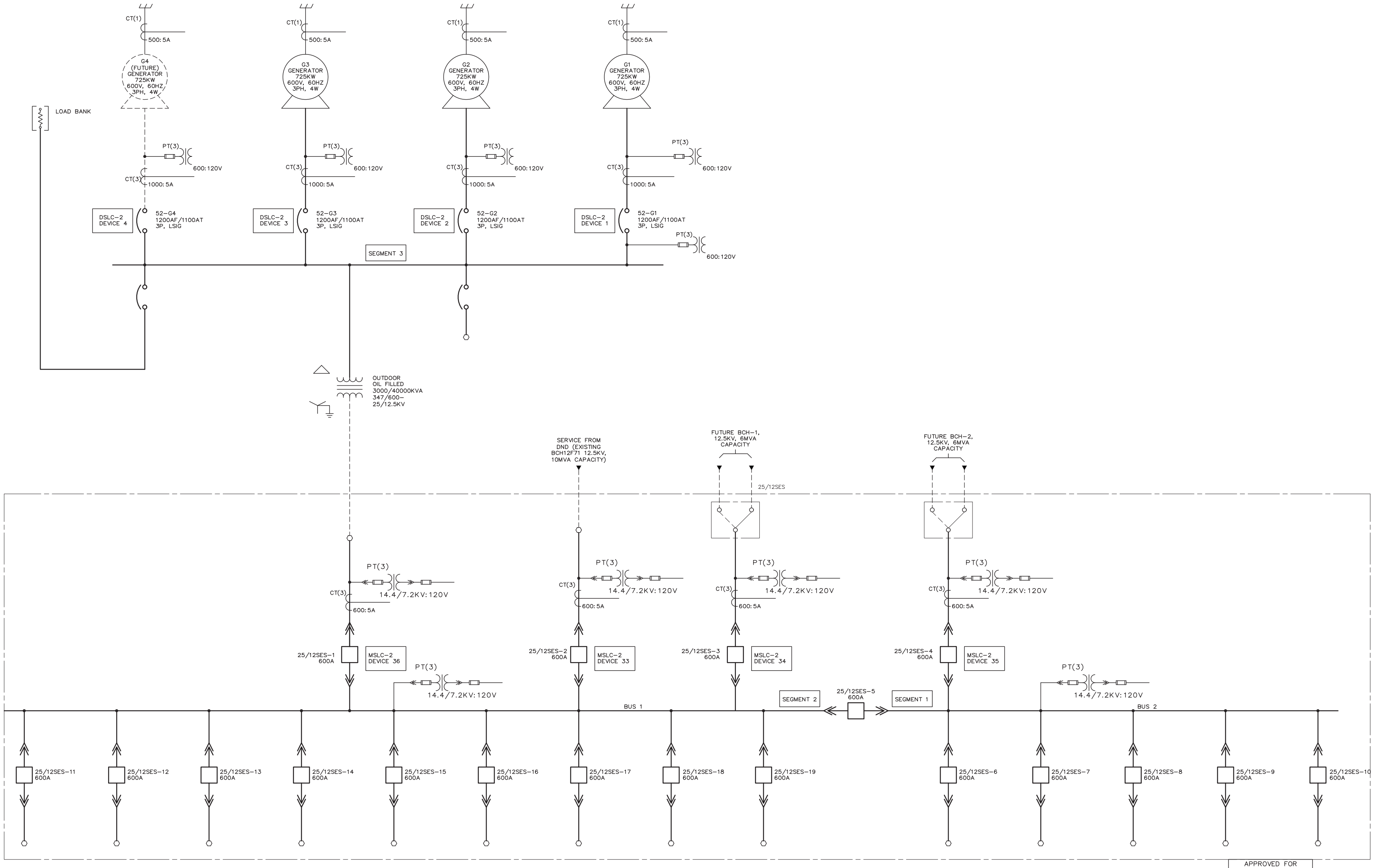
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
NAME PLATE DETAILS
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095112
DRAWN BY SD
AUTH BY SS
DATE 16–08–11
REV 2
DRAWING/FILE No. W–095112–020A
SHEET 20A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

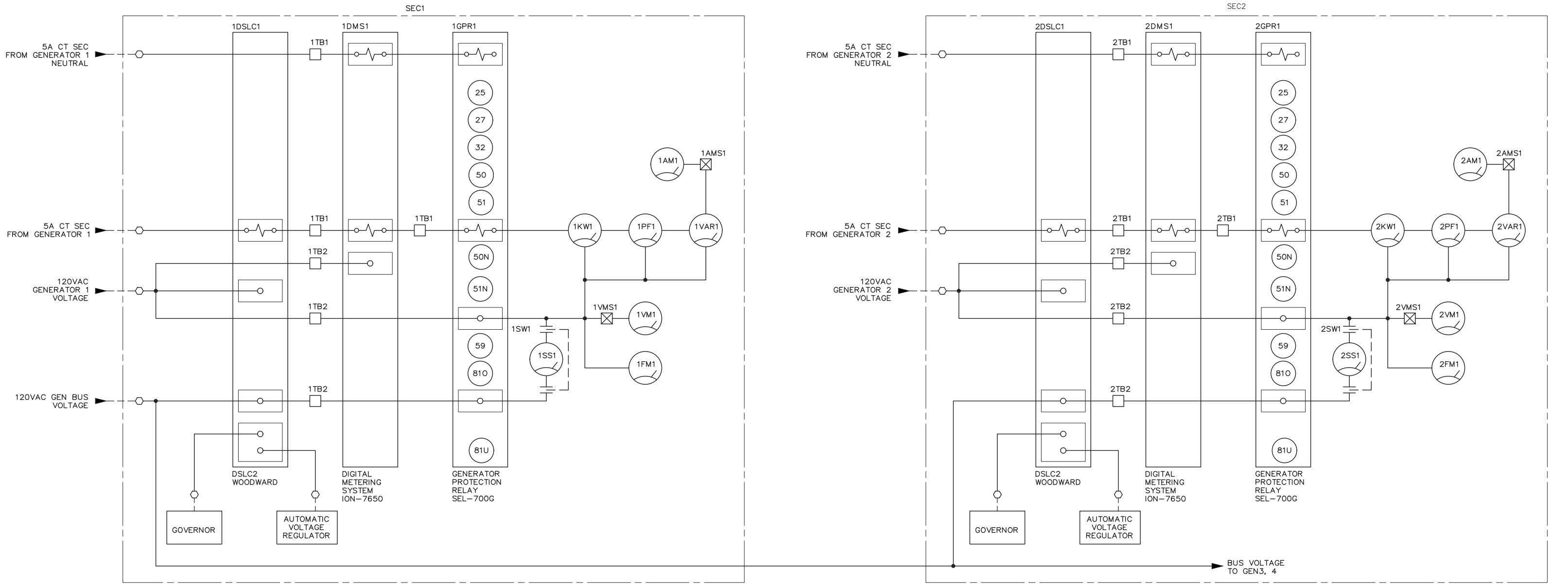
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
OVERALL SINGLE LINE DIAGRAM
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-030A
SHEET 30A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



IEEE FUNCTION	
25	SYNC CHECK
27	UNDER VOLTAGE
32	REVERSE POWER
50	INSTANTANEOUS OVERCURRENT
51	TIMED OVERCURRENT
59	OVER VOLTAGE
81O	OVER FREQUENCY
81U	UNDER FREQUENCY

NOTES	
1	DSLC2 GENERATOR CONTROLLER : WOODWARD, 8440-1878, 12-24VDC.
2	MSLC2 MASTER CONTROLLER : WOODWARD, 8440-1877, 12-24VDC.
3	GENERATOR PROTECTION RELAY : SEL, SEL-700G, 125VDC AUX.
4	DIGITAL METERING SYSTEM : SQUARE D, ION-7650, 125VDC AUX.

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

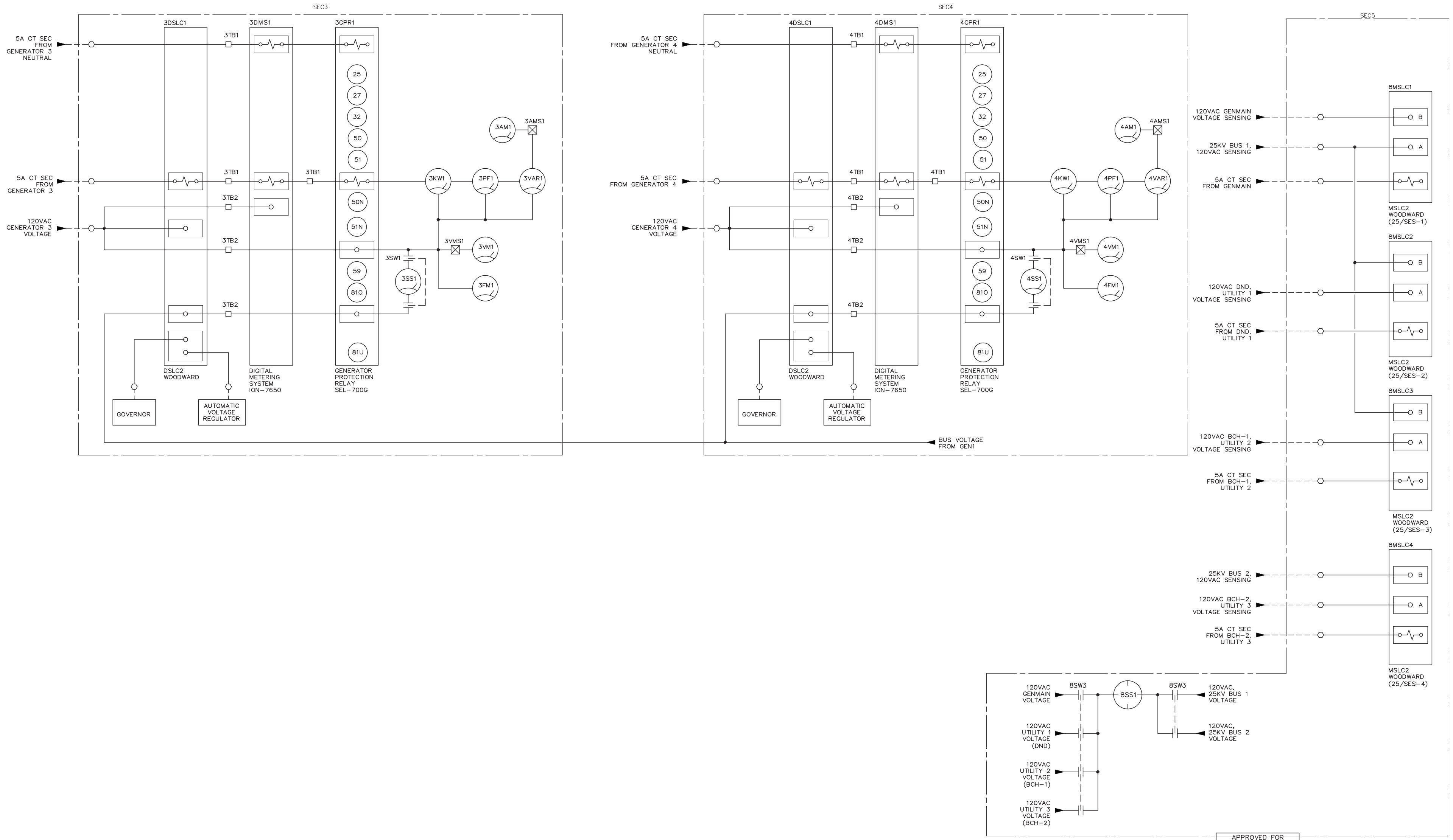
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
SINGLE LINE DIAGRAM
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-030B
SHEET 30B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

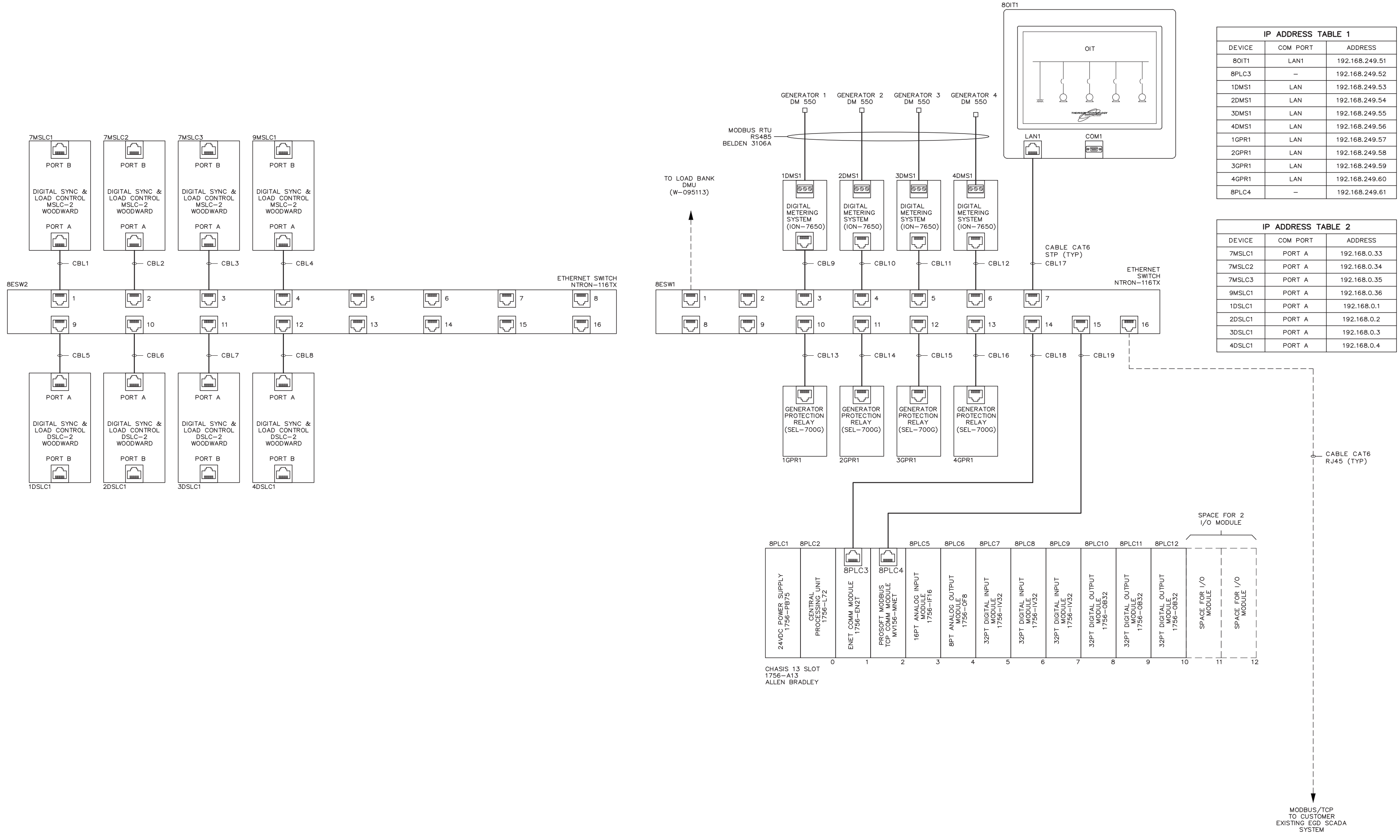
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
SINGLE LINE DIAGRAM
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No. C-054107		WORK ORDER No. W-095112	
DRAWN BY SD	AUTH BY SS	DATE 16-08-11	REV 2
DRAWING/FILE No. W-095112-030C			SHEET 30C

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



IP ADDRESS TABLE 1

DEVICE	COM PORT	ADDRESS
8OIT1	LAN1	192.168.249.51
8PLC3	–	192.168.249.52
1DMS1	LAN	192.168.249.53
2DMS1	LAN	192.168.249.54
3DMS1	LAN	192.168.249.55
4DMS1	LAN	192.168.249.56
1GPR1	LAN	192.168.249.57
2GPR1	LAN	192.168.249.58
3GPR1	LAN	192.168.249.59
4GPR1	LAN	192.168.249.60
8PLC4	–	192.168.249.61

IP ADDRESS TABLE 2

DEVICE	COM PORT	ADDRESS
7MSLC1	PORT A	192.168.0.33
7MSLC2	PORT A	192.168.0.34
7MSLC3	PORT A	192.168.0.35
9MSLC1	PORT A	192.168.0.36
1DSLC1	PORT A	192.168.0.1
2DSLC1	PORT A	192.168.0.2
3DSLC1	PORT A	192.168.0.3
4DSLC1	PORT A	192.168.0.4

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
5OC-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

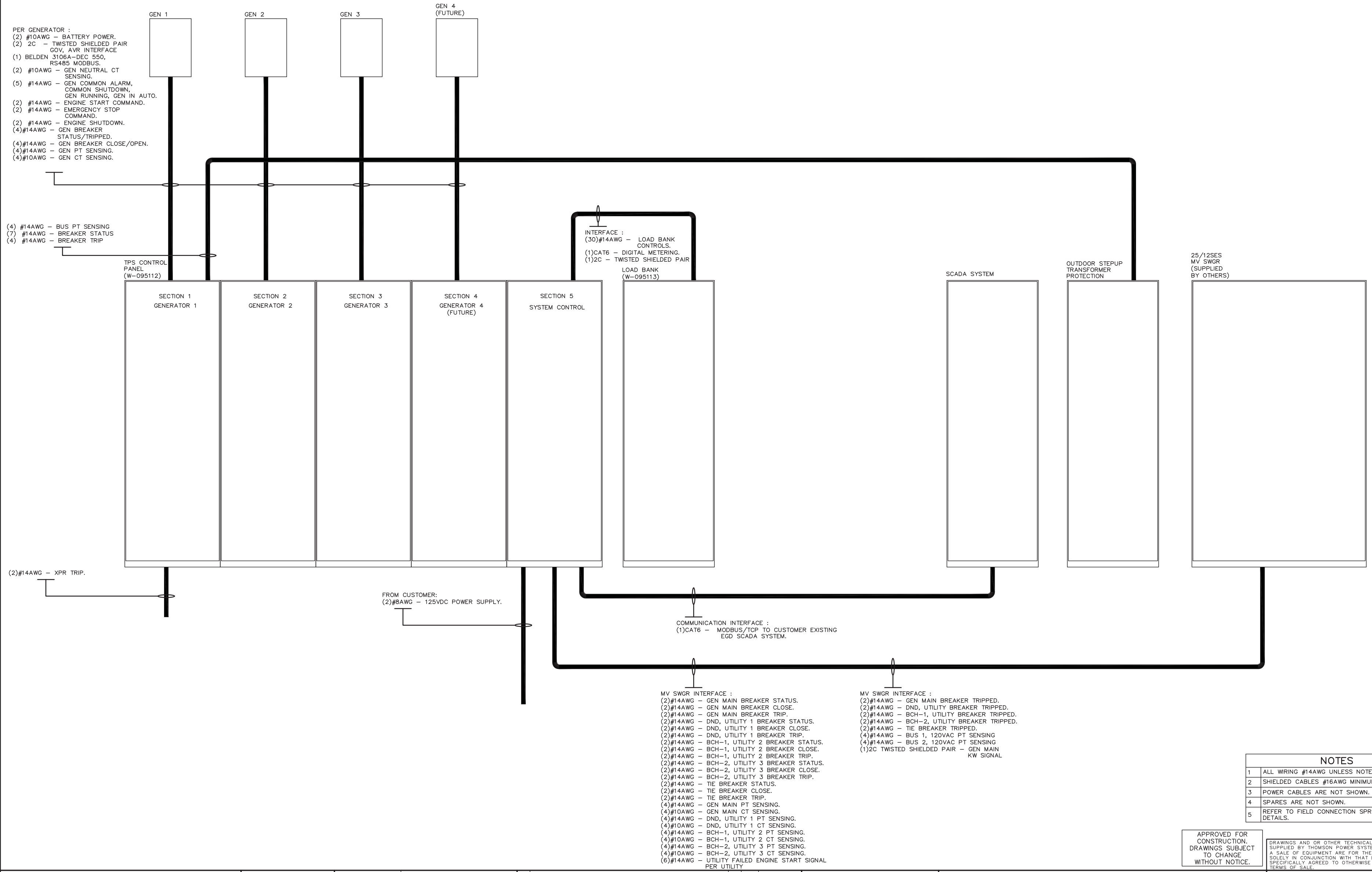
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMUNICATION BLOCK DIAGRAM
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-030D
SHEET 30D

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



NOTES

1	ALL WIRING #14AWG UNLESS NOTED OTHERWISE.
2	SHIELDED CABLES #16AWG MINIMUM.
3	POWER CABLES ARE NOT SHOWN.
4	SPARES ARE NOT SHOWN.
5	REFER TO FIELD CONNECTION SPREAD SHEET FOR DETAILS.

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

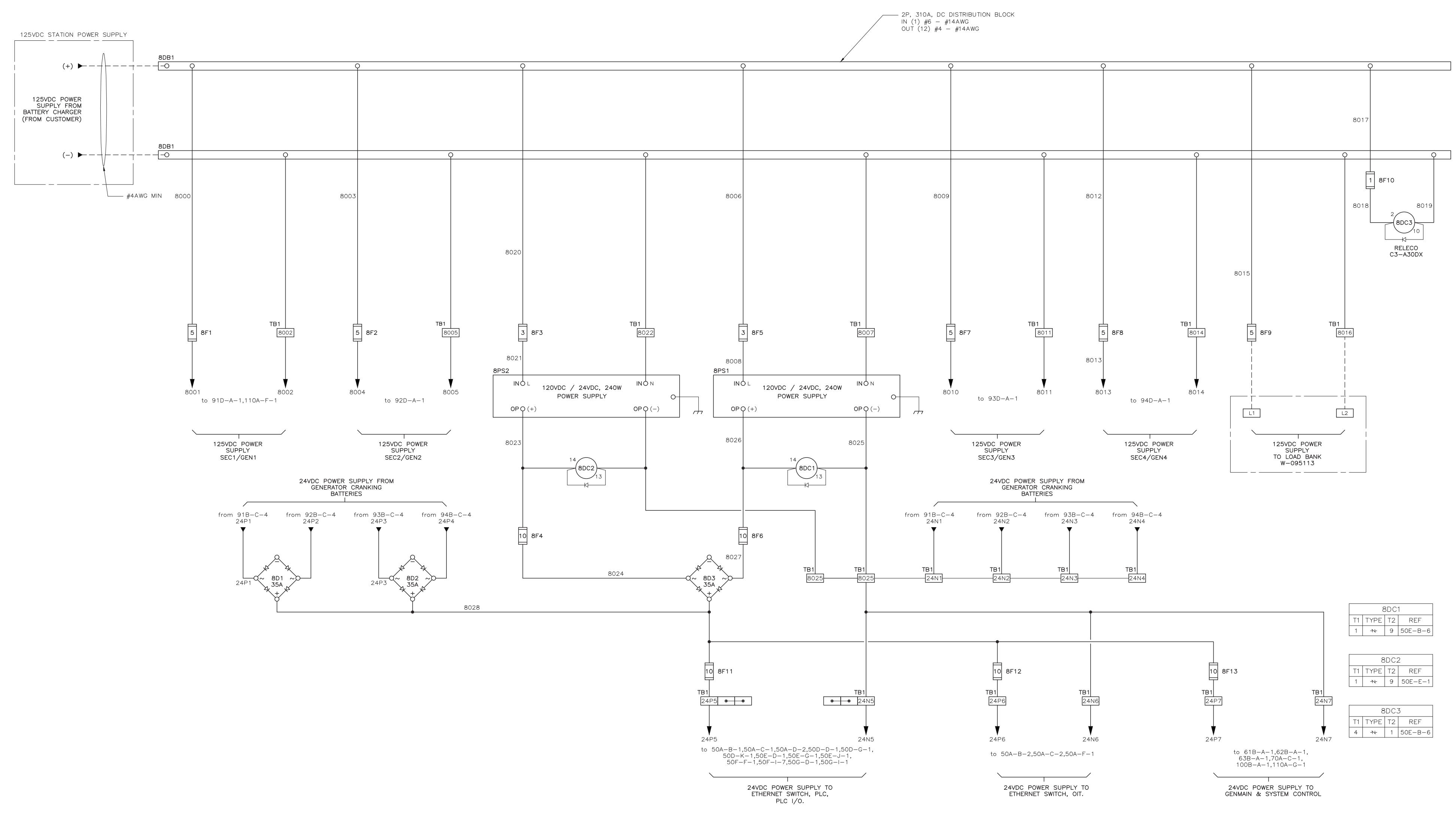
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
FIELD CONNECTION BLOCK DIAGRAM
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.		WORK ORDER No.	
C–054107		W–095112	
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16–08–11	2
DRAWING/FILE No.			SHEET
W–095112–030E			30E

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



8DC1			
T1	TYPE	T2	REF
1	⊣⊢	9	50E–B–6

8DC2			
T1	TYPE	T2	REF
1	⊣⊢	9	50E–E–1

8DC3			
T1	TYPE	T2	REF
4	⊣⊢	1	50E–B–6

SECTION# 5

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

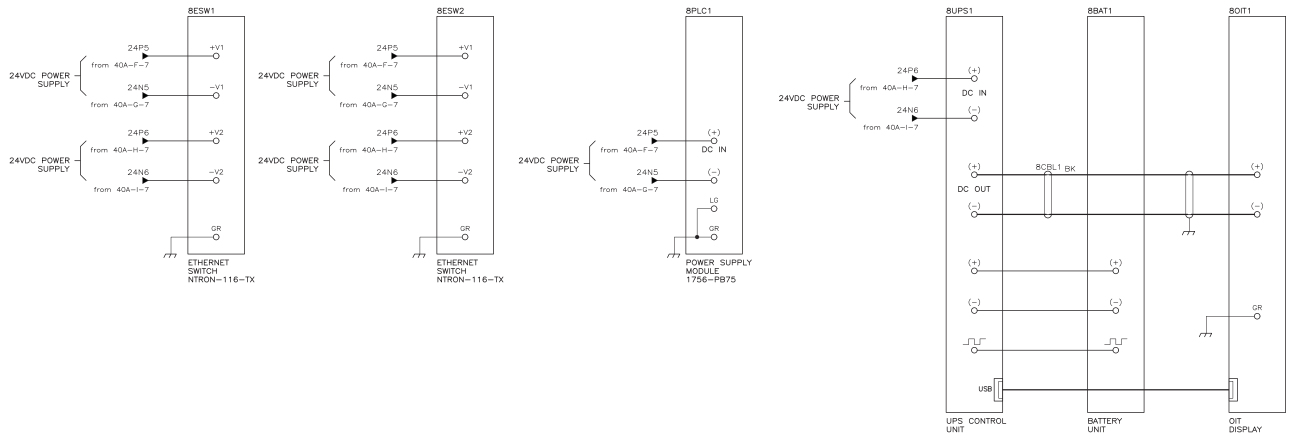
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON 24VDC SUPPLY SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095112
DRAWN BY SD
AUTH BY SS
DATE 16–08–11
REV 2
DRAWING/FILE No. W–095112–040A
SHEET 40A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 5

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

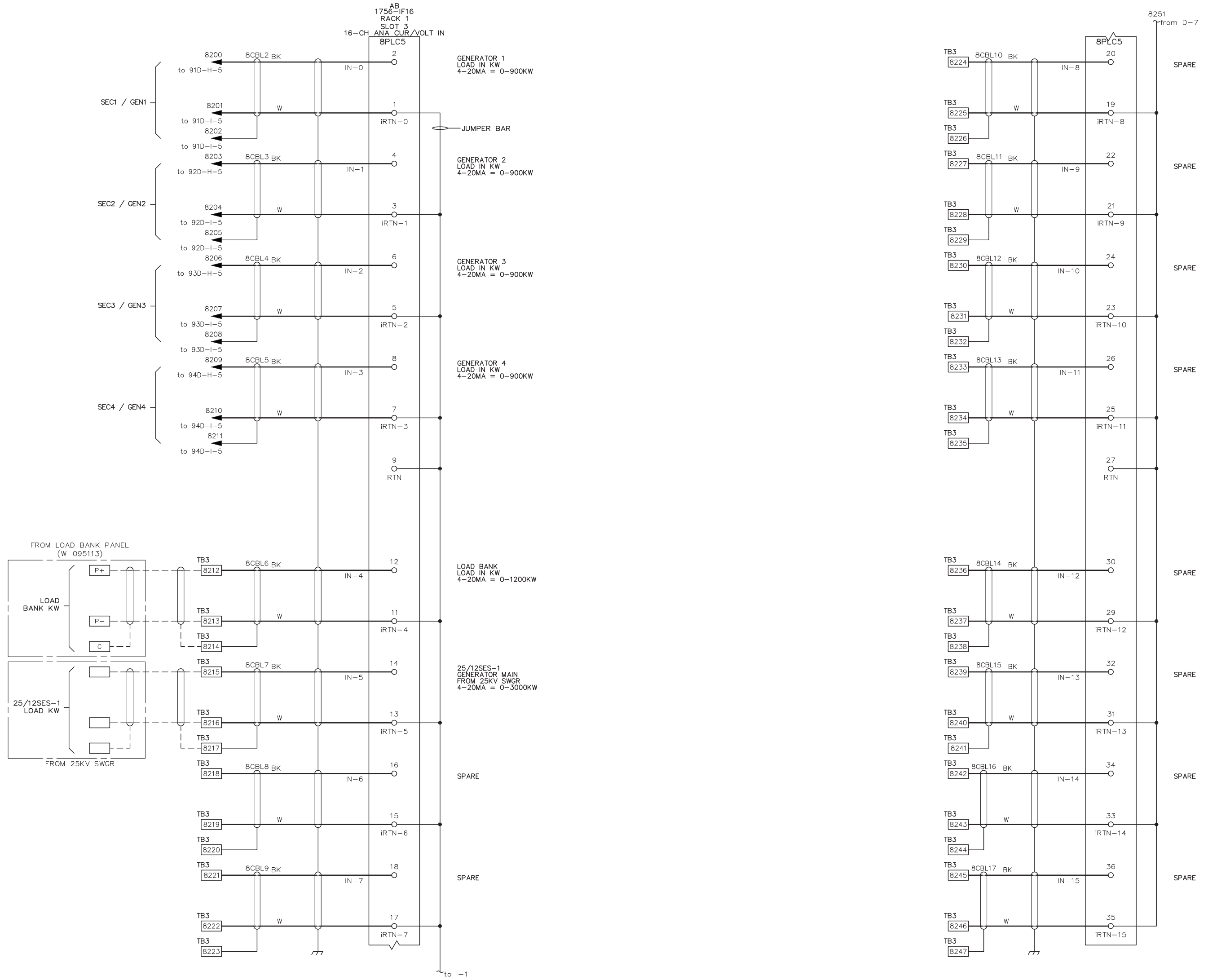
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON PLC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.		WORK ORDER No.	
C–054107		W–095112	
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16–08–11	2
DRAWING/FILE No.		SHEET	
W–095112–050A		50A	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 5

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE
LEGEND
50C-C-1
GRID
COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

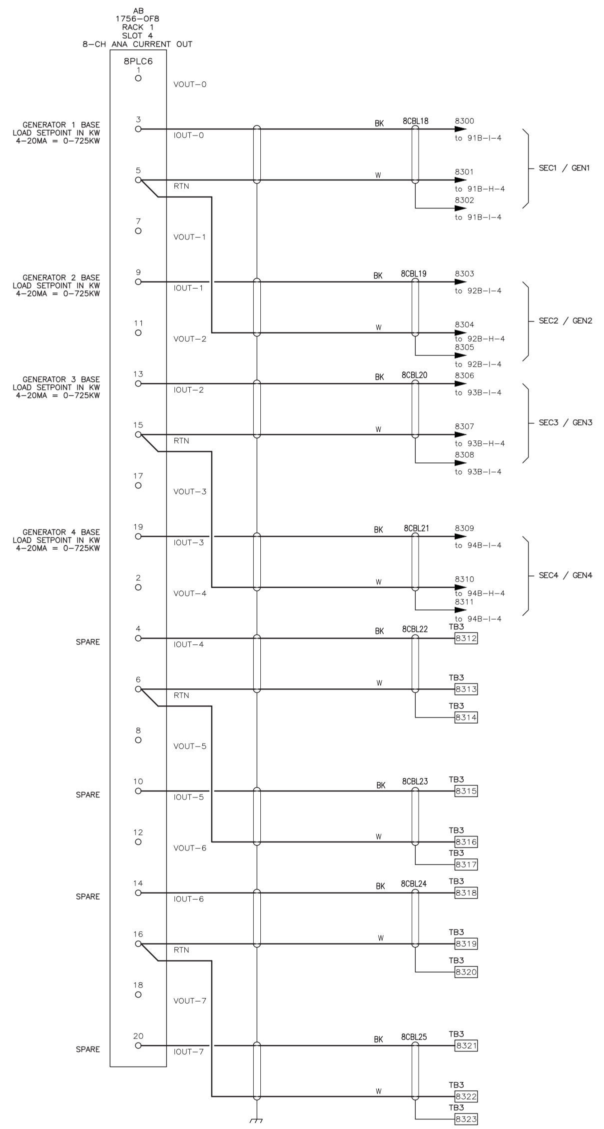
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON PLC SCHEMATIC
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER WESTERN PACIFIC ENTERPRISES GP			
CUSTOMER ORDER No. C-054107		WORK ORDER No. W-095112	
DRAWN BY SD	AUTH BY SS	DATE 16-08-11	REV 2
DRAWING/FILE No. W-095112-050B			SHEET 50B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 5

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

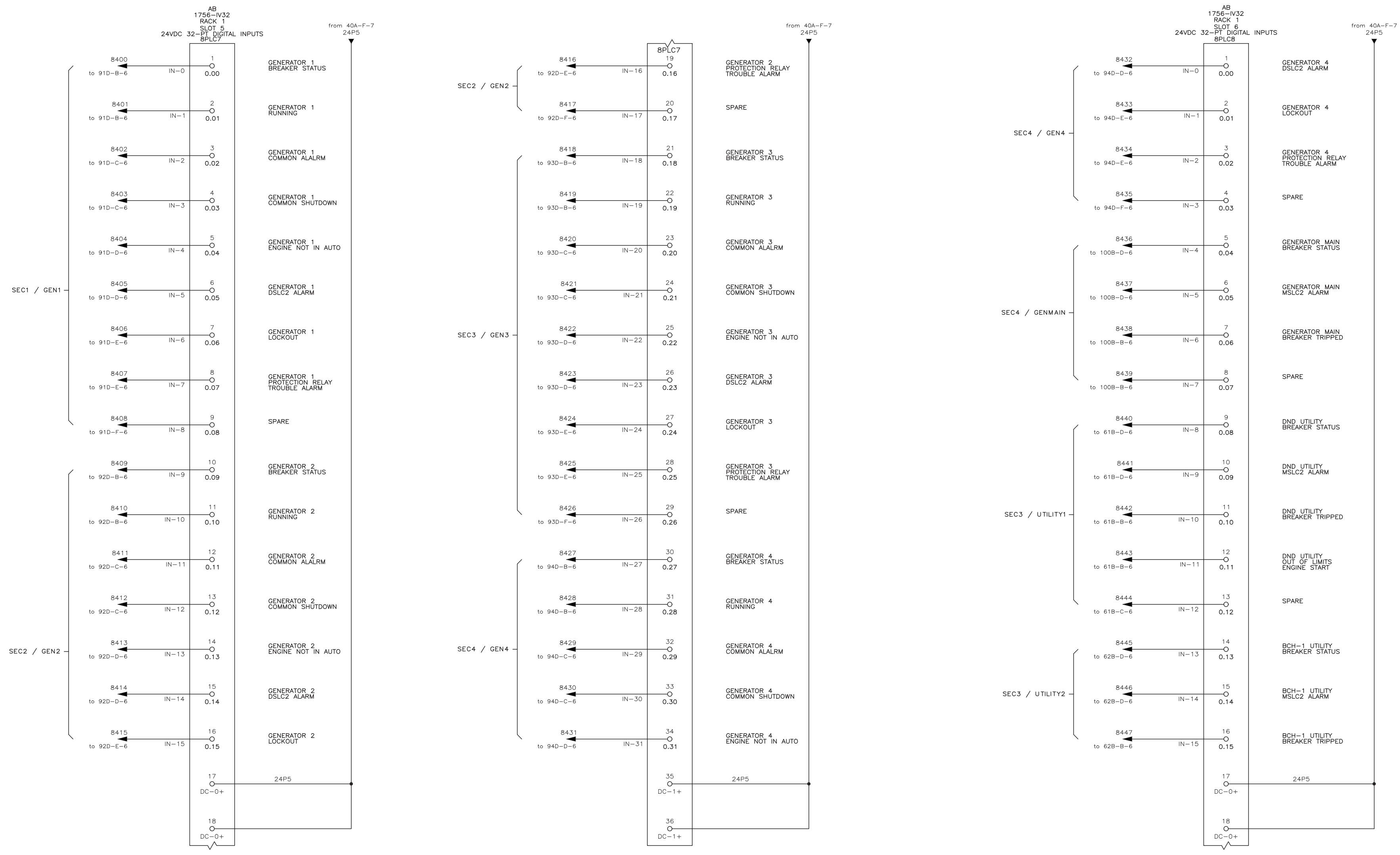
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON PLC SCHEMATIC
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-050C
SHEET 50C

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 5

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY:__________ DATE:__________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

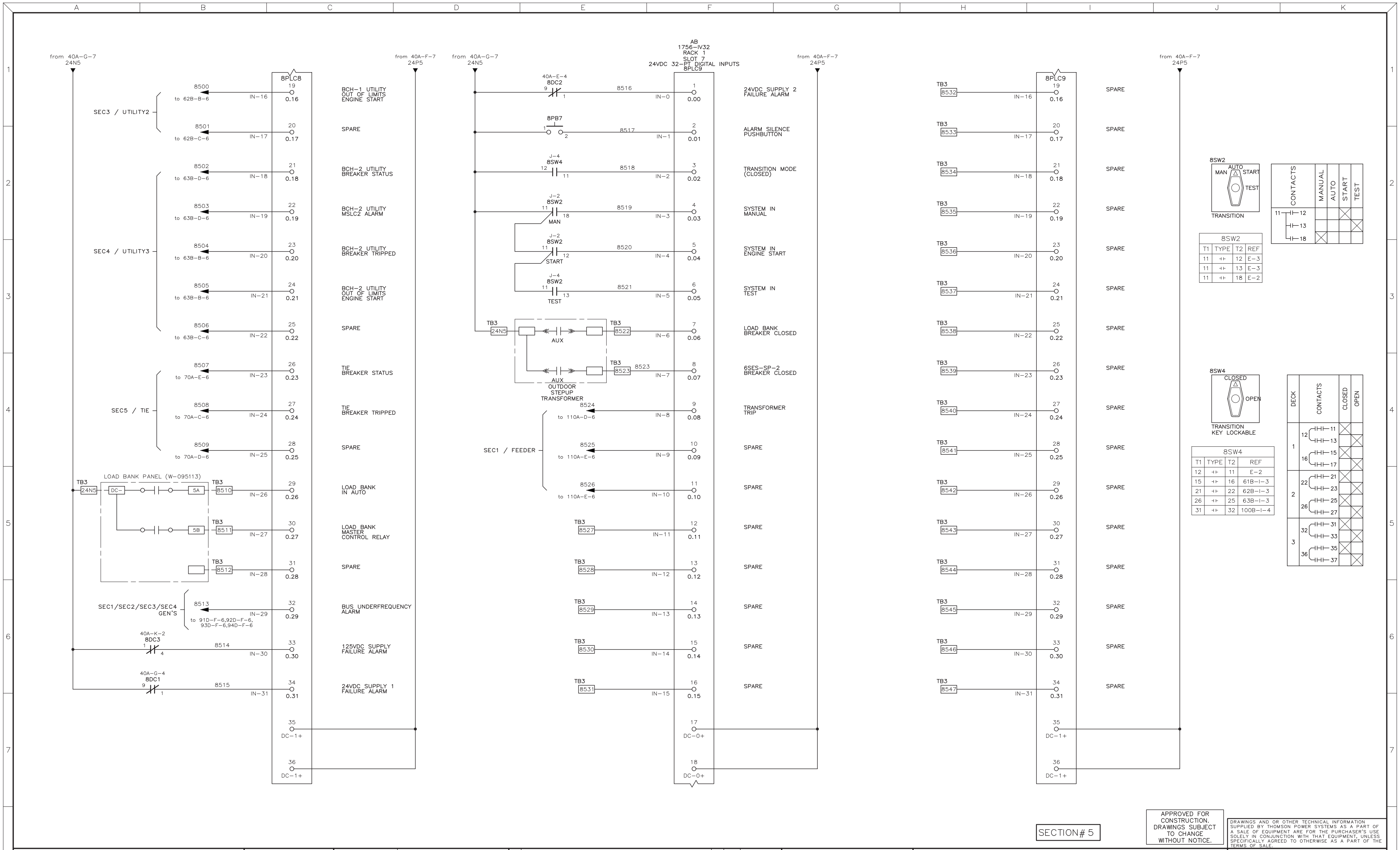
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON PLC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095112
DRAWN BY SD
AUTH BY SS
DATE 16–08–11
REV 2
DRAWING/FILE No. W–095112–050D
SHEET 50D

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



8SW2			
T1	TYPE	T2	REF
11	⊣⊢	12	E-3
11	⊣⊢	13	E-3
11	⊣⊢	18	E-2

CONTACTS	MANUAL	AUTO	START	TEST
11–12			☒	
11–13				☒
11–18	☒			

8SW4			
T1	TYPE	T2	REF
12	⊣⊢	11	E-2
15	⊣⊢	16	61B-I-3
21	⊣⊢	22	62B-I-3
26	⊣⊢	25	63B-I-3
31	⊣⊢	32	100B-I-4

DECK	CONTACTS	CLOSED	OPEN
1	12–11	☒	
	12–13		☒
	16–15	☒	
	16–17		☒
2	22–21	☒	
	22–23		☒
	26–25	☒	
	26–27		☒
3	32–31	☒	
	32–33		☒
	36–35	☒	
	36–37		☒

SECTION# 5

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

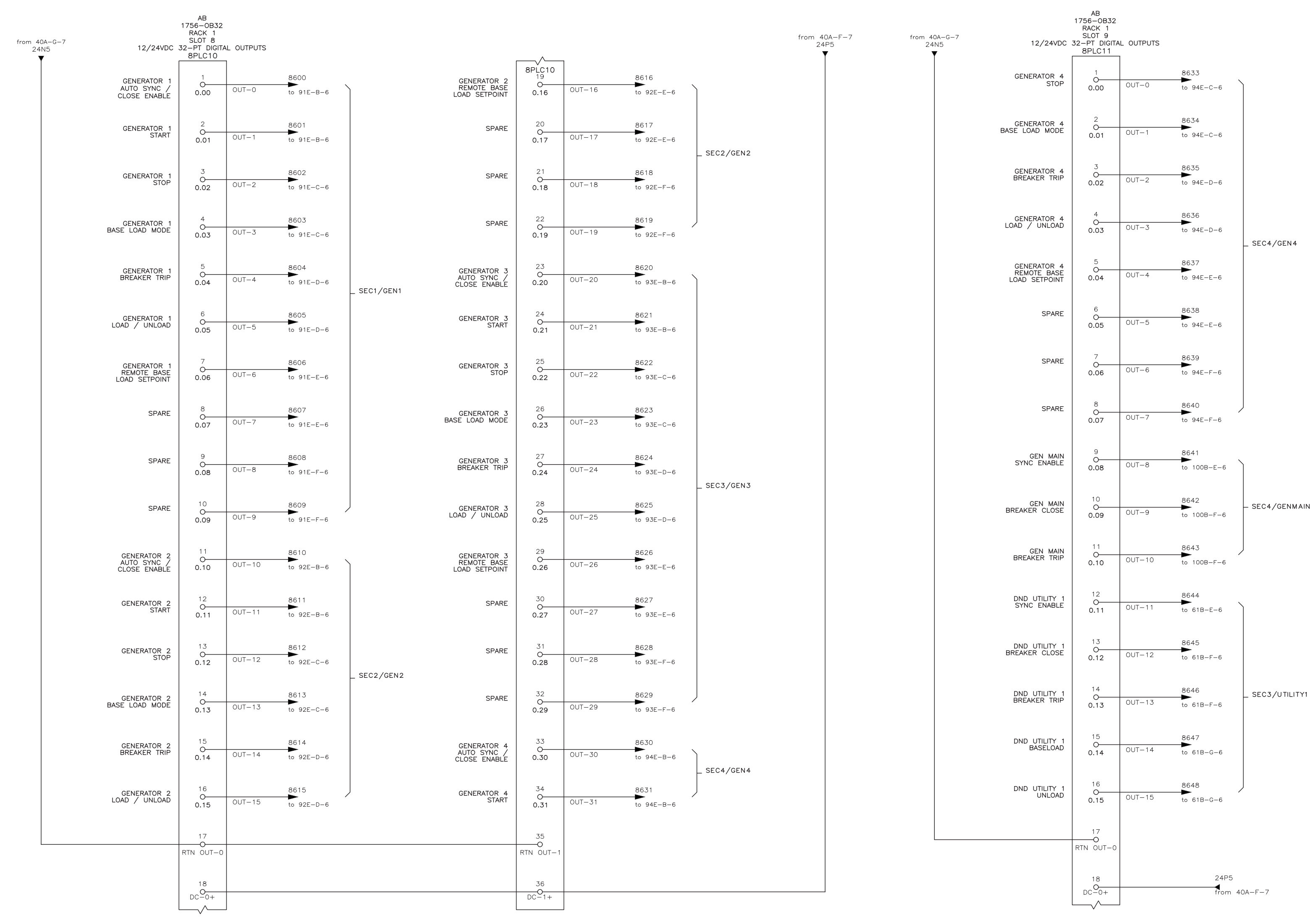
DRAWING No. | REFERENCE DRAWINGS

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON PLC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-050E
SHEET 50E

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 5

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

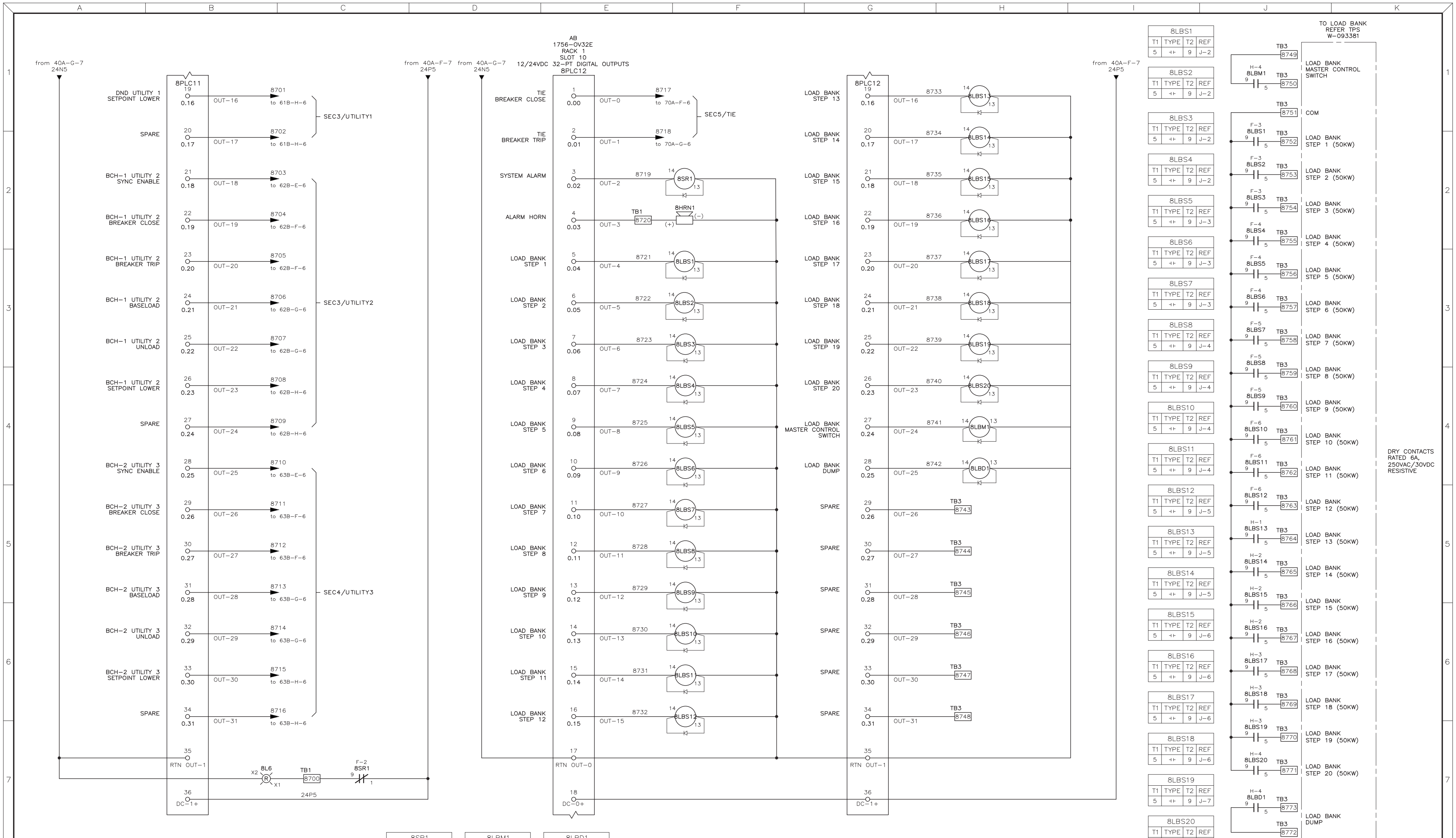
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON PLC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.	WORK ORDER No.		
C–054107	W–095112		
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16–08–11	2
DRAWING/FILE No.		SHEET	
W–095112–050F		50F	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



	T1	TYPE	T2	REF
8LBS1	5	⊣⊢	9	J-2
8LBS2	5	⊣⊢	9	J-2
8LBS3	5	⊣⊢	9	J-2
8LBS4	5	⊣⊢	9	J-2
8LBS5	5	⊣⊢	9	J-3
8LBS6	5	⊣⊢	9	J-3
8LBS7	5	⊣⊢	9	J-3
8LBS8	5	⊣⊢	9	J-4
8LBS9	5	⊣⊢	9	J-4
8LBS10	5	⊣⊢	9	J-4
8LBS11	5	⊣⊢	9	J-4
8LBS12	5	⊣⊢	9	J-5
8LBS13	5	⊣⊢	9	J-5
8LBS14	5	⊣⊢	9	J-5
8LBS15	5	⊣⊢	9	J-6
8LBS16	5	⊣⊢	9	J-6
8LBS17	5	⊣⊢	9	J-6
8LBS18	5	⊣⊢	9	J-6
8LBS19	5	⊣⊢	9	J-7
8LBS20	5	⊣⊢	9	J-7
8SR1	1	⊣/⊢	9	C-7
8LBM1	5	⊣⊢	9	J-1
8LBD1	5	⊣⊢	9	J-7

SECTION# 5

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

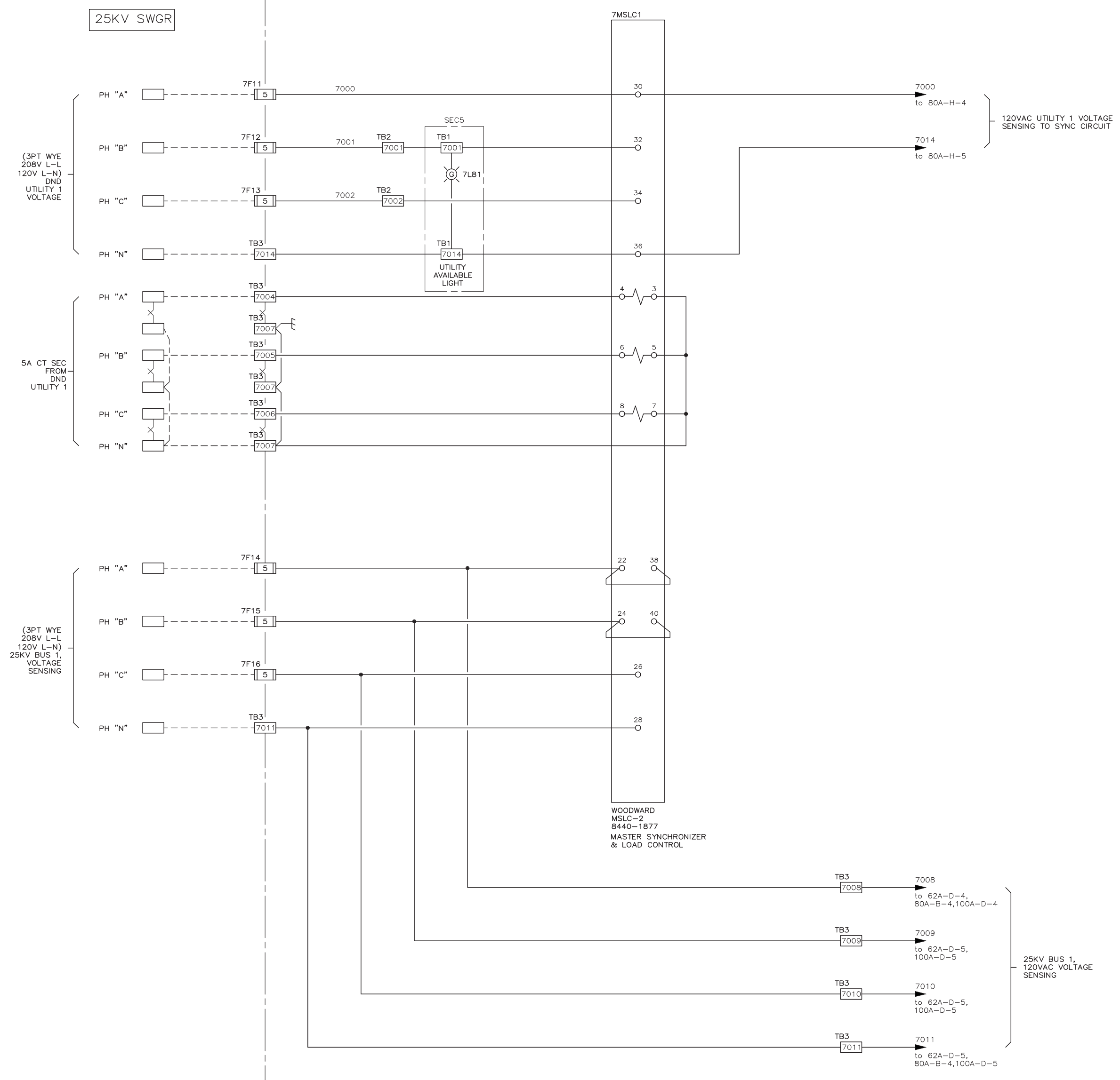
DRAWING No.	REFERENCE DRAWINGS

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
COMMON PLC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-050G
SHEET 50G

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 3

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY:__________ DATE:__________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

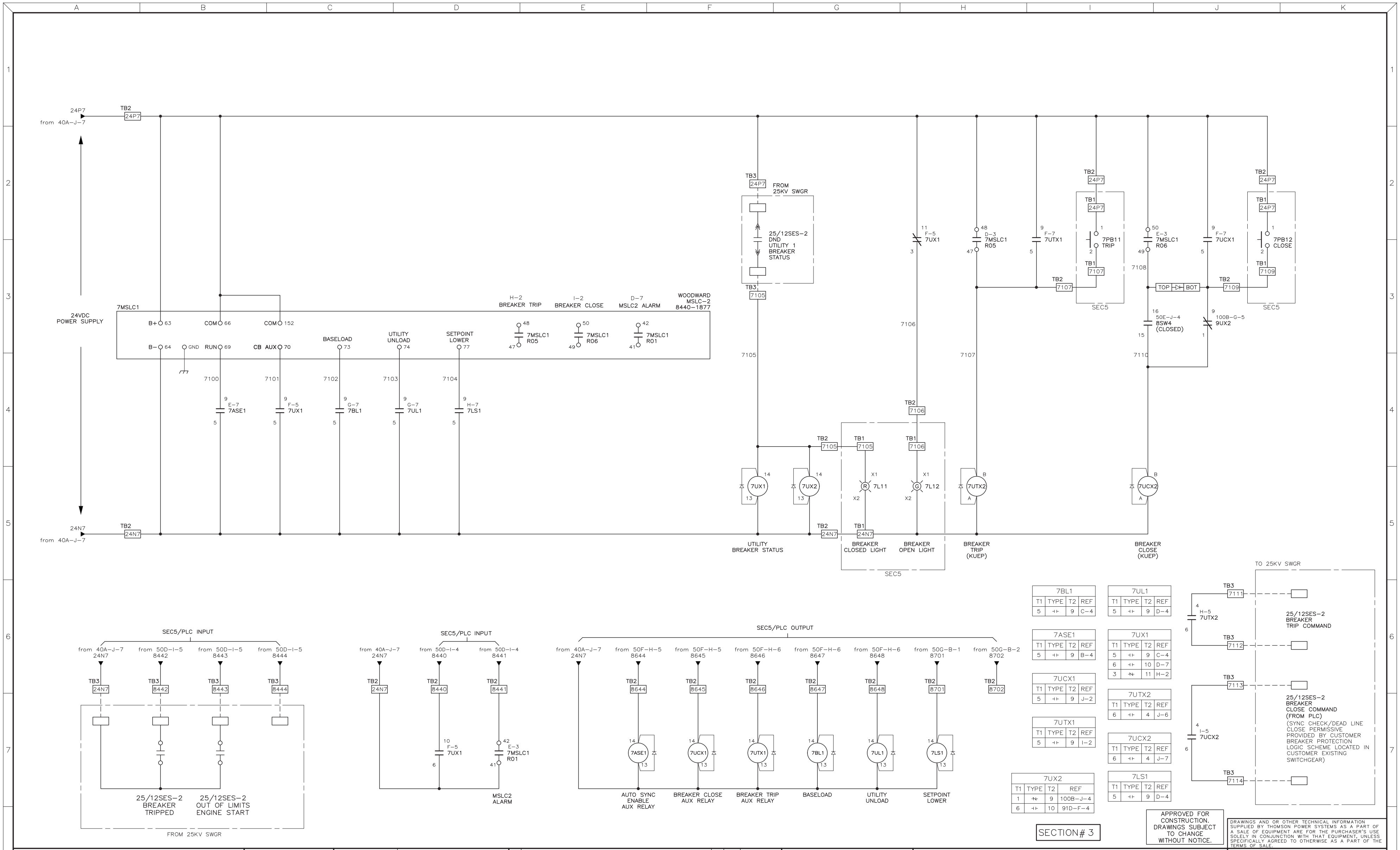
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
DND UTILITY 1 AC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.		WORK ORDER No.	
C-054107		W-095112	
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16-08-11	2
DRAWING/FILE No.		SHEET	
W-095112-061A		61A	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



7BL1			
T1	TYPE	T2	REF
5	⊣⊢	9	C-4

7ASE1			
T1	TYPE	T2	REF
5	⊣⊢	9	B-4

7UCX1			
T1	TYPE	T2	REF
5	⊣⊢	9	J-2

7UTX1			
T1	TYPE	T2	REF
5	⊣⊢	9	I-2

7UX2			
T1	TYPE	T2	REF
1	⊣/⊢	9	100B-J-4
6	⊣⊢	10	91D-F-4

7UL1			
T1	TYPE	T2	REF
5	⊣⊢	9	D-4

7UX1			
T1	TYPE	T2	REF
5	⊣⊢	9	C-4
6	⊣⊢	10	D-7
3	⊣/⊢	11	H-2

7UTX2			
T1	TYPE	T2	REF
6	⊣⊢	4	J-6

7UCX2			
T1	TYPE	T2	REF
6	⊣⊢	4	J-7

7LS1			
T1	TYPE	T2	REF
5	⊣⊢	9	D-4

SECTION# 3

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

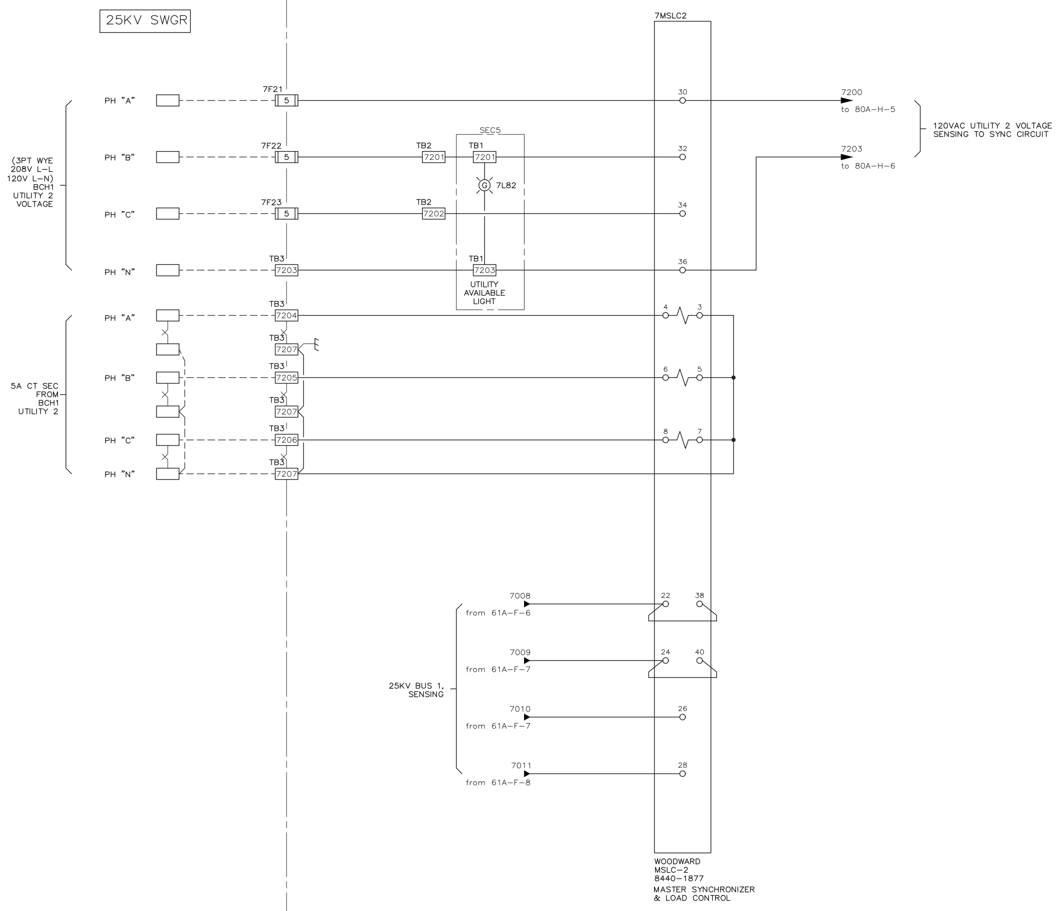
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
DND UTILITY 1 DC CONTROL SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-061B
SHEET 61B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 3

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE
LEGEND
50C-C-1
GRID
COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

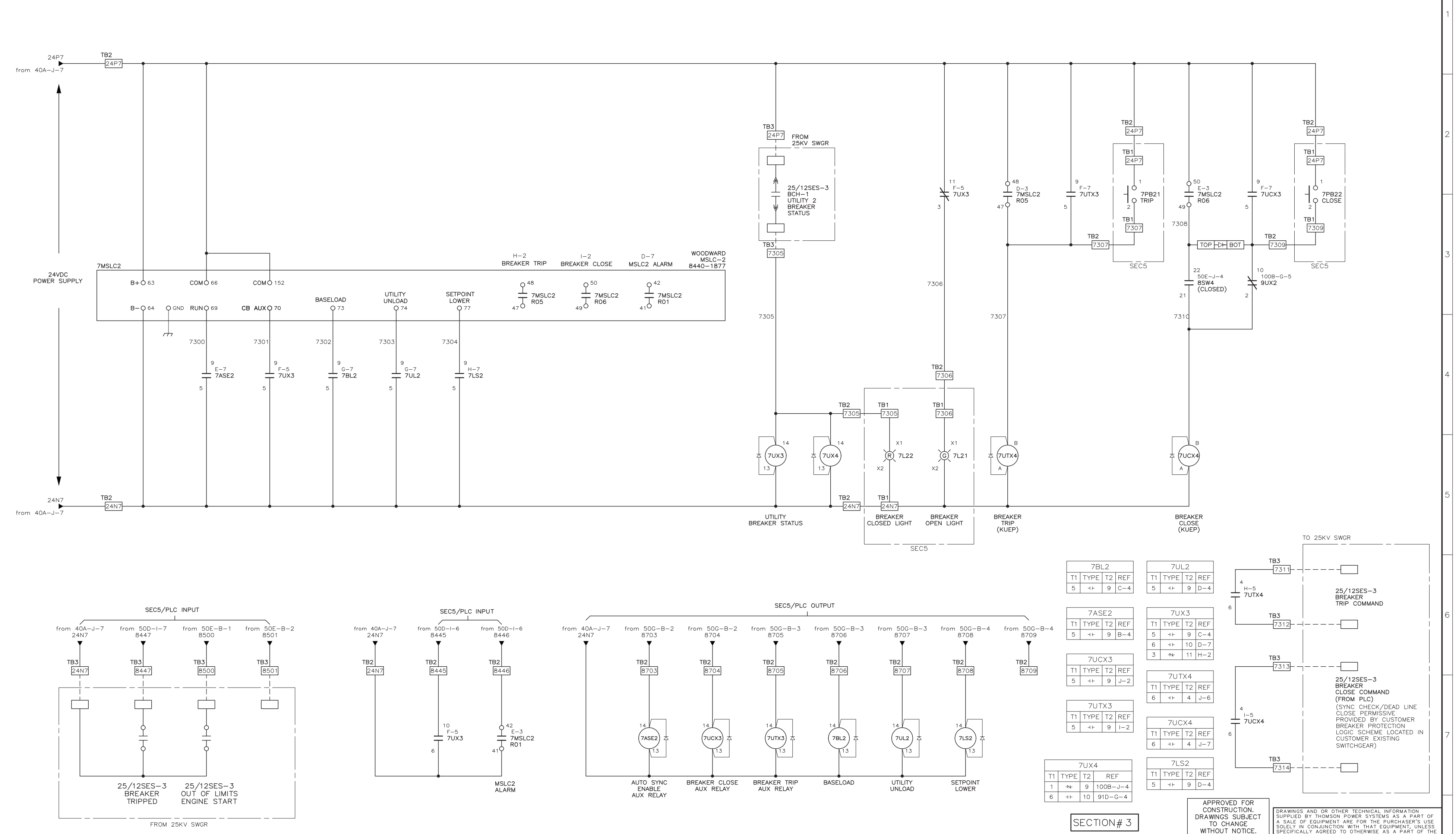
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
BCH-1 UTILITY 1 AC SCHEMATIC
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-062A
SHEET 62A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



7BL2

T1	TYPE	T2	REF
5	⊣⊢	9	C-4

7ASE2

T1	TYPE	T2	REF
5	⊣⊢	9	B-4

7UCX3

T1	TYPE	T2	REF
5	⊣⊢	9	J-2

7UTX3

T1	TYPE	T2	REF
5	⊣⊢	9	I-2

7UX4

T1	TYPE	T2	REF
1	⊣/⊢	9	100B-J-4
6	⊣⊢	10	91D-G-4

7UL2

T1	TYPE	T2	REF
5	⊣⊢	9	D-4

7UX3

T1	TYPE	T2	REF
5	⊣⊢	9	C-4
6	⊣⊢	10	D-7
3	⊣/⊢	11	H-2

7UTX4

T1	TYPE	T2	REF
6	⊣⊢	4	J-6

7UCX4

T1	TYPE	T2	REF
6	⊣⊢	4	J-7

7LS2

T1	TYPE	T2	REF
5	⊣⊢	9	D-4

SECTION# 3

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE
LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

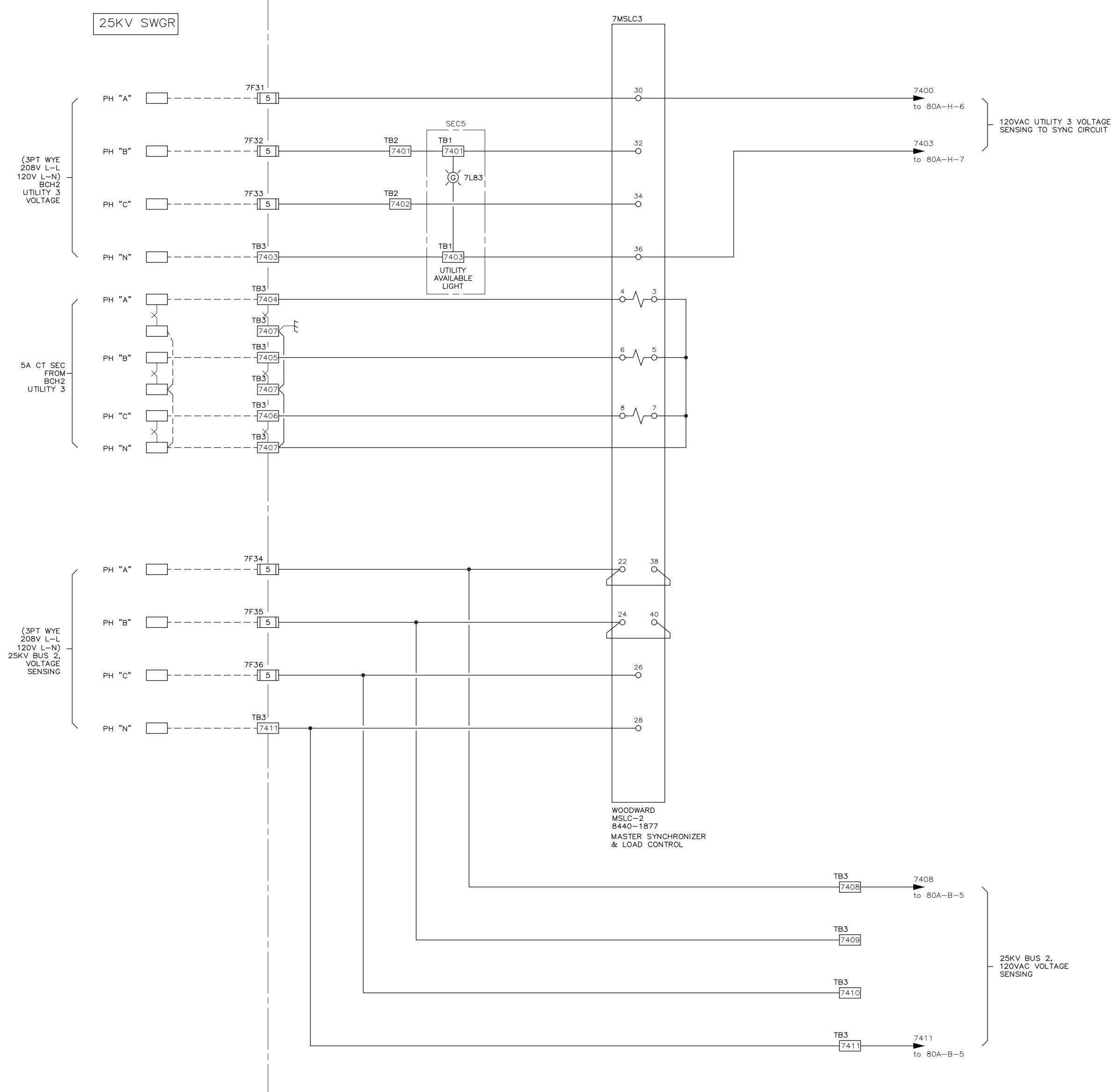
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
BCH-1 UTILITY 1 DC CONTROL SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER	WESTERN PACIFIC ENTERPRISES GP		
CUSTOMER ORDER No. C-054107		WORK ORDER No. W-095112	
DRAWN BY SD	AUTH BY SS	DATE 16-08-11	REV 2
DRAWING/FILE No. W-095112-062B			SHEET 62B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 4

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

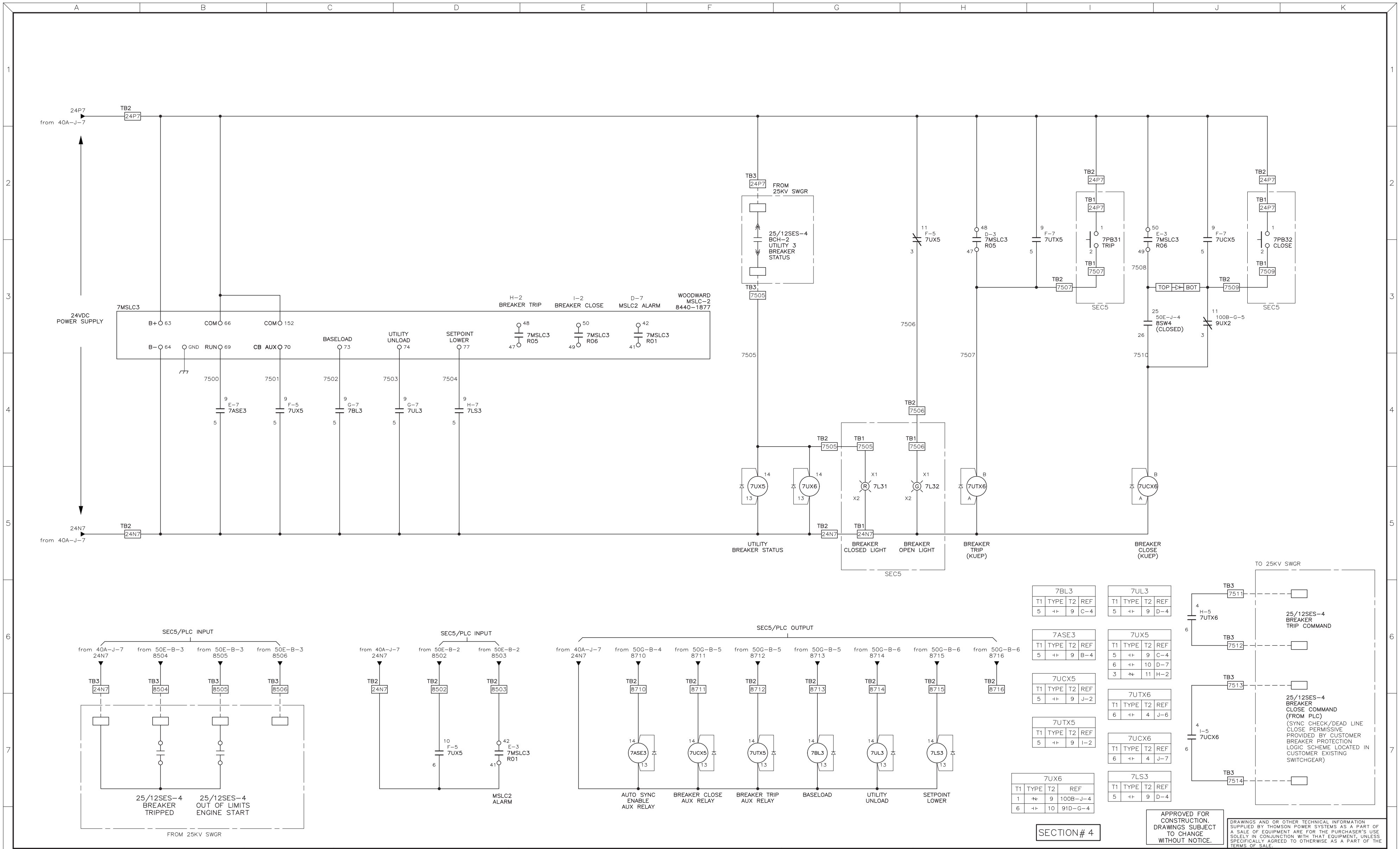
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
BCH–2 UTILITY 1 AC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.		WORK ORDER No.	
C–054107		W–095112	
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16–08–11	2
DRAWING/FILE No.		SHEET	
W–095112–063A		63A	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



7BL3			
T1	TYPE	T2	REF
5	⊣⊢	9	C−4

7ASE3			
T1	TYPE	T2	REF
5	⊣⊢	9	B−4

7UCX5			
T1	TYPE	T2	REF
5	⊣⊢	9	J−2

7UTX5			
T1	TYPE	T2	REF
5	⊣⊢	9	I−2

7UX6			
T1	TYPE	T2	REF
1	⊣/⊢	9	100B−J−4
6	⊣⊢	10	91D−G−4

7UL3			
T1	TYPE	T2	REF
5	⊣⊢	9	D−4

7UX5			
T1	TYPE	T2	REF
5	⊣⊢	9	C−4
6	⊣⊢	10	D−7
3	⊣/⊢	11	H−2

7UTX6			
T1	TYPE	T2	REF
6	⊣⊢	4	J−6

7UCX6			
T1	TYPE	T2	REF
6	⊣⊢	4	J−7

7LS3			
T1	TYPE	T2	REF
5	⊣⊢	9	D−4

SECTION# 4

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C−C−1
GRID COORDINATE
SHEET No.

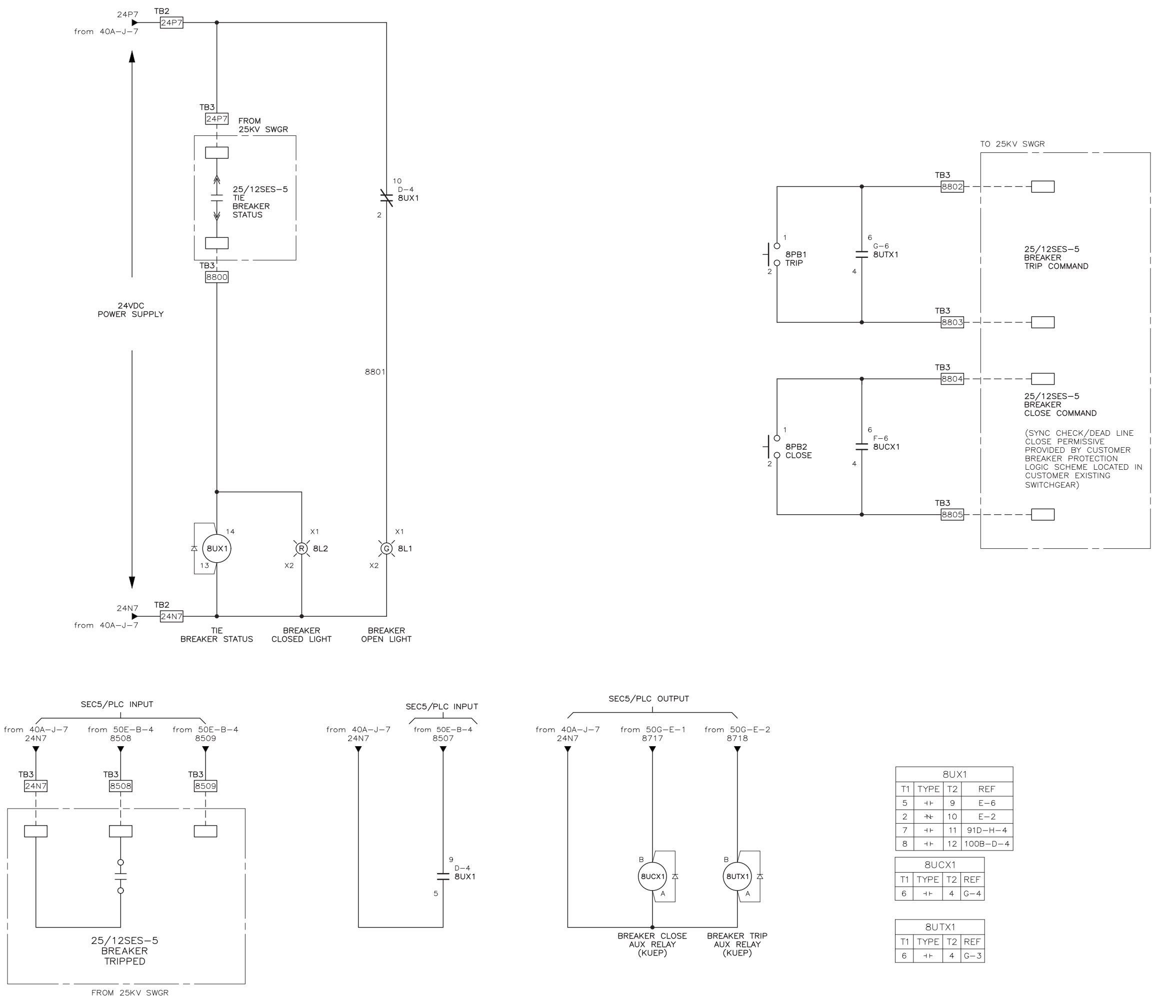
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16−10−19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16−08−25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
BCH−2 UTILITY 1 DC CONTROL SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C−054107
WORK ORDER No. W−095112
DRAWN BY SD
AUTH BY SS
DATE 16−08−11
REV 2
DRAWING/FILE No. W−095112−063B
SHEET 63B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



8UX1			
T1	TYPE	T2	REF
5	⊣⊢	9	E–6
2	⊣/⊢	10	E–2
7	⊣⊢	11	91D–H–4
8	⊣⊢	12	100B–D–4

8UCX1			
T1	TYPE	T2	REF
6	⊣⊢	4	G–4

8UTX1			
T1	TYPE	T2	REF
6	⊣⊢	4	G–3

SECTION# 5

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

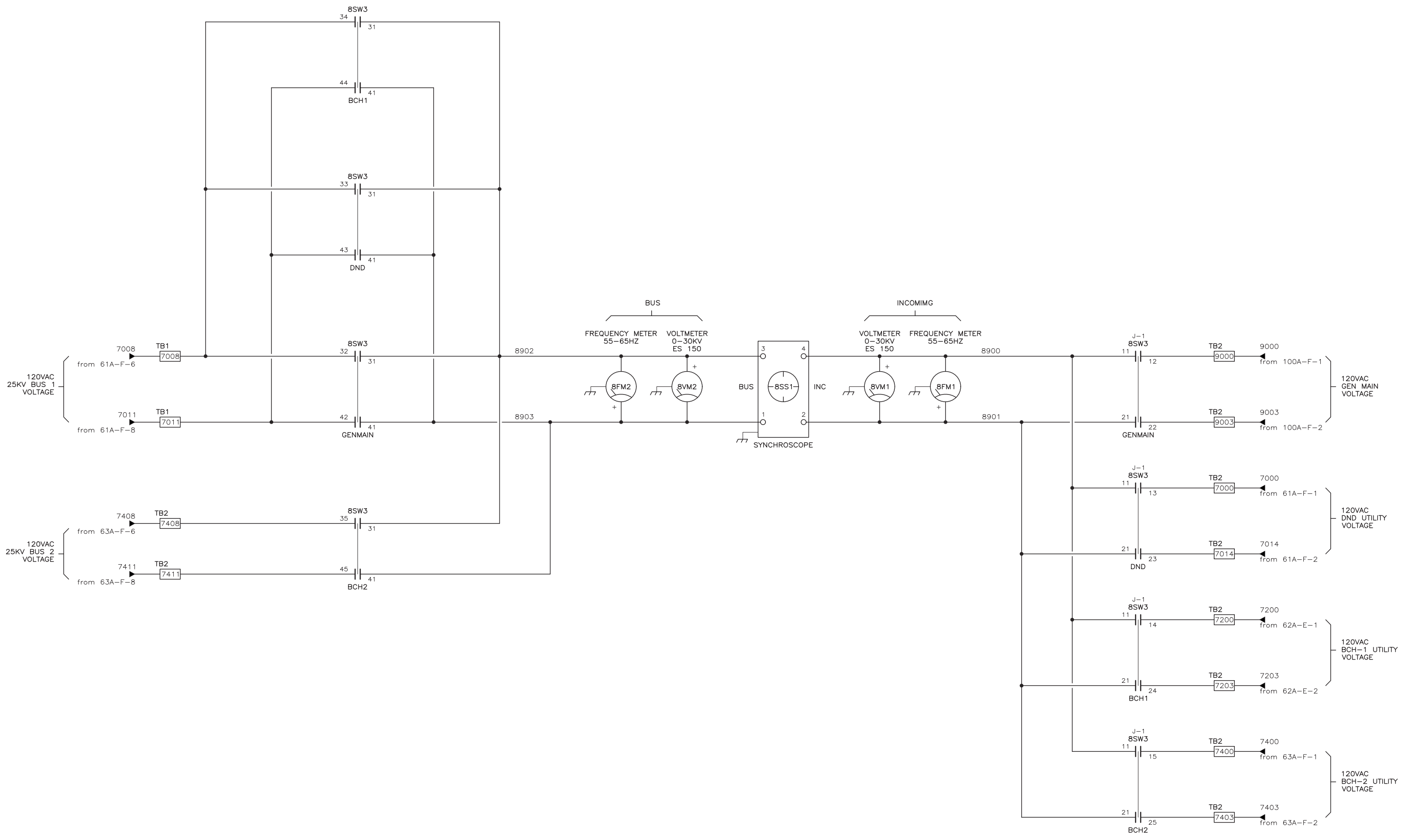
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

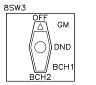
GENERATOR CONTROL SYSTEM
SERIES 2200
TIE BREAKER AC & DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER	WESTERN PACIFIC ENTERPRISES GP		
CUSTOMER ORDER No.		WORK ORDER No.	
C–054107		W–095112	
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16–08–11	2
DRAWING/FILE No.			SHEET
W–095112–070A			70A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



8SW3



8SW3			
T1	TYPE	T2	REF
11	⊣⊢	12	H–4
11	⊣⊢	13	H–4
11	⊣⊢	14	H–5
11	⊣⊢	15	H–6
21	⊣⊢	22	H–4
21	⊣⊢	23	H–5
21	⊣⊢	24	H–6
21	⊣⊢	25	H–7
32	⊣⊢	31	C–4
33	⊣⊢	31	C–2
34	⊣⊢	31	C–1
35	⊣⊢	31	C–5
42	⊣⊢	41	C–4
43	⊣⊢	41	C–3
44	⊣⊢	41	C–2
45	⊣⊢	41	C–5

		1	2	3	4	5
DECK	CONTACTS	OFF	GM	DND	BCH1	BCH2
1	11 ⊣⊢ 12		☒			
	⊣⊢ 13			☒		
	⊣⊢ 14				☒	
	⊣⊢ 15					☒
2	21 ⊣⊢ 22		☒			
	⊣⊢ 23			☒		
	⊣⊢ 24				☒	
	⊣⊢ 25					☒
3	31 ⊣⊢ 32		☒			
	⊣⊢ 33			☒		
	⊣⊢ 34				☒	
	⊣⊢ 35					☒
4	41 ⊣⊢ 42		☒			
	⊣⊢ 43			☒		
	⊣⊢ 44				☒	
	⊣⊢ 45					☒

SECTION# 5

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE
LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

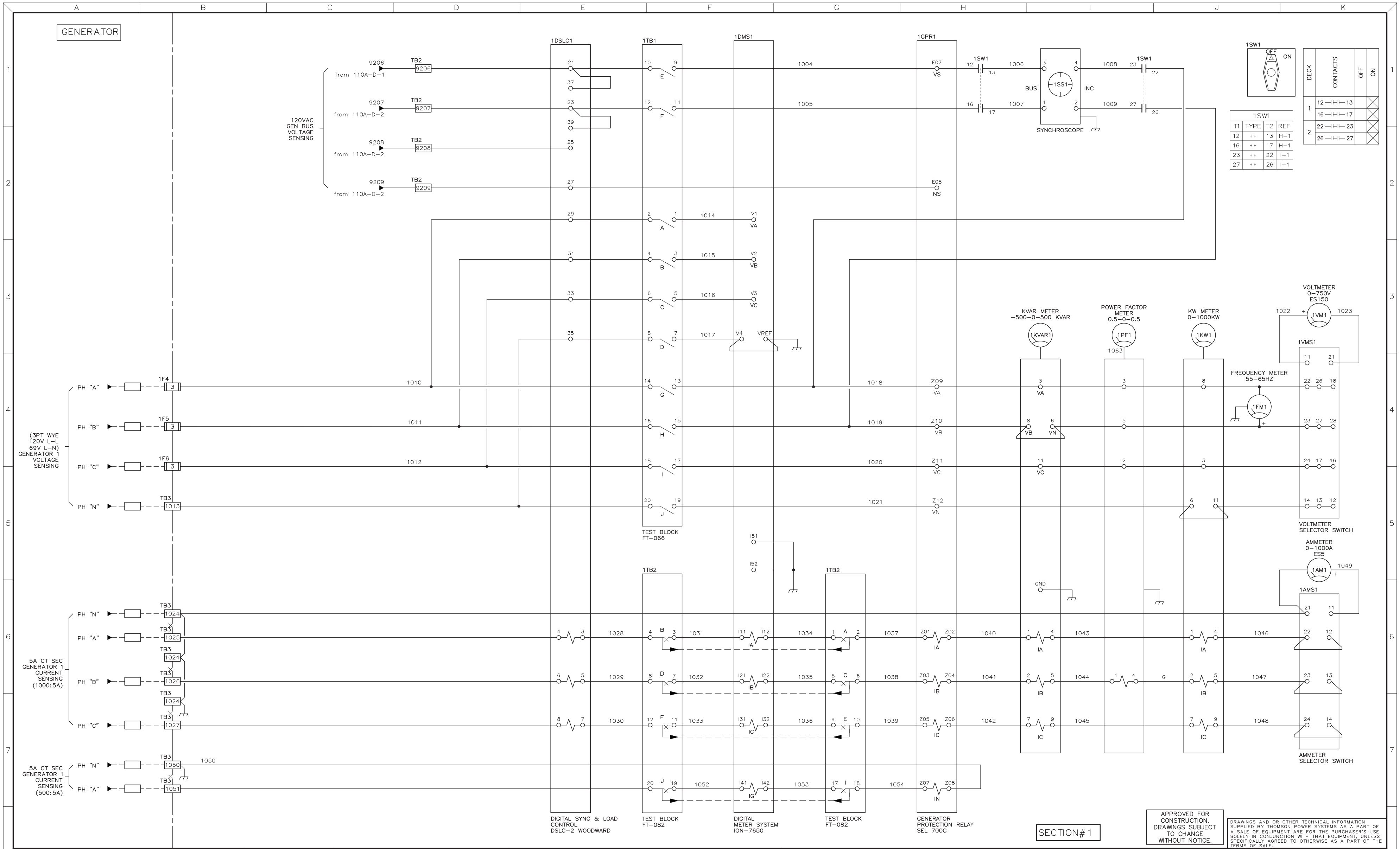
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
SYNC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095112
DRAWN BY SD
AUTH BY SS
DATE 16–08–11
REV 2
DRAWING/FILE No. W–095112–080A
SHEET 80A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



1SW1

DECK	CONTACTS	OFF	ON
1	12 ⊣⊢ 13		☒
	16 ⊣⊢ 17		☒
2	22 ⊣⊢ 23		☒
	26 ⊣⊢ 27		☒

1SW1			
T1	TYPE	T2	REF
12	⊣⊢	13	H-1
16	⊣⊢	17	H-1
23	⊣⊢	22	I-1
27	⊣⊢	26	I-1

SECTION# 1

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

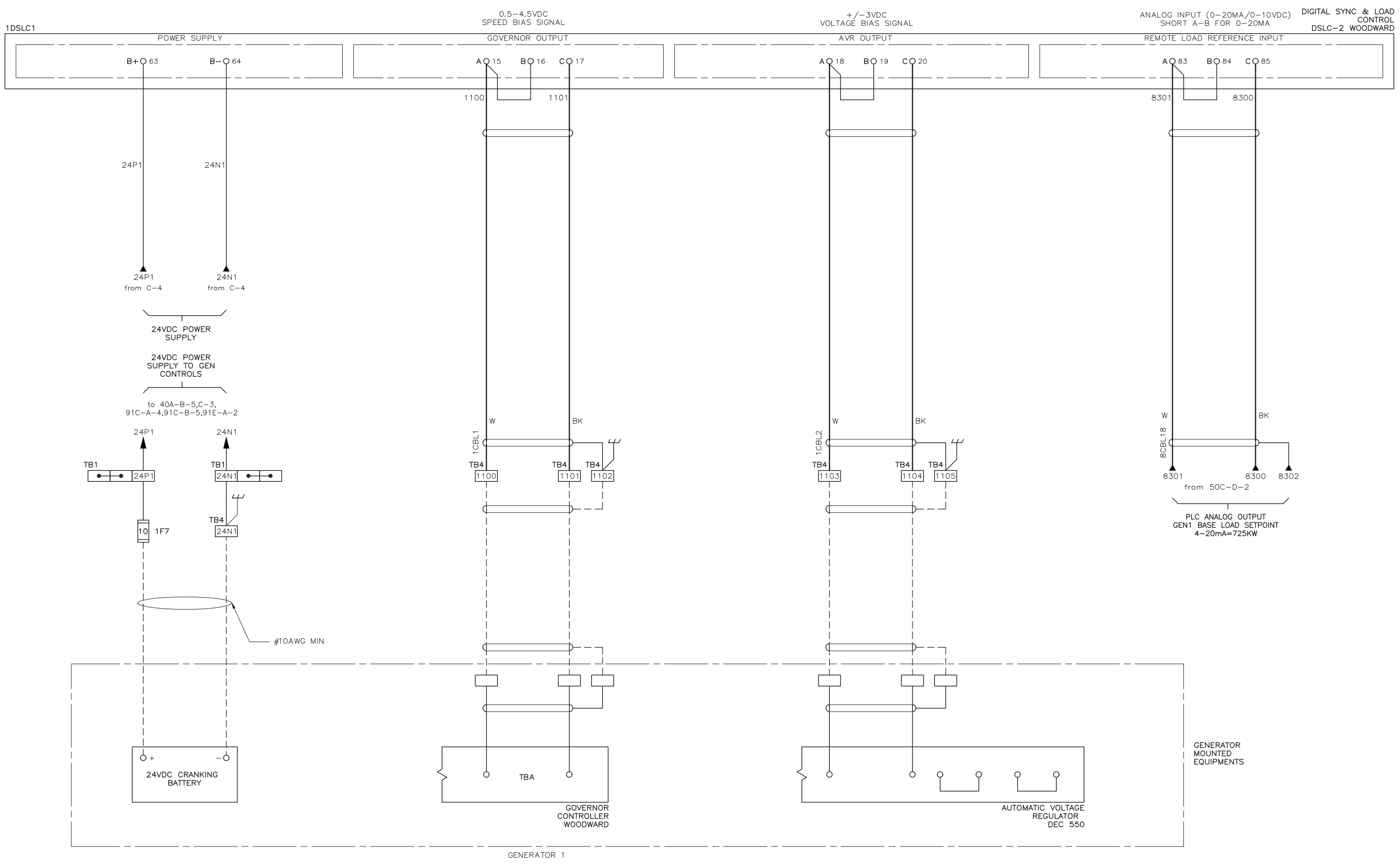
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 1 AC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-091A
SHEET 91A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 1

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE
LEGEND
50C−C−1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

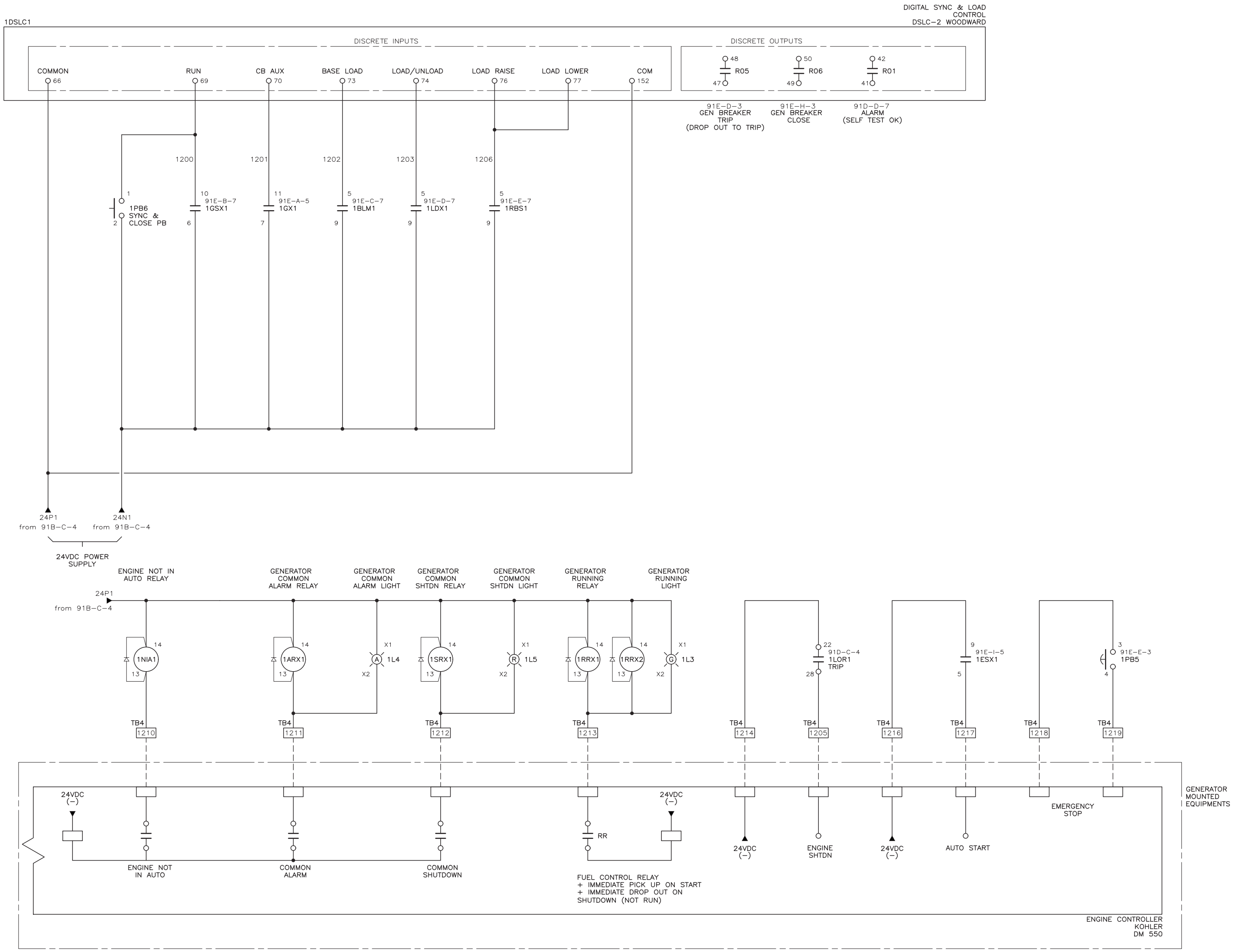
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16−10−19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16−08−25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 1 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER: WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No.: C−054107
WORK ORDER No.: W−095112
DRAWN BY: SD
AUTH BY: SS
DATE: 16−08−11
REV: 2
DRAWING/FILE No.: W−095112−091B
SHEET: 91B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



1ARX1			
T1	TYPE	T2	REF
5	⊣h	9	91E-D-2
1	⊣/⊢		
6	⊣⊢	10	91D-C-7

1NIA1			
T1	TYPE	T2	REF
5	⊣⊢	9	91D-D-7
2	⊣/⊢	10	91E-C-3

1RRX1			
T1	TYPE	T2	REF
5	⊣h	9	91E-C-2
1	⊣/⊢		
6	⊣⊢	10	91D-B-7
11	⊣/⊢	7	91E-F-3
8	⊣⊢	12	91D-F-4

1SRX1			
T1	TYPE	T2	REF
1	⊣/⊢	9	91E-I-3
6	⊣h	10	91E-E-2
2	⊣/⊢		
7	⊣⊢	11	91D-C-7

1RRX2			
T1	TYPE	T2	REF
6	⊣/⊢	10	91E-H-4

SECTION# 1

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
  ☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
  ☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

DRAWING No.	REFERENCE DRAWINGS

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 1 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

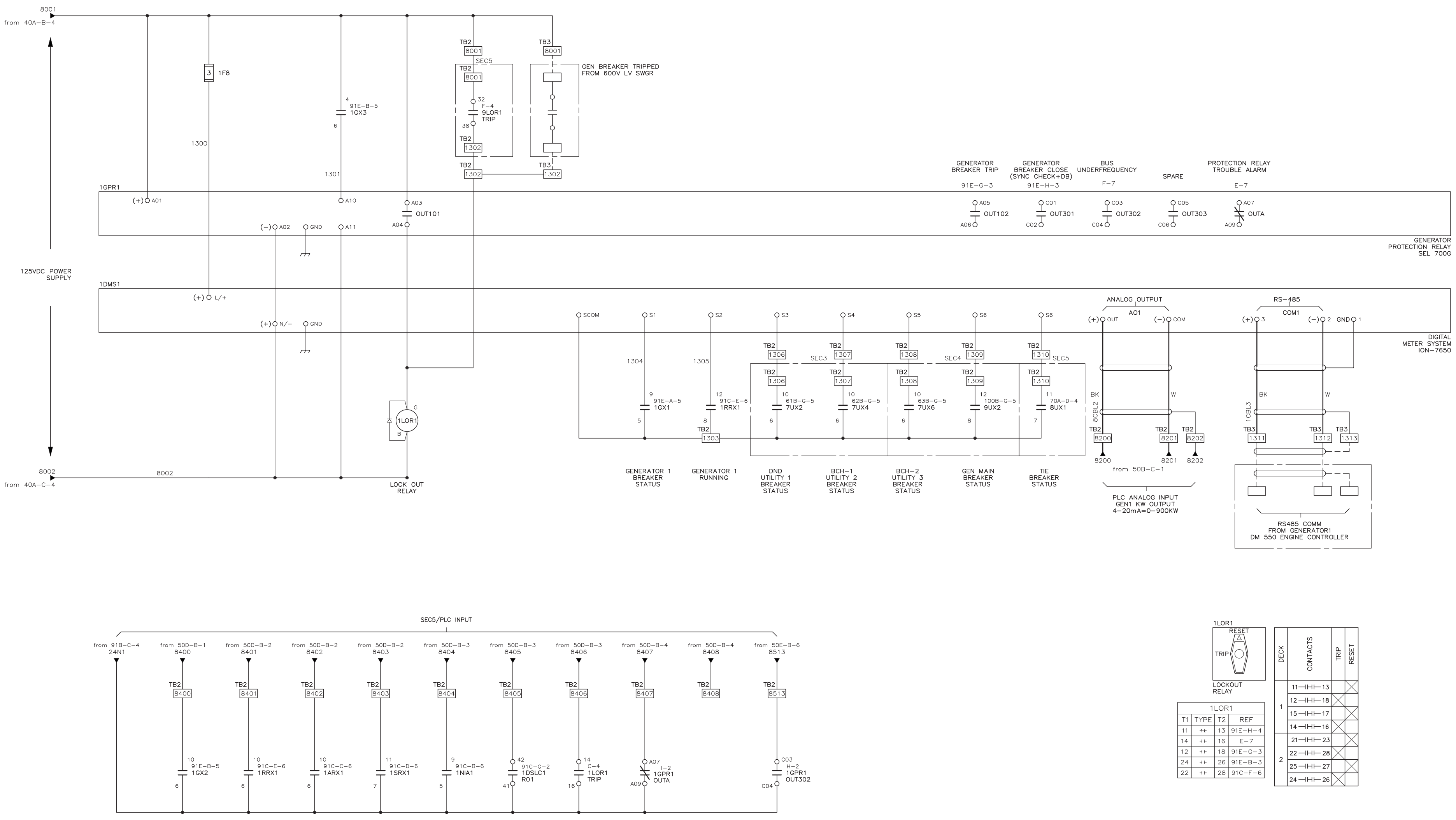
CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.	WORK ORDER No.
C-054107	W-095112

DRAWN BY	AUTH BY	DATE	REV
SD	SS	16-08-11	2

DRAWING/FILE No.	SHEET
W-095112-091C	91C

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



1LOR1			
T1	TYPE	T2	REF
11	⊣/⊢	13	91E-H-4
14	⊣⊢	16	E-7
12	⊣⊢	18	91E-G-3
24	⊣⊢	26	91E-B-3
22	⊣⊢	28	91C-F-6

DECK	CONTACTS	TRIP	RESET
1	11⊣⊢⊣⊢13		☒
	12⊣⊢⊣⊢18	☒	
	15⊣⊢⊣⊢17		☒
	14⊣⊢⊣⊢16	☒	
2	21⊣⊢⊣⊢23		☒
	22⊣⊢⊣⊢28	☒	
	25⊣⊢⊣⊢27		☒
	24⊣⊢⊣⊢26	☒	

SECTION# 1

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY _____ OF _____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

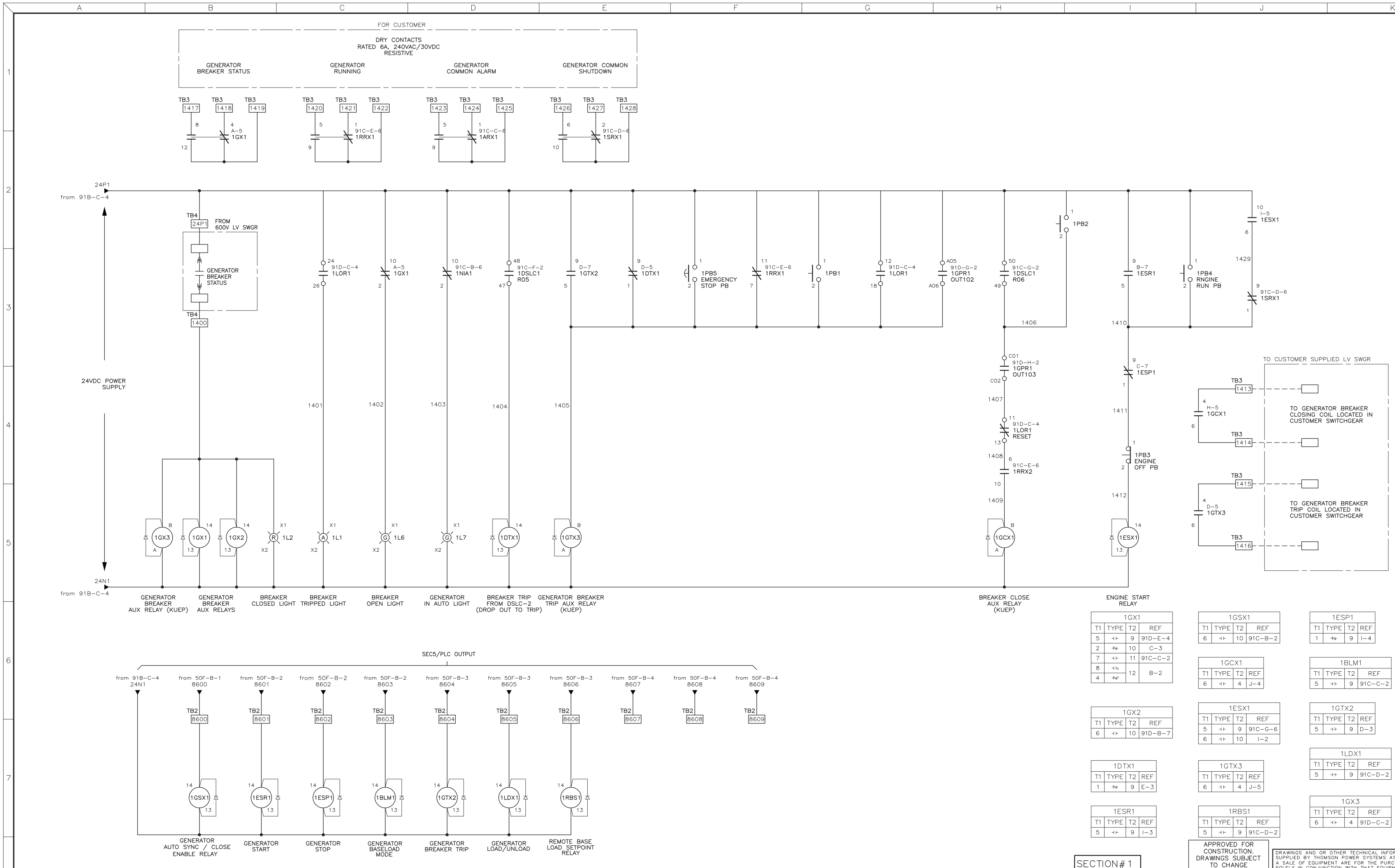
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 1 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.	WORK ORDER No.		
C-054107	W-095112		
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16-08-11	2
DRAWING/FILE No.		SHEET	
W-095112-091D		91D	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



1GX1

T1	TYPE	T2	REF
5	⊣⊢	9	91D–E–4
2	⊣/⊢	10	C–3
7	⊣⊢	11	91C–C–2
8	⊣h	12	B–2
4	⊣/⊢		

1GX2

T1	TYPE	T2	REF
6	⊣⊢	10	91D–B–7

1DTX1

T1	TYPE	T2	REF
1	⊣/⊢	9	E–3

1ESR1

T1	TYPE	T2	REF
5	⊣⊢	9	I–3

1GSX1

T1	TYPE	T2	REF
6	⊣⊢	10	91C–B–2

1GCX1

T1	TYPE	T2	REF
6	⊣⊢	4	J–4

1ESX1

T1	TYPE	T2	REF
5	⊣⊢	9	91C–G–6
6	⊣⊢	10	I–2

1GTX3

T1	TYPE	T2	REF
6	⊣⊢	4	J–5

1RBS1

T1	TYPE	T2	REF
5	⊣⊢	9	91C–D–2

1ESP1

T1	TYPE	T2	REF
1	⊣/⊢	9	I–4

1BLM1

T1	TYPE	T2	REF
5	⊣⊢	9	91C–C–2

1GTX2

T1	TYPE	T2	REF
5	⊣⊢	9	D–3

1LDX1

T1	TYPE	T2	REF
5	⊣⊢	9	91C–D–2

1GX3

T1	TYPE	T2	REF
6	⊣⊢	4	91D–C–2

SECTION# 1

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

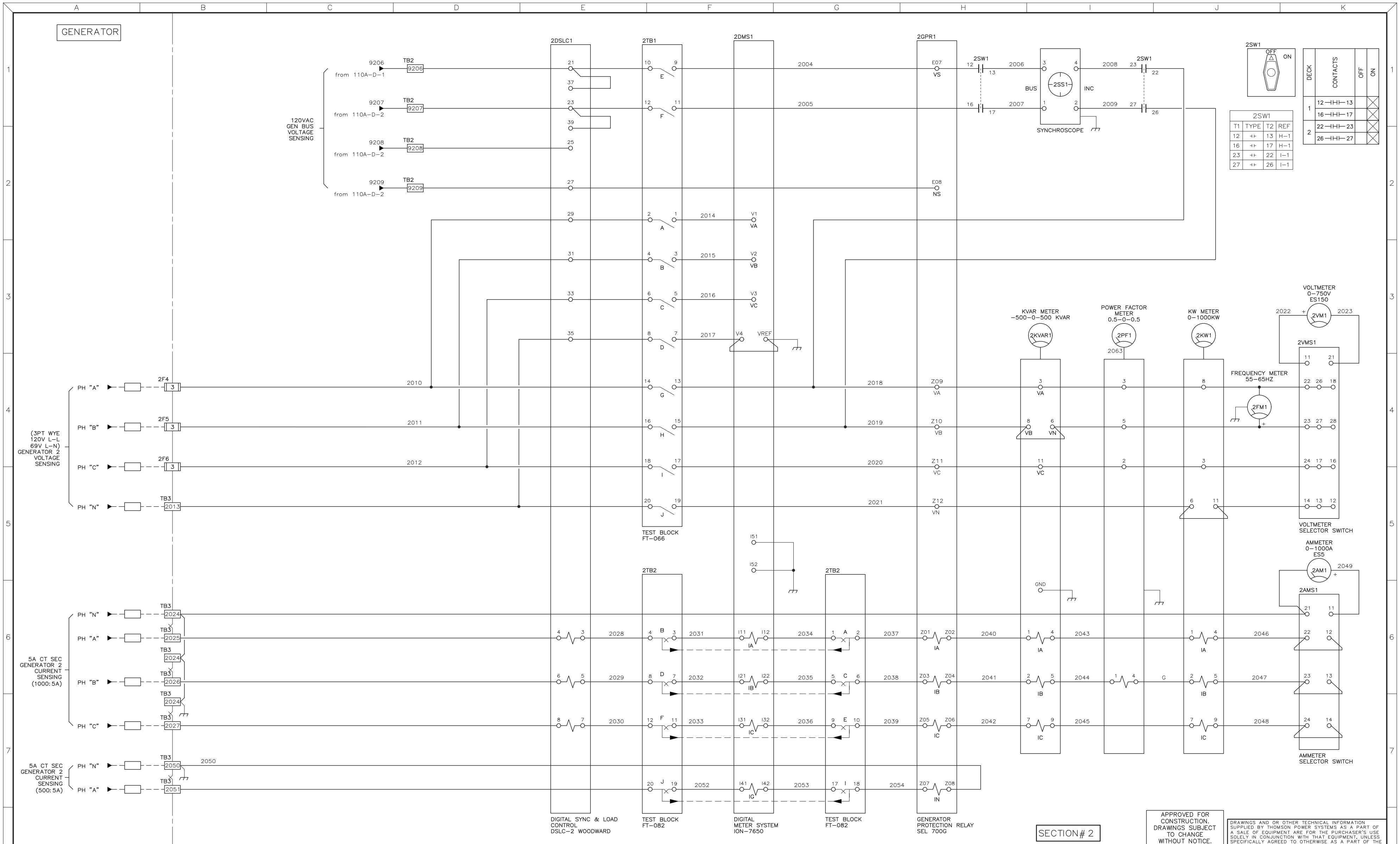
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 1 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095112
DRAWN BY SD
AUTH BY SS
DATE 16–08–11
REV 2
DRAWING/FILE No. W–095112–091E
SHEET 91E

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



2SW1			
T1	TYPE	T2	REF
12	⊣⊢	13	H-1
16	⊣⊢	17	H-1
23	⊣⊢	22	I-1
27	⊣⊢	26	I-1

DECK	CONTACTS	OFF	ON
1	12 ⊣⊢ 13		☒
	16 ⊣⊢ 17		☒
2	22 ⊣⊢ 23		☒
	26 ⊣⊢ 27		☒

SECTION# 2

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

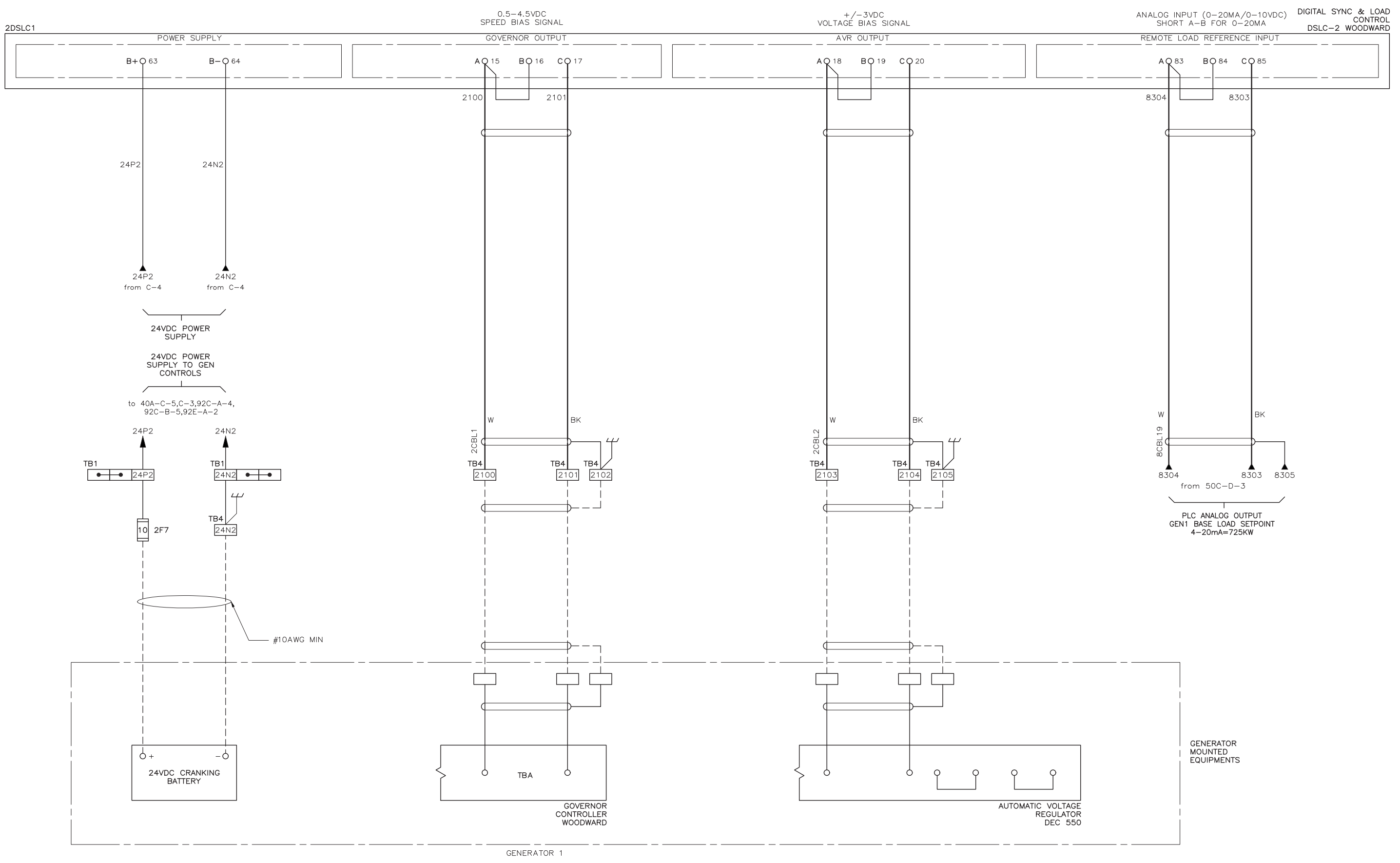
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 2 AC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER	WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107	WORK ORDER No. W-095112
DRAWN BY SD	AUTH BY SS
DATE 16-08-11	REV 2
DRAWING/FILE No. W-095112-092A	SHEET 92A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 2

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

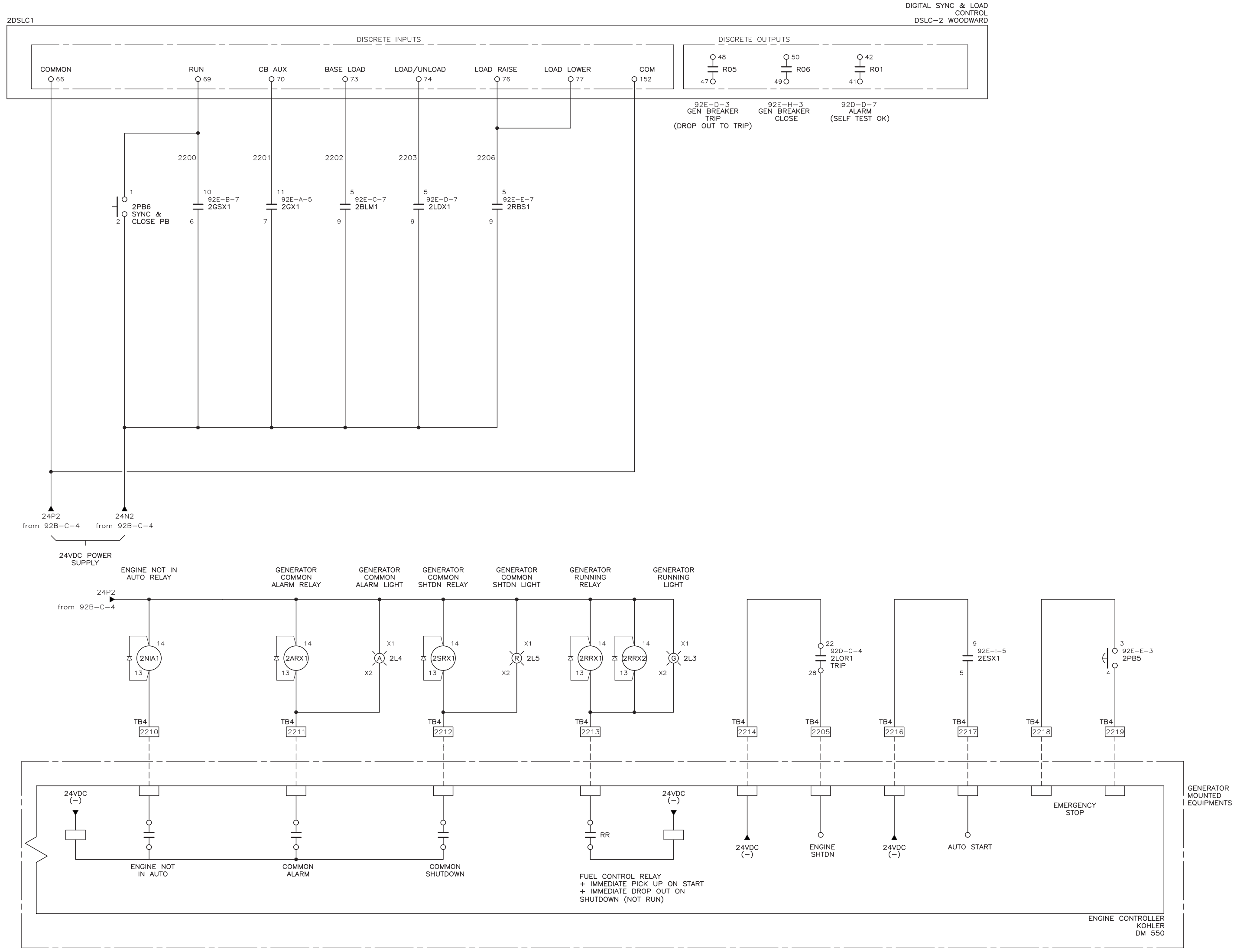
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 2 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-092B
SHEET 92B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



2ARX1

T1	TYPE	T2	REF
5	⊣ h	9	92E-D-2
1	⊣/ᒧ		
6	⊣⊢	10	92D-C-7

2NIA1

T1	TYPE	T2	REF
5	⊣⊢	9	92D-D-7
2	⊣/⊢	10	92E-C-3

2RRX1

T1	TYPE	T2	REF
5	⊣ h	9	92E-C-2
1	⊣/ᒧ		
6	⊣⊢	10	92D-B-7
11	⊣/⊢	7	92E-F-3
8	⊣⊢	12	92D-F-4

2SRX1

T1	TYPE	T2	REF
1	⊣/⊢	9	92E-I-3
6	⊣ h	10	92E-E-2
2	⊣/ᒧ		
7	⊣⊢	11	92D-C-7

2RRX2

T1	TYPE	T2	REF
6	⊣⊢	10	92E-H-4

SECTION# 2

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

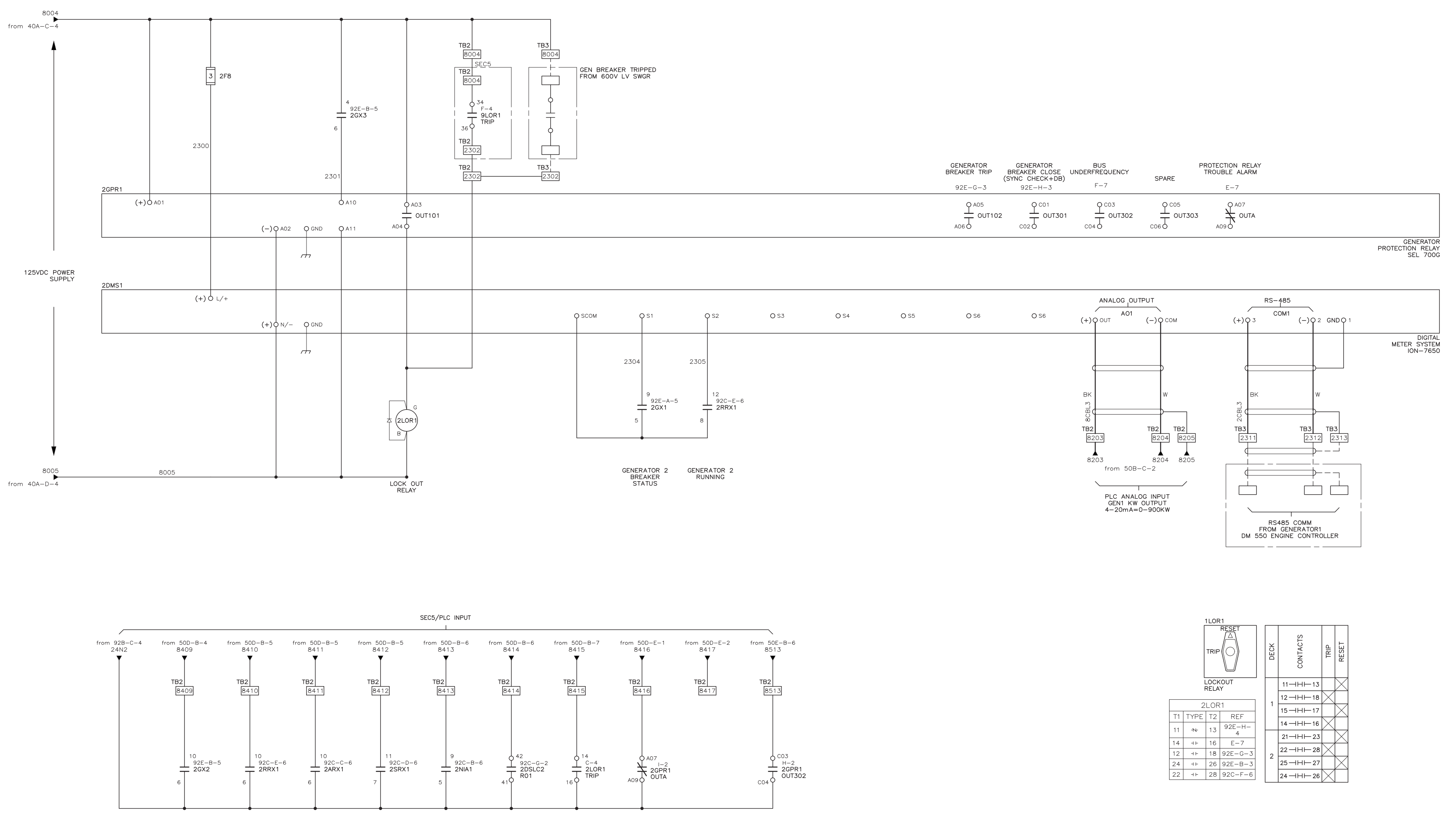
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 2 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER	WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107	WORK ORDER No. W-095112
DRAWN BY SD	AUTH BY SS
DATE 16-08-11	REV 2
DRAWING/FILE No. W-095112-092C	SHEET 92C

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



2LOR1			
T1	TYPE	T2	REF
11	⊬	13	92E-H-4
14	⊣⊢	16	E-7
12	⊣⊢	18	92E-G-3
24	⊣⊢	26	92E-B-3
22	⊣⊢	28	92C-F-6

DECK	CONTACTS	TRIP	RESET
1	11—⊣H⊢—13		☒
	12—⊣H⊢—18	☒	
	15—⊣H⊢—17		☒
	14—⊣H⊢—16	☒	
2	21—⊣H⊢—23		☒
	22—⊣H⊢—28	☒	
	25—⊣H⊢—27		☒
	24—⊣H⊢—26	☒	

SECTION# 2

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

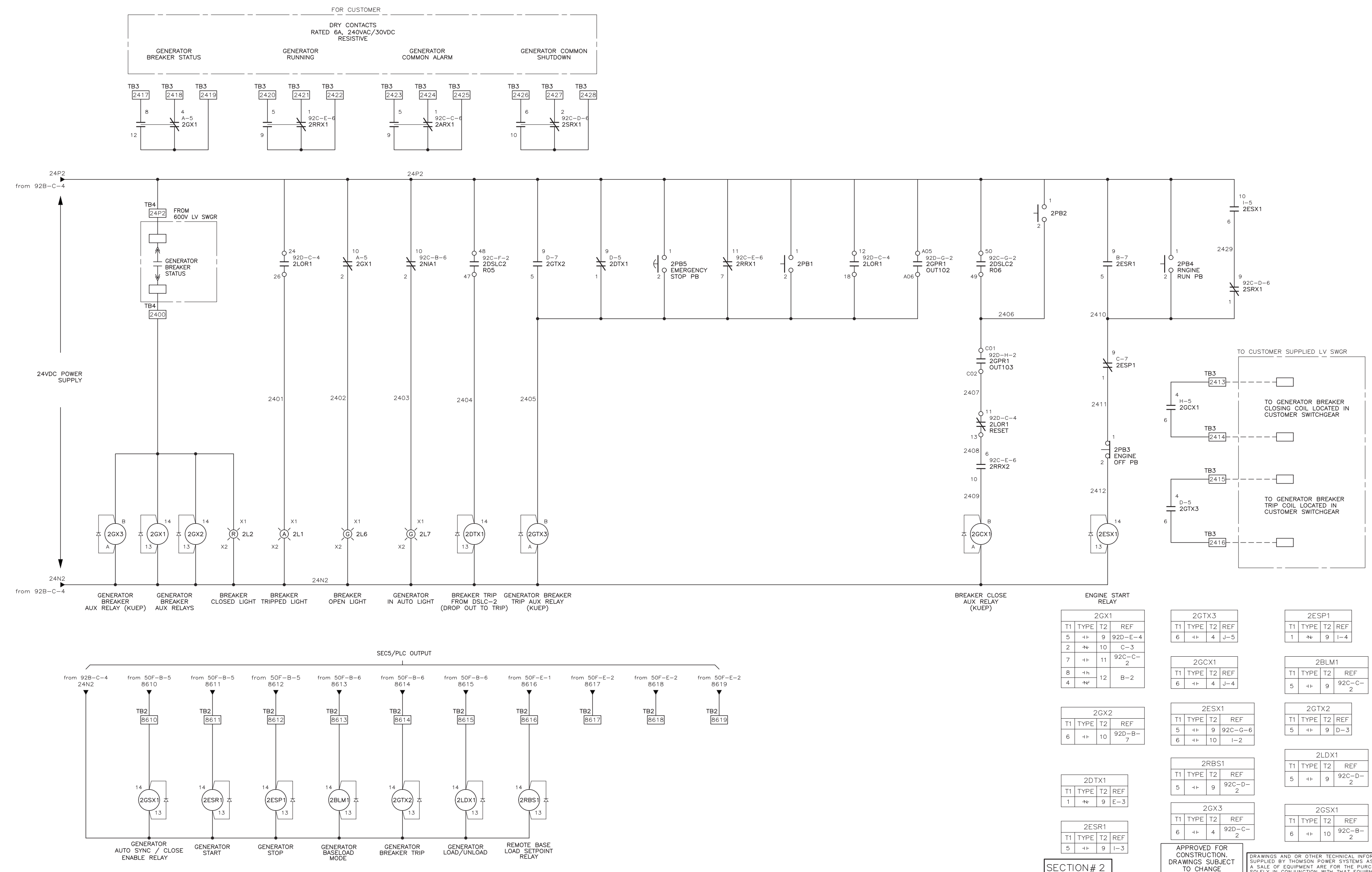
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 2 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER	WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No.	C-054107
WORK ORDER No.	W-095112
DRAWN BY	SD
AUTH BY	SS
DATE	16-08-11
REV	2
DRAWING/FILE No.	W-095112-092D
SHEET	92D

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



2GX1

T1	TYPE	T2	REF
5	⊣⊢	9	92D-E-4
2	⊣/⊢	10	C-3
7	⊣⊢	11	92C-C-2
8	⊣h	12	B-2
4	⊣/⊢		

2GX2

T1	TYPE	T2	REF
6	⊣⊢	10	92D-B-7

2DTX1

T1	TYPE	T2	REF
1	⊣/⊢	9	E-3

2ESR1

T1	TYPE	T2	REF
5	⊣⊢	9	I-3

2GTX3

T1	TYPE	T2	REF
6	⊣⊢	4	J-5

2GCX1

T1	TYPE	T2	REF
6	⊣⊢	4	J-4

2ESX1

T1	TYPE	T2	REF
5	⊣⊢	9	92C-G-6
6	⊣⊢	10	I-2

2RBS1

T1	TYPE	T2	REF
5	⊣⊢	9	92C-D-2

2GX3

T1	TYPE	T2	REF
6	⊣⊢	4	92D-C-2

2ESP1

T1	TYPE	T2	REF
1	⊣/⊢	9	I-4

2BLM1

T1	TYPE	T2	REF
5	⊣⊢	9	92C-C-2

2GTX2

T1	TYPE	T2	REF
5	⊣⊢	9	D-3

2LDX1

T1	TYPE	T2	REF
5	⊣⊢	9	92C-D-2

2GSX1

T1	TYPE	T2	REF
6	⊣⊢	10	92C-B-2

SECTION# 2

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

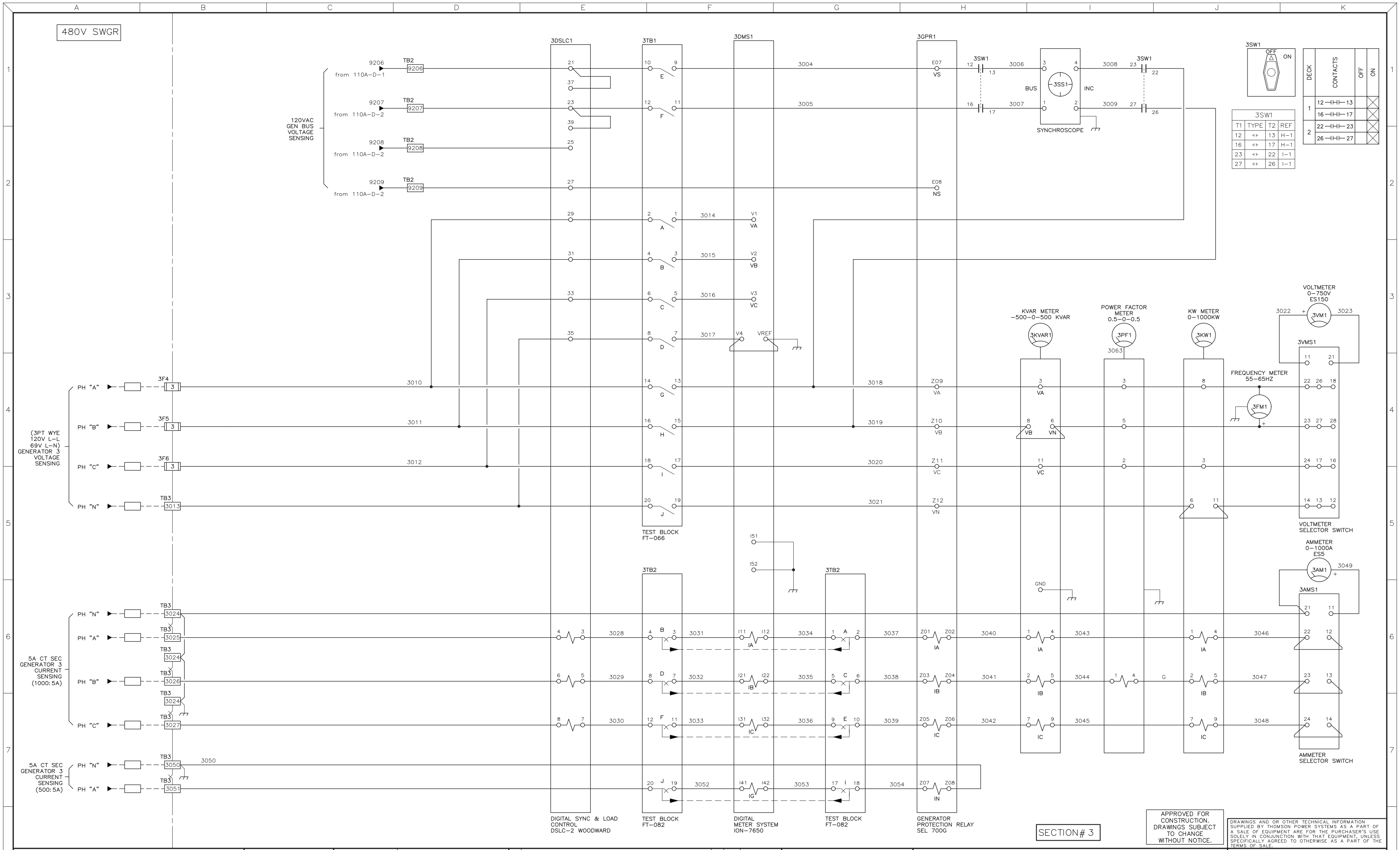
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 2 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-092E
SHEET 92E

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



3SW1			
T1	TYPE	T2	REF
12	⊣⊢	13	H-1
16	⊣⊢	17	H-1
23	⊣⊢	22	I-1
27	⊣⊢	26	I-1

DECK	CONTACTS	OFF	ON
1	12 ⊣⊢ 13		☒
	16 ⊣⊢ 17		☒
2	22 ⊣⊢ 23		☒
	26 ⊣⊢ 27		☒

SECTION# 3

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

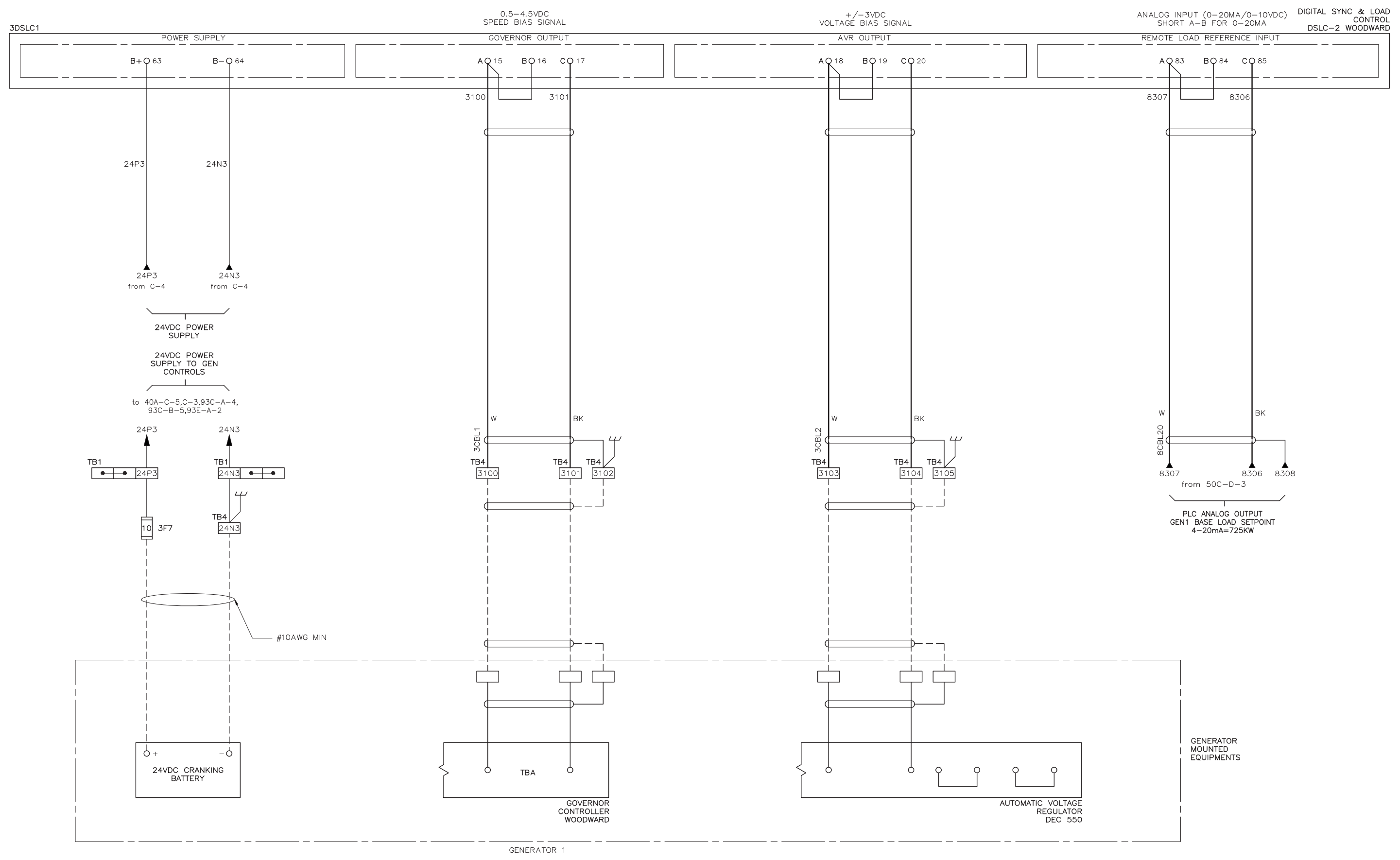
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 3 AC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP			
CUSTOMER ORDER No. C-054107		WORK ORDER No. W-095112	
DRAWN BY SD	AUTH BY SS	DATE 16-08-11	REV 2
DRAWING/FILE No. W-095112-093A		SHEET 93A	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 3

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY _____ OF _____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

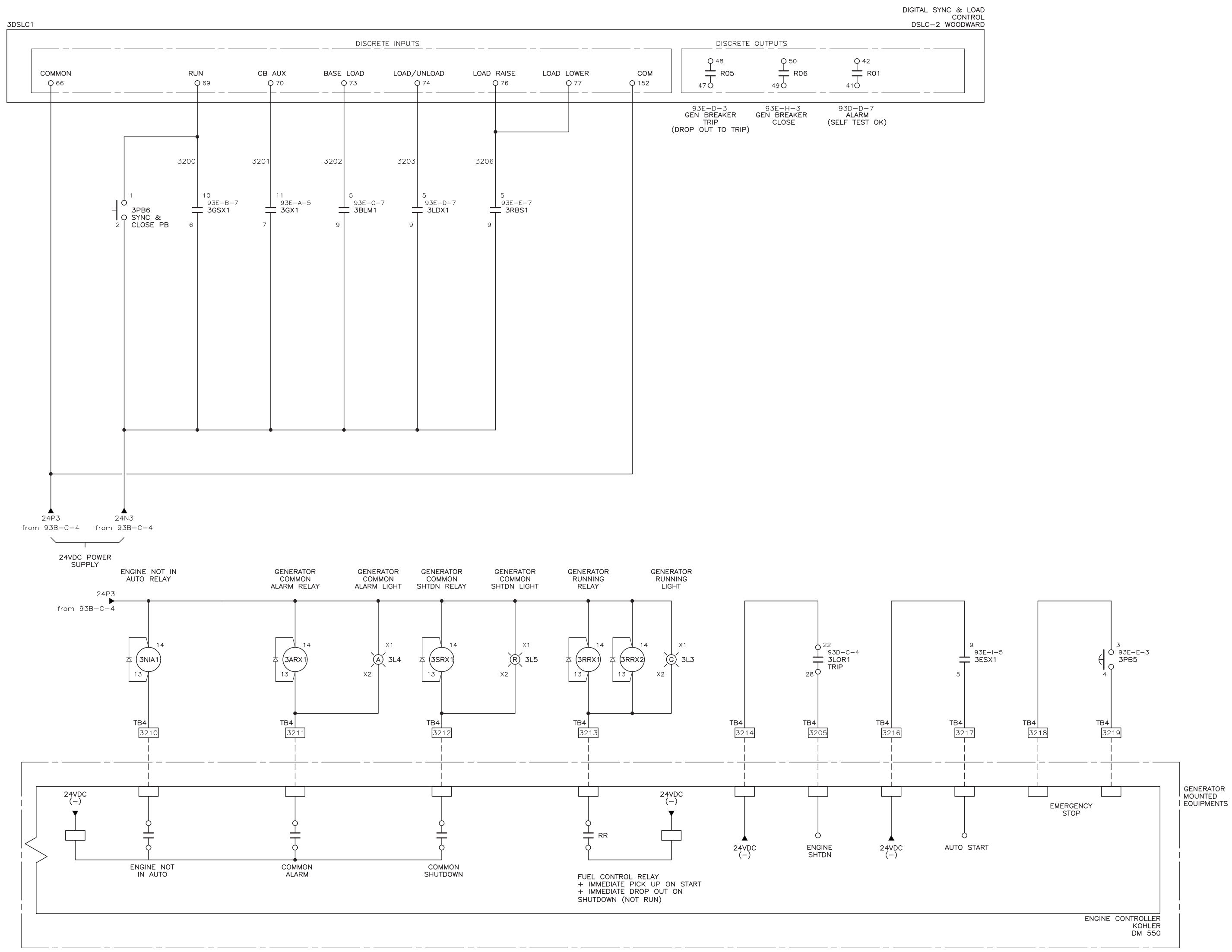
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 3 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER	WESTERN PACIFIC ENTERPRISES GP		
CUSTOMER ORDER No. C–054107	WORK ORDER No. W–095112		
DRAWN BY SD	AUTH BY SS	DATE 16–08–11	REV 2
DRAWING/FILE No. W–095112–093B	SHEET 93B		

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



3ARX1			
T1	TYPE	T2	REF
5	⊣⊢	9	93E-D-2
1	⊣/⊢		
6	⊣⊢	10	93D-C-7

3NIA1			
T1	TYPE	T2	REF
5	⊣⊢	9	93D-D-7
2	⊣/⊢	10	93E-C-3

3RRX1			
T1	TYPE	T2	REF
5	⊣⊢	9	93E-C-2
1	⊣/⊢		
6	⊣⊢	10	93D-B-7
11	⊣/⊢	7	93E-F-3
8	⊣⊢	12	93D-F-4

3SRX1			
T1	TYPE	T2	REF
1	⊣/⊢	9	93E-I-3
6	⊣⊢	10	93E-E-2
2	⊣/⊢		
7	⊣⊢	11	93D-C-7

3RRX2			
T1	TYPE	T2	REF
6	⊣⊢	10	93E-H-4

SECTION# 3

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

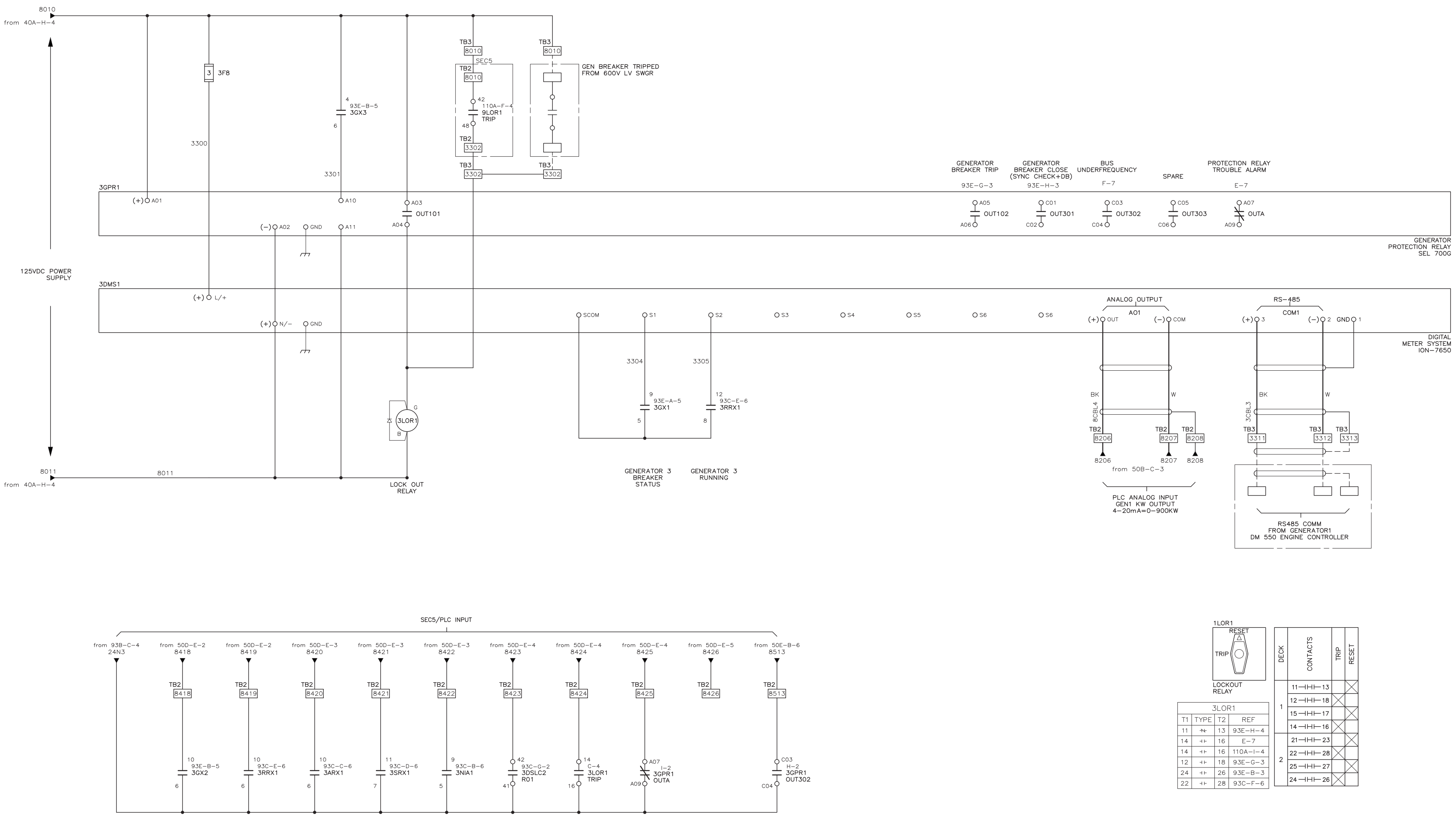
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 3 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-093C
SHEET 93C

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



3LOR1			
T1	TYPE	T2	REF
11	⊣/⊢	13	93E-H-4
14	⊣⊢	16	E-7
14	⊣⊢	16	110A-I-4
12	⊣⊢	18	93E-G-3
24	⊣⊢	26	93E-B-3
22	⊣⊢	28	93C-F-6

DECK	CONTACTS	TRIP	RESET
1	11 ⊣H⊢ 13		☒
	12 ⊣H⊢ 18	☒	
	15 ⊣H⊢ 17		☒
	14 ⊣H⊢ 16	☒	
2	21 ⊣H⊢ 23		☒
	22 ⊣H⊢ 28	☒	
	25 ⊣H⊢ 27		☒
	24 ⊣H⊢ 26	☒	

SECTION# 3

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ______ DATE: ______

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

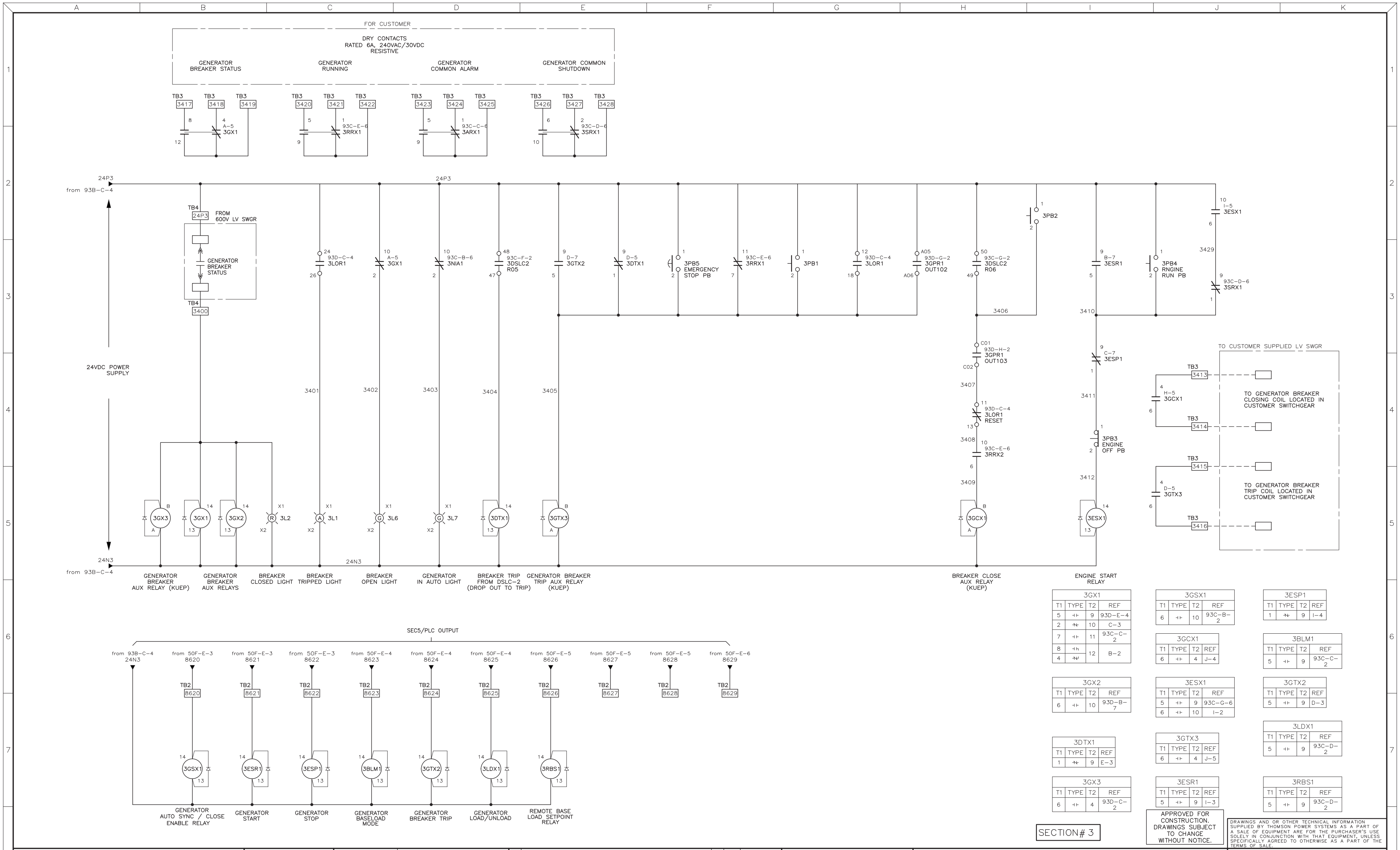
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 3 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-093D
SHEET 93D

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



3GX1

T1	TYPE	T2	REF
5	⊣⊢	9	93D-E-4
2	⊣/⊢	10	C-3
7	⊣⊢	11	93C-C-2
8	⊣⊢	12	B-2
4	⊣/⊢		

3GX2

T1	TYPE	T2	REF
6	⊣⊢	10	93D-B-7

3DTX1

T1	TYPE	T2	REF
1	⊣/⊢	9	E-3

3GX3

T1	TYPE	T2	REF
6	⊣⊢	4	93D-C-2

3GSX1

T1	TYPE	T2	REF
6	⊣⊢	10	93C-B-2

3GCX1

T1	TYPE	T2	REF
6	⊣⊢	4	J-4

3ESX1

T1	TYPE	T2	REF
5	⊣⊢	9	93C-G-6
6	⊣⊢	10	I-2

3GTX3

T1	TYPE	T2	REF
6	⊣⊢	4	J-5

3ESR1

T1	TYPE	T2	REF
5	⊣⊢	9	I-3

3ESP1

T1	TYPE	T2	REF
1	⊣/⊢	9	I-4

3BLM1

T1	TYPE	T2	REF
5	⊣⊢	9	93C-C-2

3GTX2

T1	TYPE	T2	REF
5	⊣⊢	9	D-3

3LDX1

T1	TYPE	T2	REF
5	⊣⊢	9	93C-D-2

3RBS1

T1	TYPE	T2	REF
5	⊣⊢	9	93C-D-2

SECTION# 3

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE
LEGEND
50C-C-1
GRID
COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

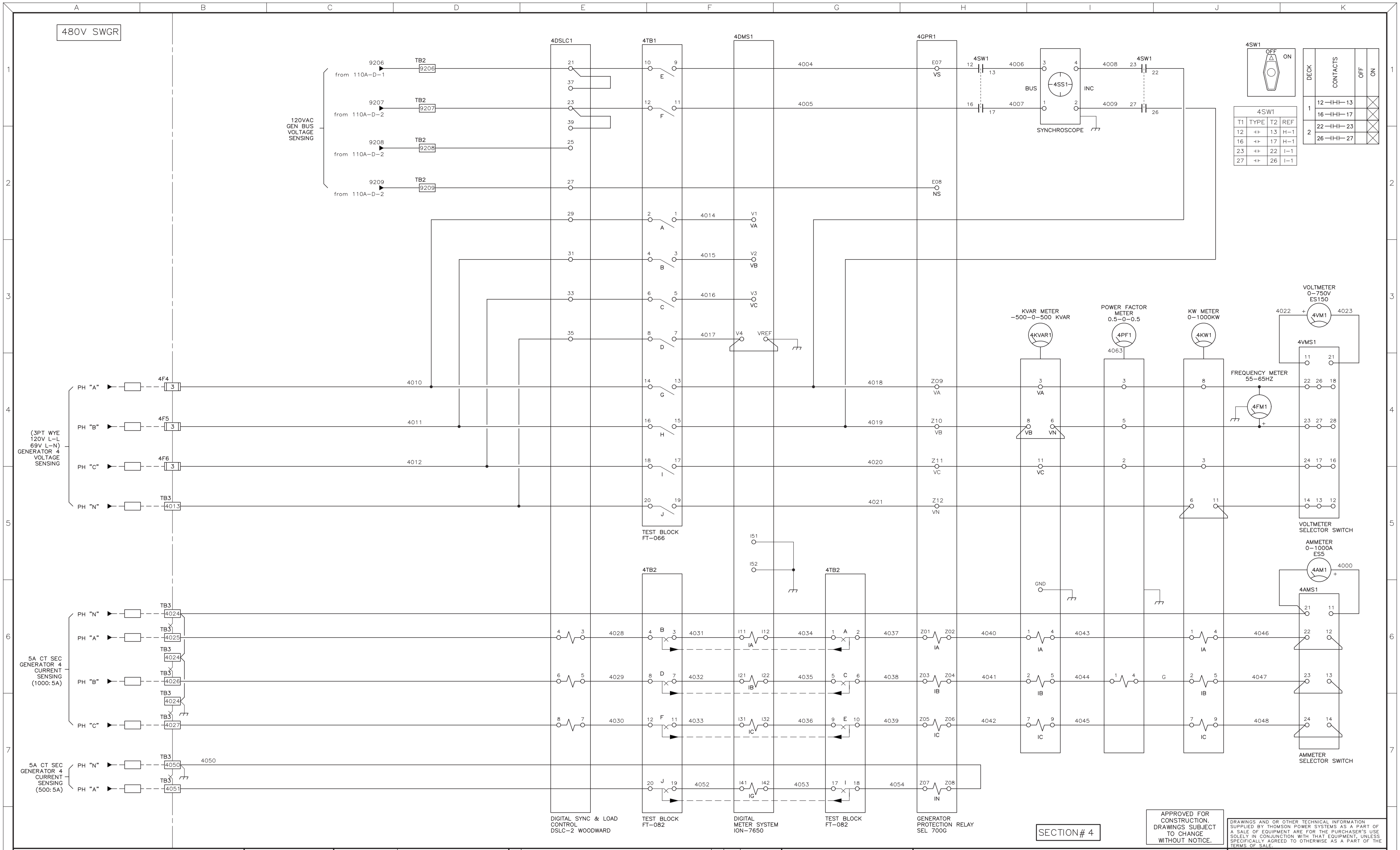
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 3 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-093E
SHEET 93E

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



4SW1			
T1	TYPE	T2	REF
12	⊣⊢	13	H-1
16	⊣⊢	17	H-1
23	⊣⊢	22	I-1
27	⊣⊢	26	I-1

DECK	CONTACTS	OFF	ON
1	12-⊣⊢-13		☒
	16-⊣⊢-17		☒
2	22-⊣⊢-23		☒
	26-⊣⊢-27		☒

SECTION# 4

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

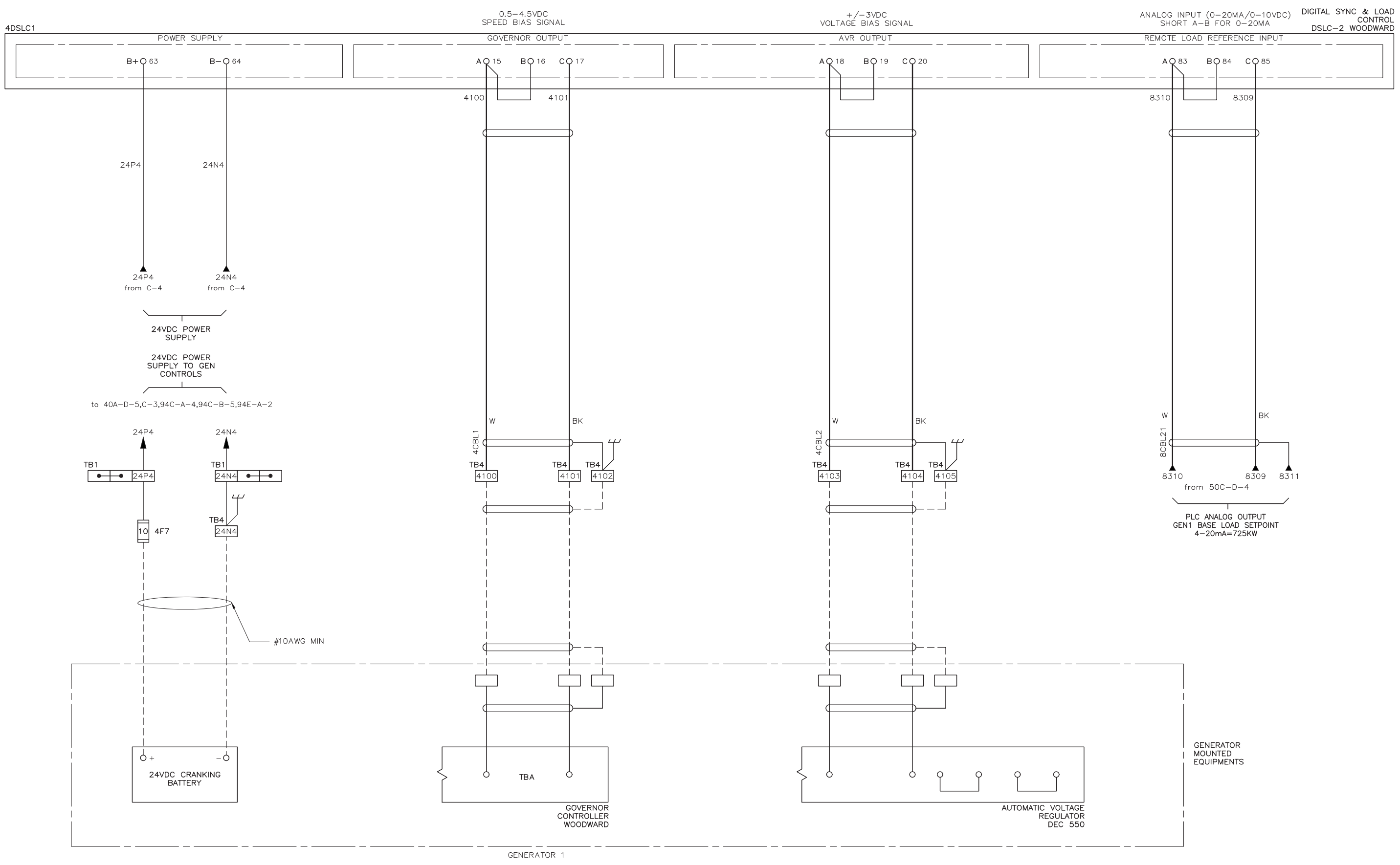
DRAWING No.	REFERENCE DRAWINGS

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 4 AC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-094A
SHEET 94A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 4

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

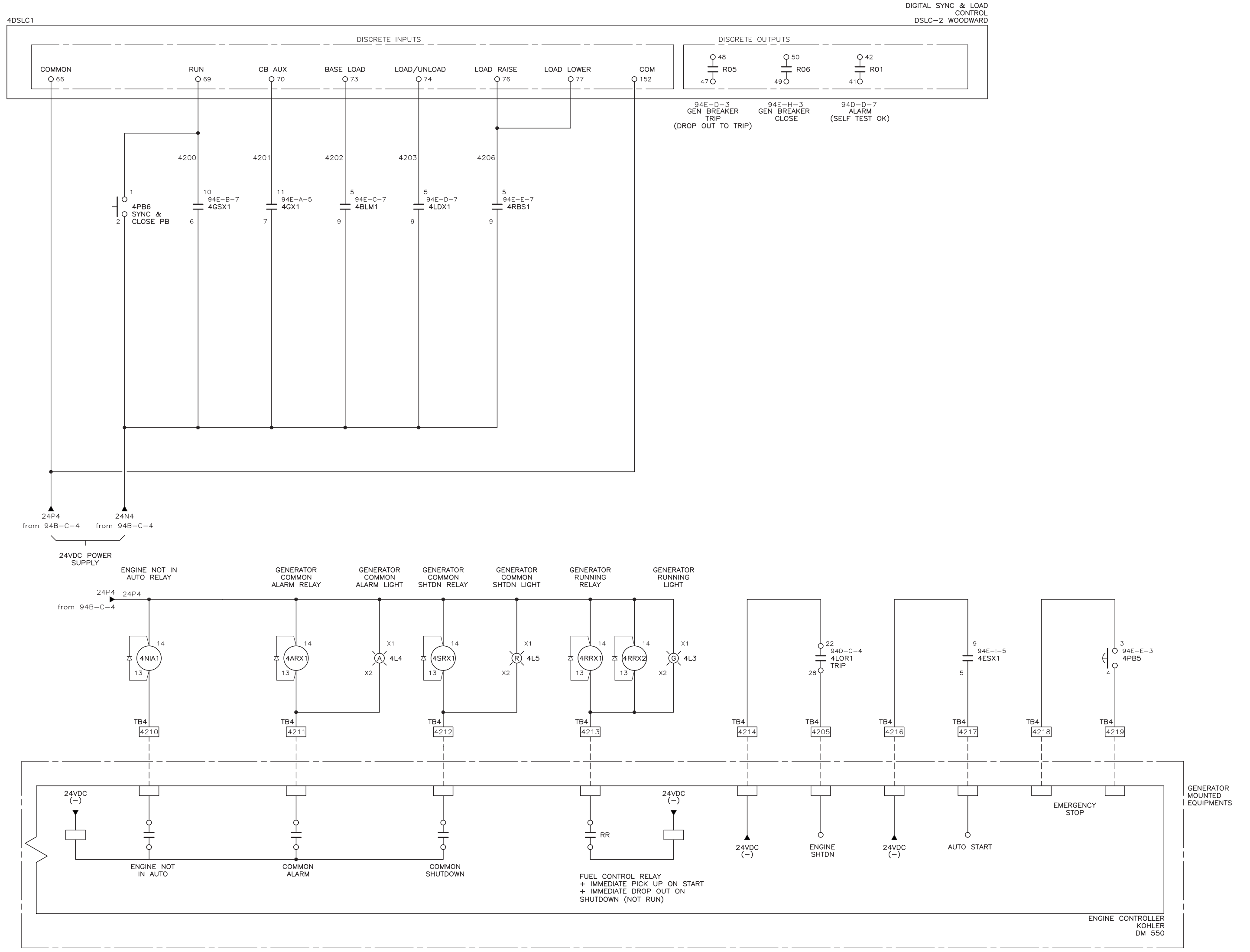
marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 4 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP

CUSTOMER ORDER No.		WORK ORDER No.	
C-054107		W-095112	
DRAWN BY	AUTH BY	DATE	REV
SD	SS	16-08-11	2
DRAWING/FILE No.		SHEET	
W-095112-094B		94B	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



4ARX1

T1	TYPE	T2	REF
5	⊣⊢	9	94E-D-2
1	⊣/⊢		
6	⊣⊢	10	94D-C-7

4NIA1

T1	TYPE	T2	REF
5	⊣⊢	9	94D-D-7
2	⊣/⊢	10	94E-C-3

4RRX1

T1	TYPE	T2	REF
5	⊣⊢	9	94E-C-2
1	⊣/⊢		
6	⊣⊢	10	94D-B-7
11	⊣/⊢	7	94E-F-3
8	⊣⊢	12	94D-F-4

4SRX1

T1	TYPE	T2	REF
1	⊣/⊢	9	94E-I-3
6	⊣⊢	10	94E-E-2
2	⊣/⊢		
7	⊣⊢	11	94D-C-7

4RRX2

T1	TYPE	T2	REF
6	⊣⊢	10	94E-H-4

SECTION# 4

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

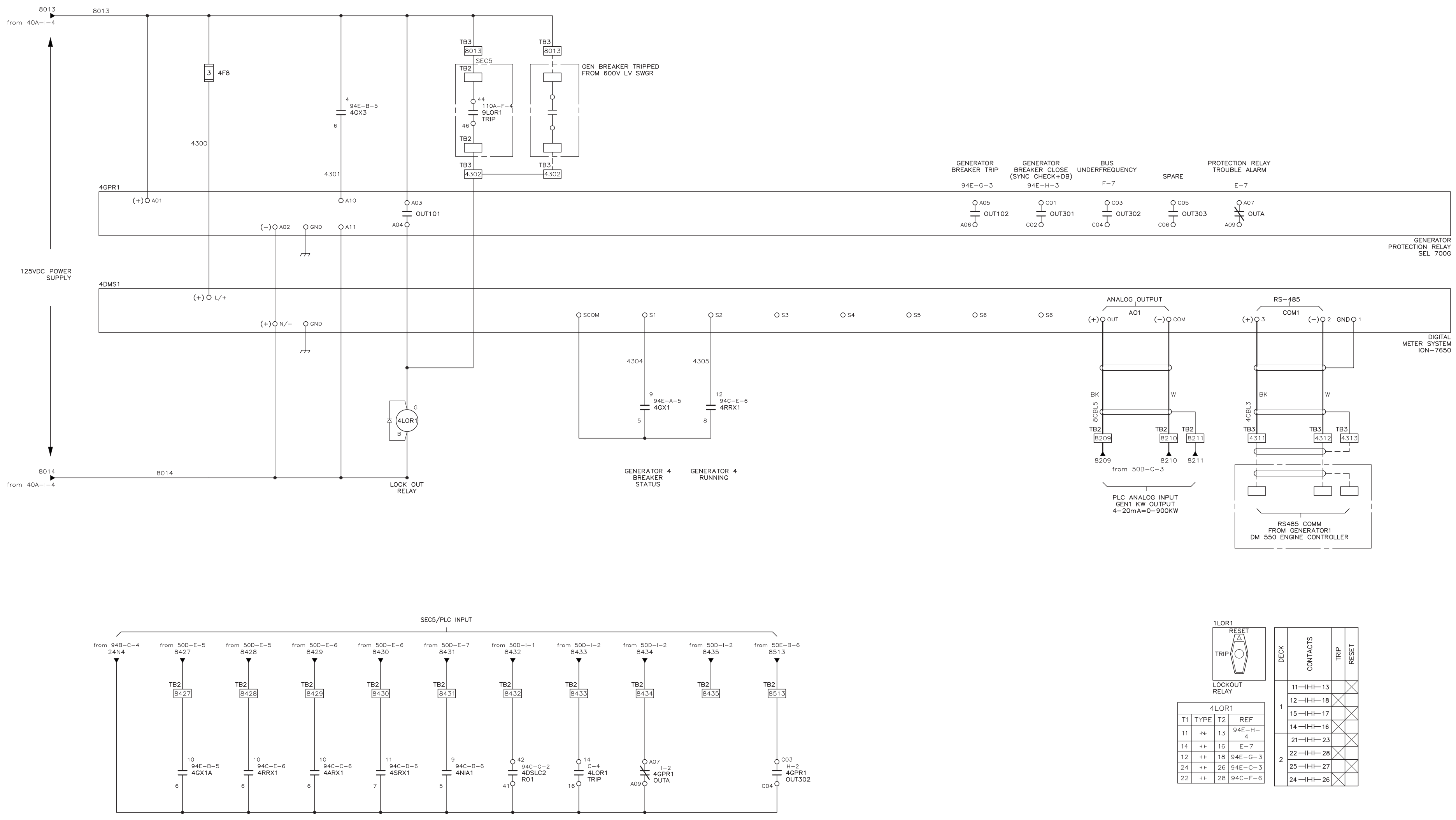
DRAWING No. | REFERENCE DRAWINGS

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 4 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-094C
SHEET 94C

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



4LOR1			
T1	TYPE	T2	REF
11	⊬	13	94E–H–4
14	⊣⊢	16	E–7
12	⊣⊢	18	94E–G–3
24	⊣⊢	26	94E–C–3
22	⊣⊢	28	94C–F–6

DECK	CONTACTS	TRIP	RESET
1	11 ⊣⊢ 13		☒
	12 ⊣⊢ 18	☒	
	15 ⊣⊢ 17		☒
	14 ⊣⊢ 16	☒	
2	21 ⊣⊢ 23		☒
	22 ⊣⊢ 28	☒	
	25 ⊣⊢ 27		☒
	24 ⊣⊢ 26	☒	

SECTION# 4

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

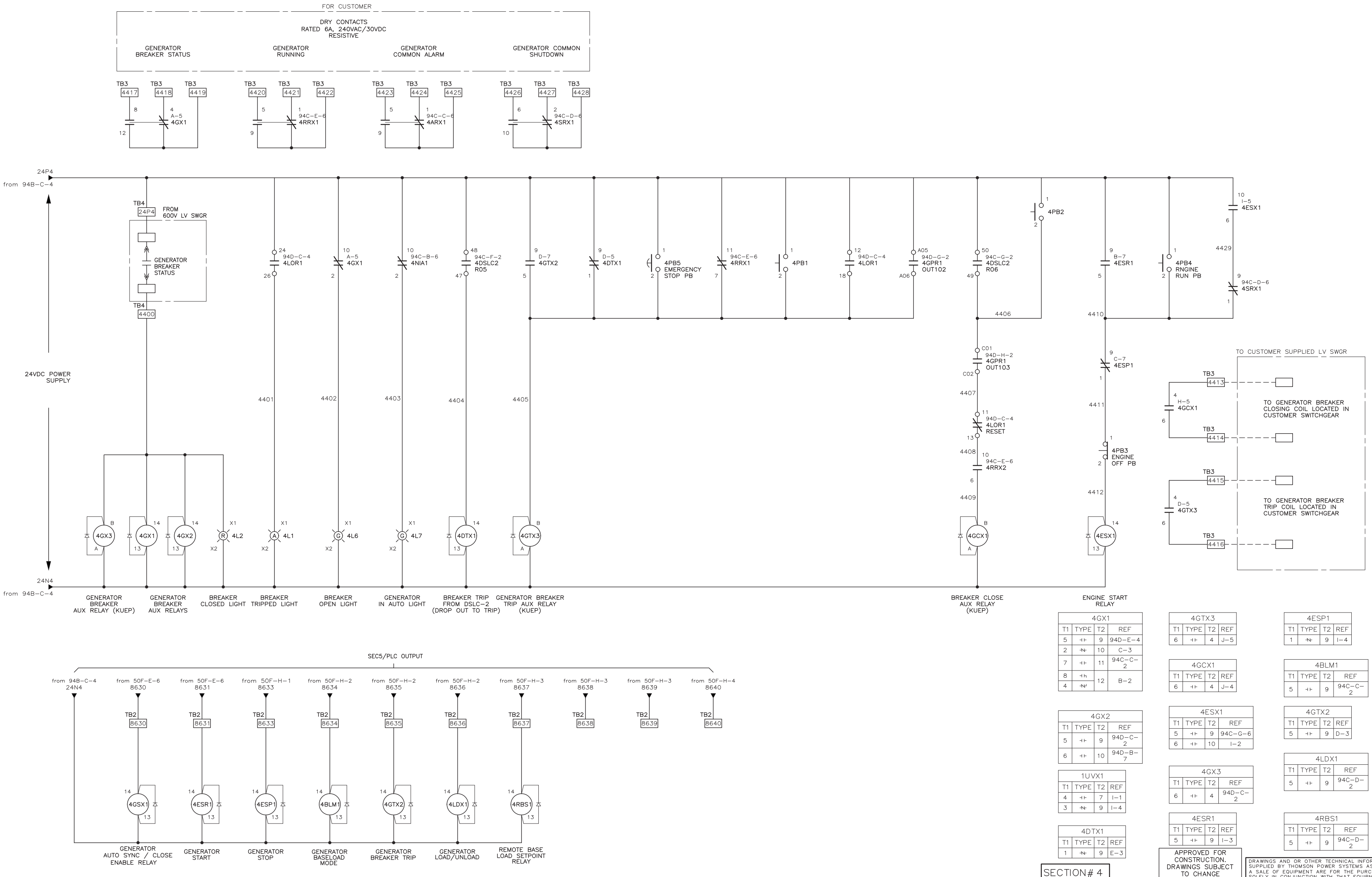
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 4 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095112
DRAWN BY SD
AUTH BY SS
DATE 16–08–11
REV 2
DRAWING/FILE No. W–095112–094D
SHEET 94D

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



4GX1			
T1	TYPE	T2	REF
5	⊣⊢	9	94D–E–4
2	⊣/⊢	10	C–3
7	⊣⊢	11	94C–C–2
8	⊣h	12	B–2
4	⊣/⊢		

4GX2			
T1	TYPE	T2	REF
5	⊣⊢	9	94D–C–2
6	⊣⊢	10	94D–B–7

1UVX1			
T1	TYPE	T2	REF
4	⊣⊢	7	I–1
3	⊣/⊢	9	I–4

4DTX1			
T1	TYPE	T2	REF
1	⊣/⊢	9	E–3

4GTX3			
T1	TYPE	T2	REF
6	⊣⊢	4	J–5

4GCX1			
T1	TYPE	T2	REF
6	⊣⊢	4	J–4

4ESX1			
T1	TYPE	T2	REF
5	⊣⊢	9	94C–G–6
6	⊣⊢	10	I–2

4GX3			
T1	TYPE	T2	REF
6	⊣⊢	4	94D–C–2

4ESR1			
T1	TYPE	T2	REF
5	⊣⊢	9	I–3

4ESP1			
T1	TYPE	T2	REF
1	⊣/⊢	9	I–4

4BLM1			
T1	TYPE	T2	REF
5	⊣⊢	9	94C–C–2

4GTX2			
T1	TYPE	T2	REF
5	⊣⊢	9	D–3

4LDX1			
T1	TYPE	T2	REF
5	⊣⊢	9	94C–D–2

4RBS1			
T1	TYPE	T2	REF
5	⊣⊢	9	94C–D–2

SECTION# 4

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ______ OF ______
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

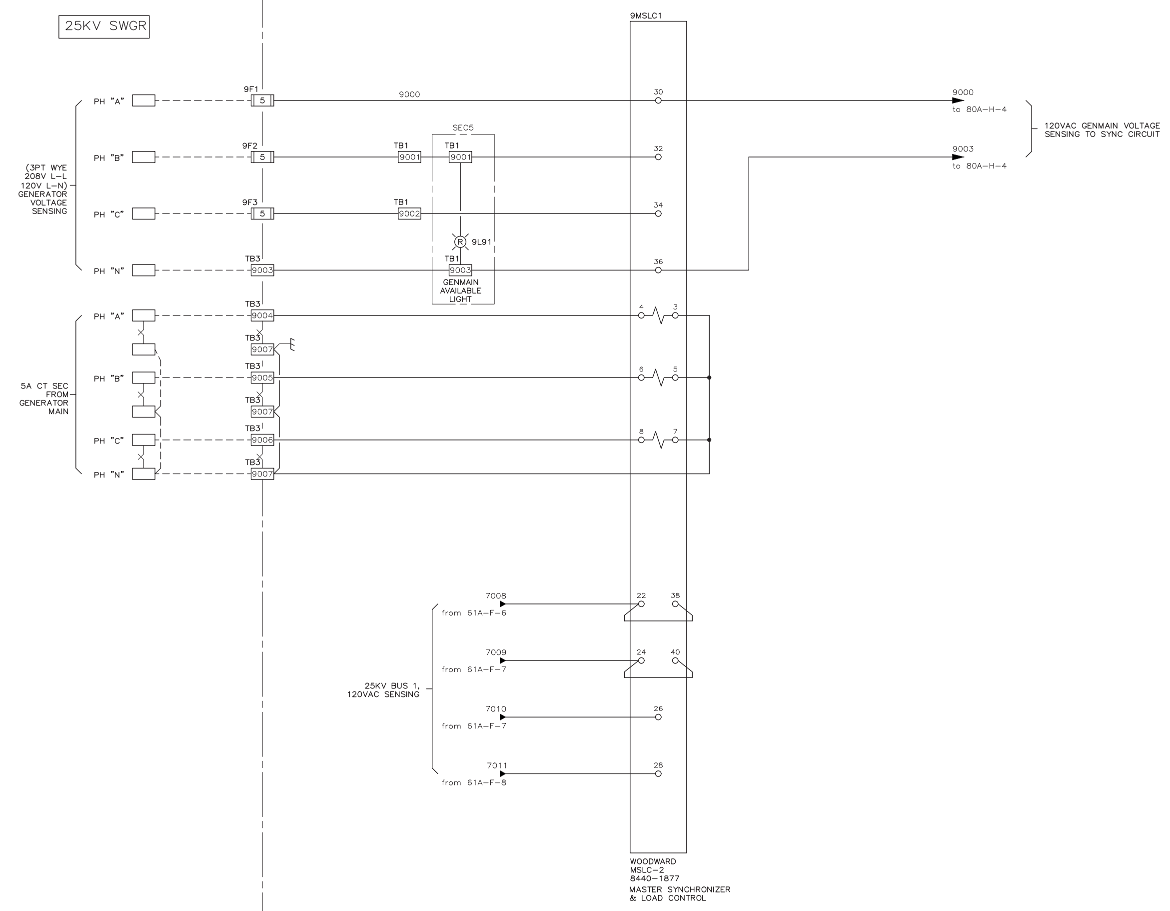
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16–10–19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16–08–25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR 4 DC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C–054107
WORK ORDER No. W–095112
DRAWN BY SD
AUTH BY SS
DATE 16–08–11
REV 2
DRAWING/FILE No. W–095112–094E
SHEET 94E

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SECTION# 4

APPROVED FOR CONSTRUCTION.
DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ________ DATE: ________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

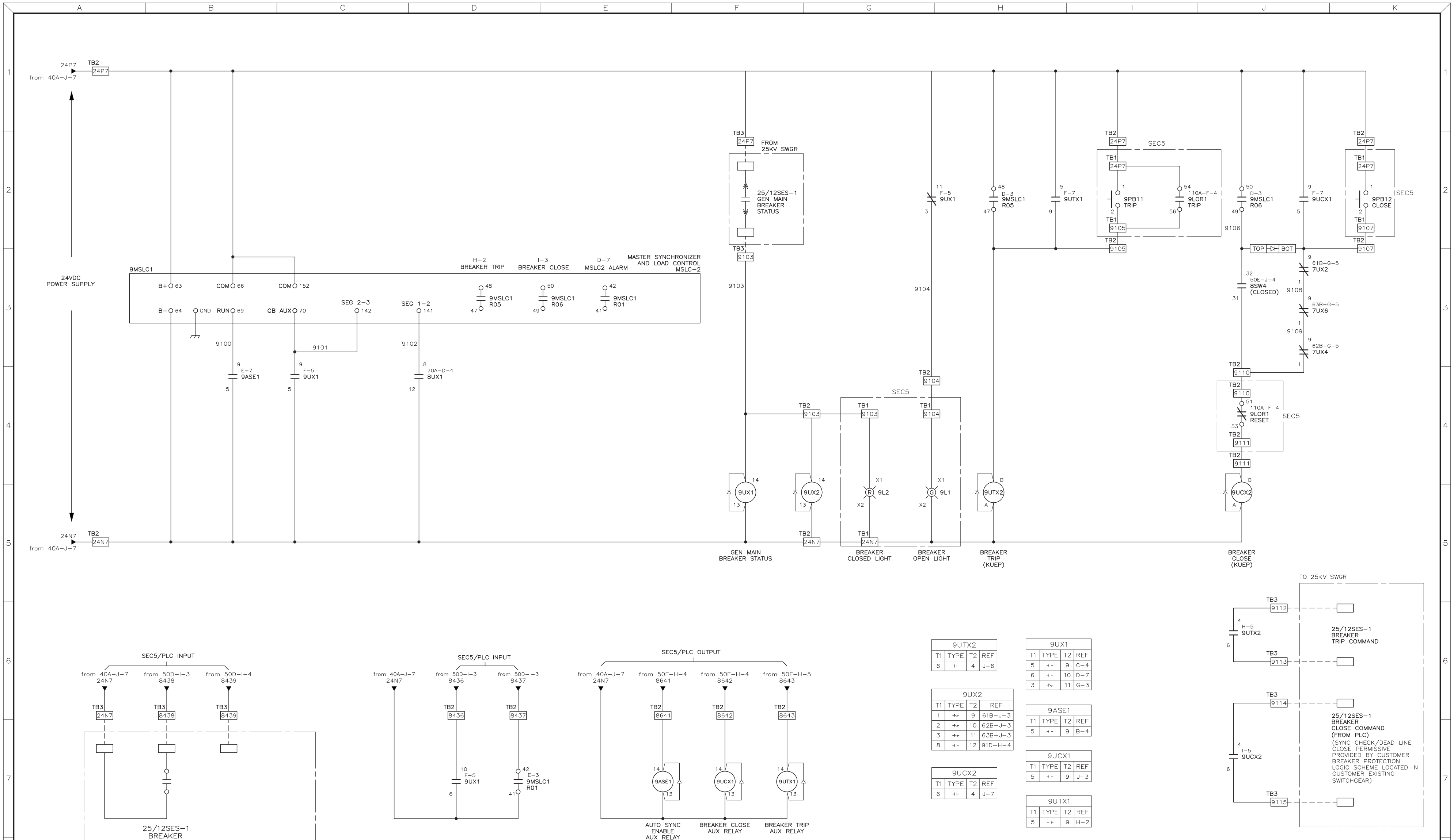
No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR MAIN AC SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-100A
SHEET 100A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



9UTX2			
T1	TYPE	T2	REF
6	⊣⊢	4	J–6

9UX2			
T1	TYPE	T2	REF
1	⊬	9	61B–J–3
2	⊬	10	62B–J–3
3	⊬	11	63B–J–3
8	⊣⊢	12	91D–H–4

9UCX2			
T1	TYPE	T2	REF
6	⊣⊢	4	J–7

9UX1			
T1	TYPE	T2	REF
5	⊣⊢	9	C–4
6	⊣⊢	10	D–7
3	⊬	11	G–3

9ASE1			
T1	TYPE	T2	REF
5	⊣⊢	9	B–4

9UCX1			
T1	TYPE	T2	REF
5	⊣⊢	9	J–3

9UTX1			
T1	TYPE	T2	REF
5	⊣⊢	9	H–2

SECTION# 4

APPROVED FOR
CONSTRUCTION.
DRAWINGS SUBJECT
TO CHANGE
WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE
LEGEND
50C-C-1
GRID
COORDINATE
SHEET No.

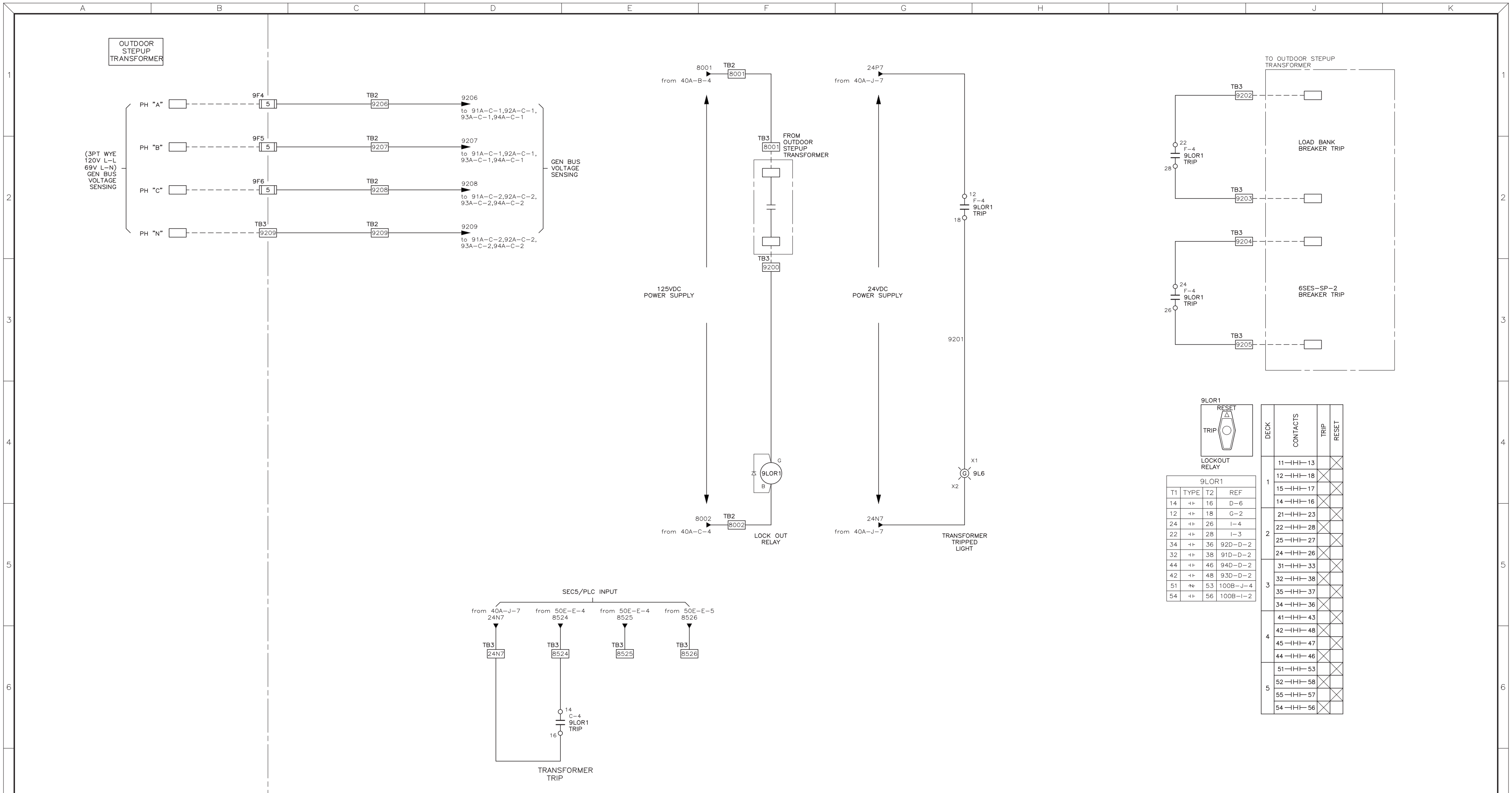
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE
		2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
		1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
GENERATOR MAIN DC CONTROL SCHEMATIC
ESQUIMALT GRAVING DOCK

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-100B
SHEET 100B

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



9LOR1			
T1	TYPE	T2	REF
14	⊣⊢	16	D-6
12	⊣⊢	18	G-2
24	⊣⊢	26	I-4
22	⊣⊢	28	I-3
34	⊣⊢	36	92D-D-2
32	⊣⊢	38	91D-D-2
44	⊣⊢	46	94D-D-2
42	⊣⊢	48	93D-D-2
51	⊣/⊢	53	100B-J-4
54	⊣⊢	56	100B-I-2

DECK	CONTACTS	TRIP	RESET
1	11—⊣⊢—13		☒
	12—⊣⊢—18	☒	
	15—⊣⊢—17		☒
	14—⊣⊢—16	☒	
2	21—⊣⊢—23		☒
	22—⊣⊢—28	☒	
	25—⊣⊢—27		☒
	24—⊣⊢—26	☒	
3	31—⊣⊢—33		☒
	32—⊣⊢—38	☒	
	35—⊣⊢—37		☒
	34—⊣⊢—36	☒	
4	41—⊣⊢—43		☒
	42—⊣⊢—48	☒	
	45—⊣⊢—47		☒
	44—⊣⊢—46	☒	
5	51—⊣⊢—53		☒
	52—⊣⊢—58	☒	
	55—⊣⊢—57		☒
	54—⊣⊢—56	☒	

SECTION# 5

APPROVED FOR CONSTRUCTION. DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
2	CUSTOMER COMMENTS INCORPORATED	SD	SS	16-10-19
1	ADDED SCHEMATIC DRAWINGS	SD	SS	16-08-25

marathon™
Thomson Power Systems

GENERATOR CONTROL SYSTEM
SERIES 2200
OUTDOOR TRANSFORMER AC & DC SCHEMATIC
ESQUIMALT GRAVING DOCK

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

CUSTOMER WESTERN PACIFIC ENTERPRISES GP
CUSTOMER ORDER No. C-054107
WORK ORDER No. W-095112
DRAWN BY SD
AUTH BY SS
DATE 16-08-11
REV 2
DRAWING/FILE No. W-095112-110A
SHEET 110A

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
X APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Sep 16, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 027

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – MTS**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	**File Type**	**File Name and Description**	**Status**
1	PDF	**MCS870M113 (3pgs)**	RVW

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section – 26 36 23.01
Panel 6A & Panel 6C

AES ENGINEERING LTD.
REVIEWED ONLY
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. APPROVAL OF DIMENSIONS AND OTHER GENERAL CONSTRUCTION FEATURES IS NOT IMPLIED.
☒ REVIEWED ☐ REVISE AND RESUBMIT
☐ REVIEWED AS MODIFIED ☐ NOT REVIEWED
Project Number: 1-16-008 Date: 2016-09-20
Reviewed By: Jacob Bieling

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

marathon™
Thomson Power Systems

Approval Drawings

Project Name/Reference: **ESQUIMALT GRAVING DOCK**

Customer: **FRONTIER POWER PRODUCTS**

Thomson Customer Order: **C-054460/1**

WorkOrder/Serial Number: **W-095662-001; W-095662-002; W-095662-003**

Model Number **TS 873A0250A2CN7AKKAA**

Attached Drawings:

Physical Drawing MCS870M113 REV#0

ATTACHED DOCUMENTS ARE DRAFT FOR REVIEW ONLY AND ARE SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE STANDARD TERMS CONDITIONS.

THE INFORMATION CONTAINED IN THESE DRAWINGS IS THE PROPERTY OF THOMSON POWER SYSTEMS, IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.

NOTE:
ANY PROGRAM SETTINGS SHOWN REFLECT FACTORY DEFAULT SETTINGS ONLY. FINAL SETTINGS WILL BE REQUIRED TO BE SET BY THE COMMISSIONING AUTHORITY. FAILURE TO DO SO MAY RESULT IN EQUIPMENT FAILURE.

Features/Ratings:

Amperage:	**250A**	Utility (or Source 1) Switching Device:	**Moulded Case Switch**
Voltage:	**347 - 600V 3 Phase (4 Wire)**	Generator (or Source 2) Switching Device:	**Moulded Case Switch**
Poles:	**3POLE**	Approval Standard:	**CSA C22.2 No. 178/ UL1008 -non SE ATS**
Frequency:	**60HZ**	System Options:	
Configuration	**Standard ATS**		
Application	**Standard ATS**		
Operation	**Manual Electrically Operated**		
Enclosure Type	**NEMA 1 Enclosure**		
ATS Controller	**No Controller**		

SHOP DRAWING / SUBMITTAL REVIEW

☐ APPROVED ☐ APPROVED WITH CHANGES NOTED

☐ REVISE AND RESUBMIT ☐ REJECTED ________

SUBMITTAL WAS RECEIVED FOR DESIGN CONFORMITY AND GENERAL CONFORMANCE TO CONTRACT DOCUMENTS ONLY. THE CONTRACTOR FOR CONFIRMING AND CORRELATING DIMENSIONS AT JOB SITES FOR TOLERANCES, CLEARANCES, QUANTITIES, FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION, COORDINATION OF HIS WORK WITH OTHER TRADES AND FULL COMPLIANCE WITH CONTRACT

BY ______________________________ DATE __________

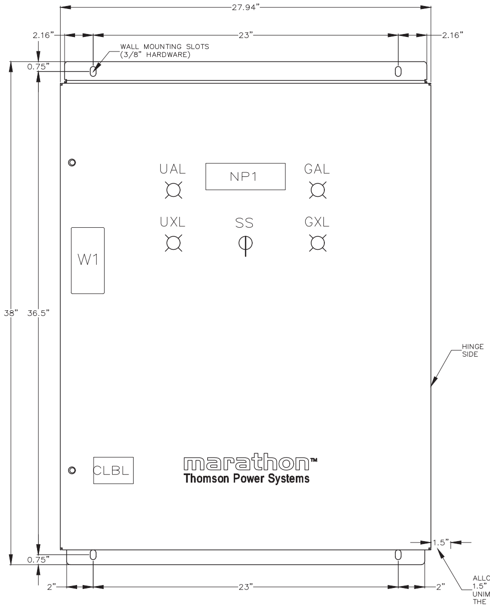
COMPANY NAME ________________________________

CITY _______________________ STATE/PROV ________

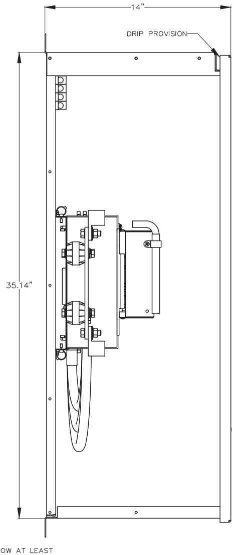
WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: **SSES Standby Power**
WPE# **C847**
Date: **15 Sept, 2016**
REVIEWED by _GW_
W P

SHEET 1 of 2

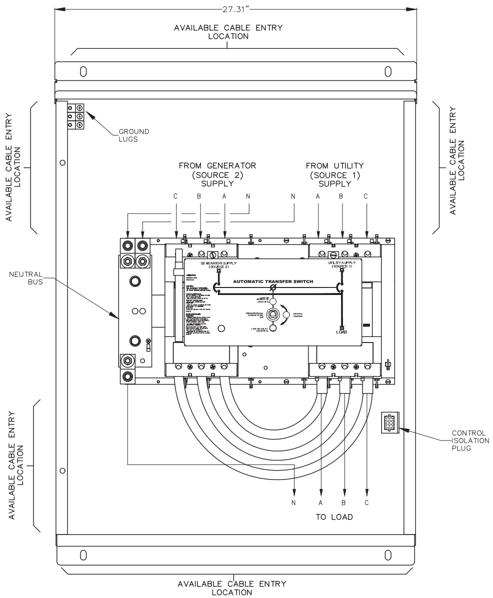
REGAL



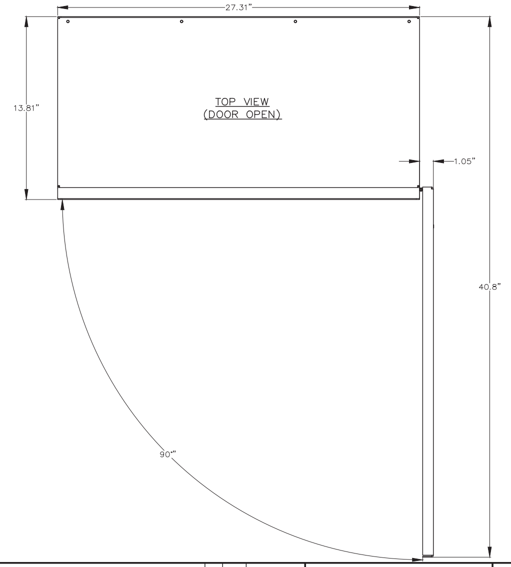
FRONT VIEW



LHS VIEW
(SIDE COVER REMOVED)



INTERIOR FRONT VIEW
(DOOR NOT SHOWN)



TOP VIEW
(DOOR OPEN)

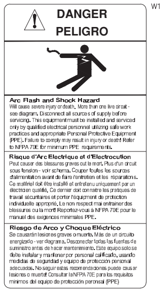
BASIC MODEL TS87xA	STANDARD MTS				
	CLOSING AND WITHSTAND RATING AVAILABLE AMPS (RMS) CLOSING & WITHSTAND RATINGS SHOWN ARE ONLY FOR MTS UTILITY AND/OR GENERATOR POWER SWITCHING DEVICE(S) THAT ARE NOT FACTORY SUPPLIED WITH INTEGRAL OVERCURRENT PROTECTION. PLEASE REFER TO PRODUCT INSTRUCTION MANUAL FOR FURTHER INFORMATION ON UPSTREAM PROTECTION REQUIREMENT.				
	MAX. VOLTAGE	RATED CURRENT (A)	@240V	@480V	@600V
TS 87xA–250	600	250	65,000	65,000	35,000

CONNECTION DATA		
250A MTS	UTILITY (SRC1)	1C, #6–350MCM Cu/Al PER PHASE
	GENERATOR (SRC2)	1C, #6–350MCM Cu/Al PER PHASE
	LOAD	1C, #6–350MCM Cu/Al PER PHASE
	NEUTRAL	1C, #6–350MCM Cu/Al PER SOURCE
	GROUND	3C, #14–2/0 Cu/Al

GENERAL NOTES	
1	POWER SWITCHING DEVICES ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE DEVICE IS CLOSED AT A TIME
2	ENCLOSURE FINISH : ASA #61 GREY
3	REFER PROJECT SPECIFIC OPTIONS LIST FOR SELECTED ENCLOSURE TYPE

2.5" x 5"

W1



DANGER
PELIGRO

Arc Flash and Shock Hazard
Will cause severe injury or death. More than one live circuit - see diagram. Disconnect all sources of supply before servicing. This equipment must be installed and serviced only by qualified electrical personnel utilizing safe work practices and appropriate Personal Protective Equipment (PPE). Failure to comply may result in injury or death! Refer to NFPA 70E for minimum PPE requirements.

Risque d'Arc Electrique et d'Electrocution
Peut causer des blessures graves out la mort. Plus d'un circuit sous tension - voir schema. Couper toutes les sources d'alimentation avant de faire i'entretien et les réparations. Ce matériel doit être installé et entretenu uniquement par un électricien qualifié. Ce dernier doit connaitre les pratiques de travail sécuritaires et porter l'équipment de protection individuelle approprié. Le non respect mai entrainer des blessures ou la mort! Reportez-vous à NFPA 70E pour le manuel des exigences minimales PPE.

Riesgo de Arco y Choque Eléctrico
Se causarán lesiones graves o muerte. Más de un circuito energizado - ver diagrama. Desconectar todas las fuentes de suministro antes de hacer mantenimiento. Este equipo solo se debe instalar y mantener por personal calificado, usando medidas de seguridad y equipo de protección personal adecuados. No seguir estas recomendaciones puede causar lesiones o muerte! Consultar la NFPA 70E para los requisitos minimos del equipo de protección peronsal (PPE)

QTY = 1

2" x 6"
(TYPICAL)
WHITE LETTERS ON BLACK BACKGROUND

NP1

MANUAL
TRANSFER
SWITCH

QTY = 1

0.75" x 2"
(TYPICAL)

UAL
UTILITY
POWER
AVAILABLE
QTY = 1

UXL
LOAD ON
UTILITY
QTY = 1

GAL
GENERATOR
POWER
AVAILABLE
QTY = 1

GXL
LOAD ON
GENERATOR
QTY = 1

SS
SOURCE
SELECTOR
UTILITY GENERATOR
QTY = 1

FOR REVIEW ONLY

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY _____ OF _____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

CROSS REFERENCE LEGEND
50C–C–1
GRID COORDINATE
SHEET No.

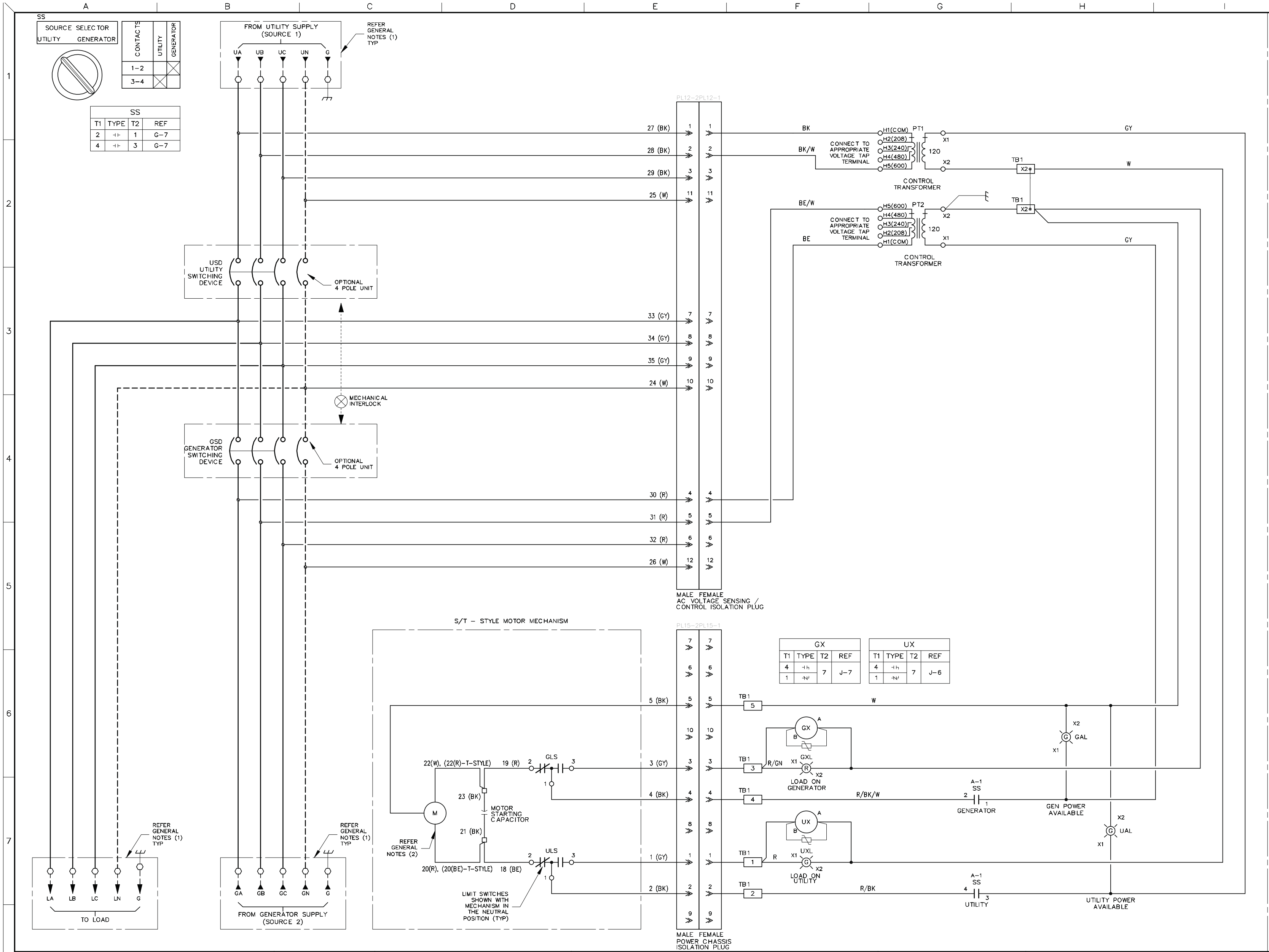
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS	BY	AUTH	DATE

marathon™
Thomson Power Systems

MANUAL TRANSFER SWITCH
MODEL TS 870
PHYSICAL LAYOUT & INSTALLATION DETAILS
250A, 2P/3P, NEMA 1/2/12/3R, SINGLE DOOR, MTS, STD

CUSTOMER THOMSON POWER SYSTEMS			
CUSTOMER ORDER No. C–XXXXXX		WORK ORDER No. W–XXXXXX	
DRAWN BY AP	AUTH BY OG	DATE 16–01–26	REV 0
DRAWING/FILE No. MCS870M113		SHEET 10A	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.



SS			
T1	TYPE	T2	REF
2	⊣⊢	1	G-7
4	⊣⊢	3	G-7

GX			
T1	TYPE	T2	REF
4	⊣⊢	7	J-7
1	⊣/⊢		

UX			
T1	TYPE	T2	REF
4	⊣⊢	7	J-6
1	⊣/⊢		

GENERAL NOTES

1	THREE PHASE CONNECTION SHOWN. FOR SINGLE PHASE CONNECT A & B ONLY
2	MOTOR CONNECTION COLOR CODE IN BRACKETS IS FOR SL/SR T-STYLE SWITCH APPLICATION. FOR XL/XR, GLS CONNECTS TO 'BE' AND ULS CONNECTS TO 'R'
3	VOLTAGE SENSING WIRE HARNESS PART ID : T-STYLE - 013700 (1000-1200A) S-STYLE - 013007 (100-200A) S-STYLE - 013095 (250A) S-STYLE - 013096 (400A) S-STYLE - 013097 (600-800A)
4	POWER CHASSIS WIRE HARNESS PART ID : T-STYLE - 013702 (1000-1200A) S-STYLE - 013005 (100-800A)

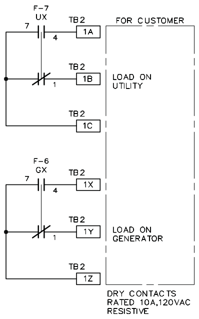
PL15#	DESCRIPTION OF CONTROL
1	LOAD ON UTILITY STATUS
2	CLOSE USD COMMAND FROM SS
3	LOAD ON GEN STATUS
4	CLOSE GSD COMMAND FROM SS
5	AC COMMON (GRD)
6	NOT USED
7	NOT USED
8	NOT USED
9	NOT USED
10	NOT USED
11	NOT USED
12	NOT USED
13	NOT USED
14	NOT USED
15	NOT USED

PL12#	AC VOLTAGE SENSING
1	ϕA UTILITY VOLTAGE
2	ϕB UTILITY VOLTAGE
3	ϕC UTILITY VOLTAGE
4	ϕA GEN VOLTAGE
5	ϕB GEN VOLTAGE
6	ϕC GEN VOLTAGE
7	ϕA LOAD VOLTAGE
8	ϕB LOAD VOLTAGE
9	ϕC LOAD VOLTAGE
10	ϕN LOAD VOLTAGE
11	ϕN UTILITY VOLTAGE
12	ϕN GEN VOLTAGE

COLOR KEY	
BK	BLACK
BE	BLUE
BN	BROWN
GN	GREEN
GY	GREY
OR	ORANGE
PE	PURPLE
R	RED
W	WHITE
Y	YELLOW
V	VIOLET

VOLTAGE
(⊗ DENOTES HIGH POLARITY MARKER)

PT TAP	208	240	380	400	416	480	600
H1	⊗	⊗			⊗	⊗	⊗
H2	☒		⊗	⊗			
H3		☒					
H4					☒	☒	
H5			☒	☒			☒



FOR CUSTOMER

LOAD ON UTILITY

LOAD ON GENERATOR

DRY CONTACTS
RATED 10A,120VAC
RESISTIVE

FOR REVIEW ONLY

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON POWER SYSTEMS AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ______
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

CROSS REFERENCE LEGEND
50C-C-1
GRID COORDINATE
SHEET No.

DRAWING No.	REFERENCE DRAWINGS

No.	REVISIONS	BY	AUTH	DATE
1	WIRE HARNESS UPDATED AS PER ECR-0114744	AP	OG	16-07-22

marathon™
Thomson Power Systems

MANUAL TRANSFER SWITCH
MODEL TS 870
MCS AC SCHEMATIC, T-STYLE / S-STYLE, STD
100 - 1200A

CUSTOMER THOMSON POWER SYSTEMS			
CUSTOMER ORDER No. C-XXXXXX		WORK ORDER No. W-XXXXXX	
DRAWN BY SR	AUTH BY OG	DATE 16-01-26	REV 1
DRAWING/FILE No. MCS870E300		SHEET 20A	

© THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF THOMSON POWER SYSTEMS. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
☒ APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Feb 23,2017
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 045

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – 600v 5000amp CTs rev 1**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**13-402 4000:5 (1 pg)**	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 12 13
CTs for T25/12SES-2

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

CURRENT TRANSFORMERS

RELAY/METER CLASS CURRENT TRANSFORMER *MODEL* 130

FEATURES

- UL Recognized
- Window I.D. - 5.75"
- Relaying and Metering Applications

600V CLASS

® E93779 ® LR89403

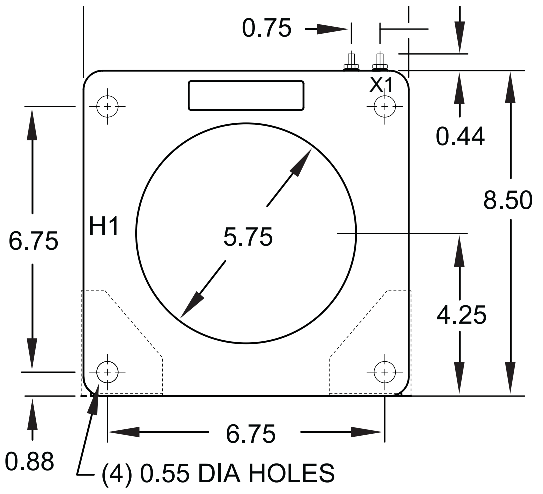
SPECIFICATIONS

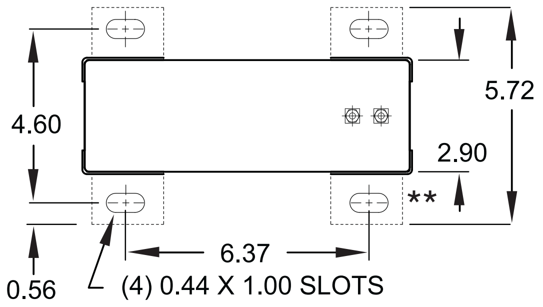
Frequency 50-400Hz
Insulation Class ....0.6kV, 10kV BIL Full Wave
Terminals ....Brass Studs No. 8-32 UNC
with one flat washer, lock washer and regular nut.
Weight ....Approximately 18 lbs.
Mounting Bracket.. P/N 0221B00186
Manufactured to meet the requirements of ANSI/IEEE C57.13

APPLICATION AND ORDERING DATA

CATALOG NUMBER	CURRENT RATIO	RELAY CLASS	ANSI METERING CLASS AT 60Hz					SECONDARY WINDING RESISTANCE (Ω @75°C)	CONTINUOUS THERMAL RATING FACTOR	
			B0.1	B0.2	B0.5	B0.9	B1.8		@30°C	@55°C
130-201	200:5	C10	0.6	0.6	2.4	2.4	4.8	0.064	2.0	2.0
130-301	300:5	C20	0.3	0.3	1.2	1.2	2.4	0.105	2.0	2.0
130-401	400:5	C20	0.3	0.3	0.6	1.2	1.2	0.140	2.0	2.0
130-501	500:5	C20	0.3	0.3	0.3	0.6	1.2	0.175	2.0	2.0
130-601	600:5	C20	0.3	0.3	0.3	0.6	1.2	0.210	2.0	1.5
130-801	800:5	C50	0.3	0.3	0.3	0.3	0.6	0.324	2.0	1.5
130-102	1000:5	C50	0.3	0.3	0.3	0.3	0.3	0.404	1.5	1.33
130-122	1200:5	C100	0.3	0.3	0.3	0.3	0.3	0.485	1.5	1.0
130-152	1500:5	C100	0.3	0.3	0.3	0.3	0.3	0.607	1.5	1.0
130-162	1600:5	C100	0.3	0.3	0.3	0.3	0.3	0.647	1.33	1.0
130-202	2000:5	C100	0.3	0.3	0.3	0.3	0.3	0.783	1.33	1.0
130-252	2500:5	C100	0.3	03	0.3	0.3	0.3	0.979	1.0	0.8
130-302	3000:5	C100	0.3	0.3	0.3	0.3	0.3	1.175	1.0	0.8
130-402	4000:5	C100	0.3	0.3	0.3	0.3	0.3	1.484	1.0	0.6

DIMENSIONS

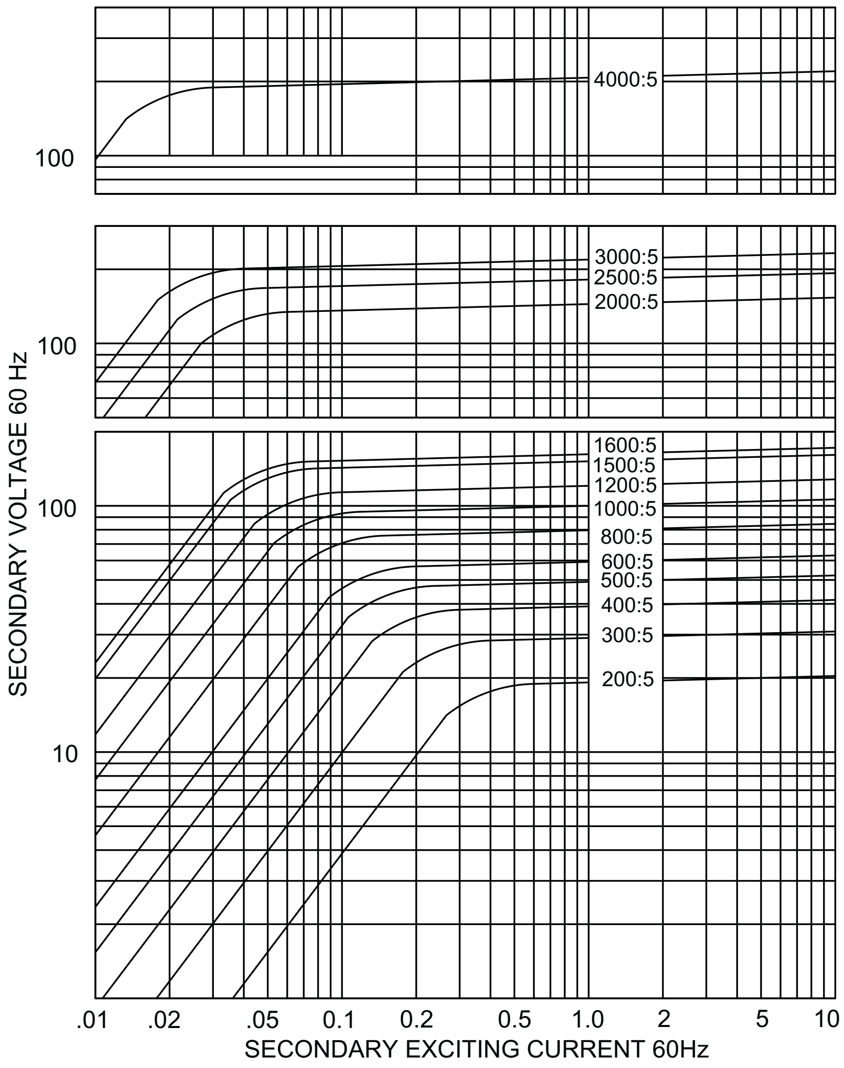




** Shown with optional mounting brackets: P/N #0221B00186

All Dimensions In Inches

EXCITATION CURVE



WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: Feb 23, 2017
REVIEWED by _GW_

Ensure the current transformer are adequately supported independant of busbars/conductors.

Applied Engineering Solutions Ltd.
3rd Floor, 1815 Blanshard Street
Victoria, BC V8T 5A4

☒ Reviewed
☐ Revise and Resubmit
☐ Reviewed as Modified
☐ Not Reviewed

This review is only for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on shop drawings during this review do not relieve the contractor from compliance with the requirement of the plans and specifications. Review of the specific item shall not include review of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades; and for performing all Work in a safe and satisfactory manner.

Project No.: 16-008
Date: Feb 28, 2017
By: Iain Barnes

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
☒ SUBMITTAL

FOR:
☒ APPROVAL
☐ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☐ INFORMATION
☐ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: Oct 6, 2016
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 030

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – Temp Pwr Connection Box**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**16-7717-CAM LOK (2pgs)**	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 26 36 23 item 1.3

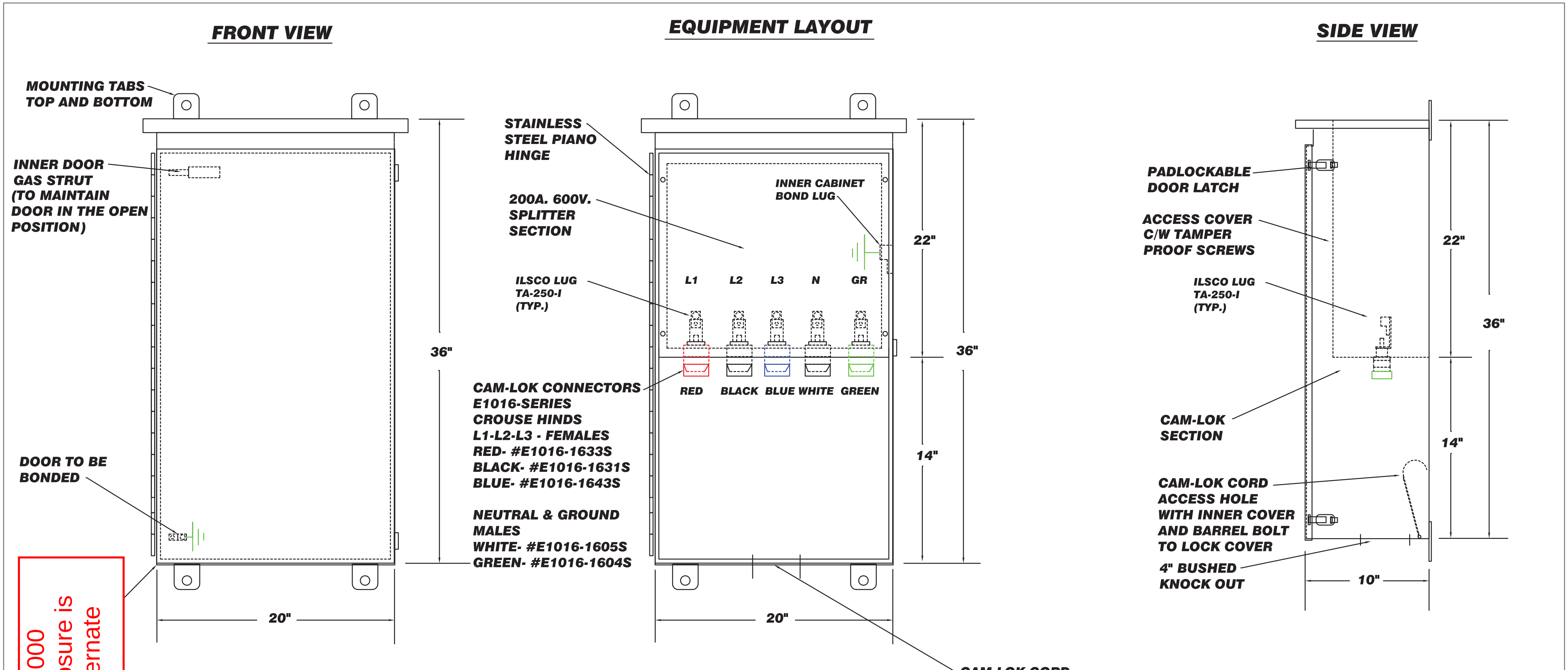
AES ENGINEERING LTD.
REVIEWED ONLY
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. APPROVAL OF DIMENSIONS AND OTHER GENERAL CONSTRUCTION FEATURES IS NOT IMPLIED.
☒ REVIEWED
☐ REVISE AND RESUBMIT
☐ REVIEWED AS MODIFIED
☐ NOT REVIEWED
Project Number: 1-16-008 Date: 2016-10-19
Reviewed By: Jacob Bieling

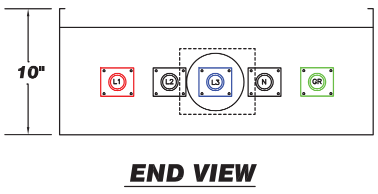
Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax ☒ Email





Marine Grade 5000
Series 3R enclosure is
accepted as alternate

IMPORTANT NOTICE:
This document, and all the information presented are the exclusive property of West Coast Electric Ltd. Distribution or copying of this drawing is strictly prohibited under applicable law.

**** NOTES ****

- **CSA TYPE 3R - ALUMINUM CABINET.**
- **MADE OUT OF 1/8" MARINE GRADE ALUMINUM.**
- **DOOR TO BE CLOSED WITH STAINLESS STEEL TENSION LATCH WITH PROVISION FOR A PADLOCK.**
- **DOOR TO HAVE INNER NEOPRENE GASKET.**

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: Oct 6, 2016
REVIEWED by _GW_

WCE
MANUFACTURERS OF ELECTRICAL EQUIPMENT – CSA CERTIFIED

WEST COAST ELECTRIC LTD.
8040 RIVER ROAD RICHMOND, B.C. V6X 1X7
PH. 604-279-0448 FAX. 604-279-0265

CAM - LOK SPLITTER CABINET
200A. 347/600V. 3PH. 4W. + GR.

DATE: **OCT. 6 / 16**	REV.	SCALE **N.T.S.**	DRWN. BY **DK**
CHECK BY:	QUANTITY	DRW. # **16-7717-CAM-LOK**	

Single Pole Connectors

Project Name:	Prepared By:
Project Number:	Date:
Catalog Number:	Type:

Cam-Lok™ J-Series E1016 Receptacles

Cable Size #6 AWG – 250 MCM
600V AC/DC, Up to 400A Continuous
NEMA 3R

J-Series E1016, Elastomeric, Threaded Stud

FEATURES

- Double cam principle provides a positive, vibration-proof connection.
- Self-compensating for wear.
- No moving contact surfaces, eliminating arcing or burning.
- Superior electro-mechanical connections.
- Locked contacts will withstand a pulling force of 1,000 lbs.
- 1/3 of a turn assures a high pressure contact approaching 600 lbs. per sq. in. providing minimum resistance.
- Contacts carefully machined from a high conductivity brass to a smooth sliding fit and easy locking action.
- Watertight elastomeric body molded from colorfast material, color-coded for easy phase identification.
- Recessed contacts protected by insulating jacket that extends beyond contact ends for safety.
- Receptacles are safety insulated for direct mounting to steel panels.

INSULATED RECEPTACLES - 1 1/8" THREADED STUD

COLOR	MALE COMPLETE PART NO.	FEMALE COMPLETE PART NO.
BLACK	E1016-1600S	E1016-1631S
RED	E1016-1602S	E1016-1633S
GREEN	E1016-1604S	E1016-1635S
WHITE	E1016-1605S	E1016-1636S
BLUE	E1016-1612S	E1016-1643S
BROWN	E1016-1619S	E1016-1687S
ORANGE	E1016-1603S	E1016-1634S
YELLOW	E1016-1601S	E1016-1632S

Stud Size: 1/2"-13, Maximum Torque: 40 ft. lbs.

E1016-1602S 1 1/8"

INSULATED RECEPTACLES - 3/4" THREADED STUD

COLOR	MALE COMPLETE PART NO.	FEMALE COMPLETE PART NO.
BLACK	E1016-1600	E1016-1631
RED	E1016-1602	E1016-1633
GREEN	E1016-1604	E1016-1635
WHITE	E1016-1605	E1016-1636
BLUE	E1016-1612	E1016-1643
BROWN	E1016-1619	E1016-1687
ORANGE	E1016-1603	E1016-1634
YELLOW	E1016-1601	E1016-1632

Stud Size: 1/2"-13, Maximum Torque: 40 ft. lbs.

E1016-1600 3/4"

To order single packaged products add a "K" suffix to the complete part number

For E1016 Threaded Stud Receptacle Drawings, see page 35

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: Oct 6, 2016
REVIEWED by _GW_

TESTING & CODE COMPLIANCE

- Listed to UL498, file no. E67181
- CSA Certified to C22.2, no. 182.3-M1987, file no. LR13963

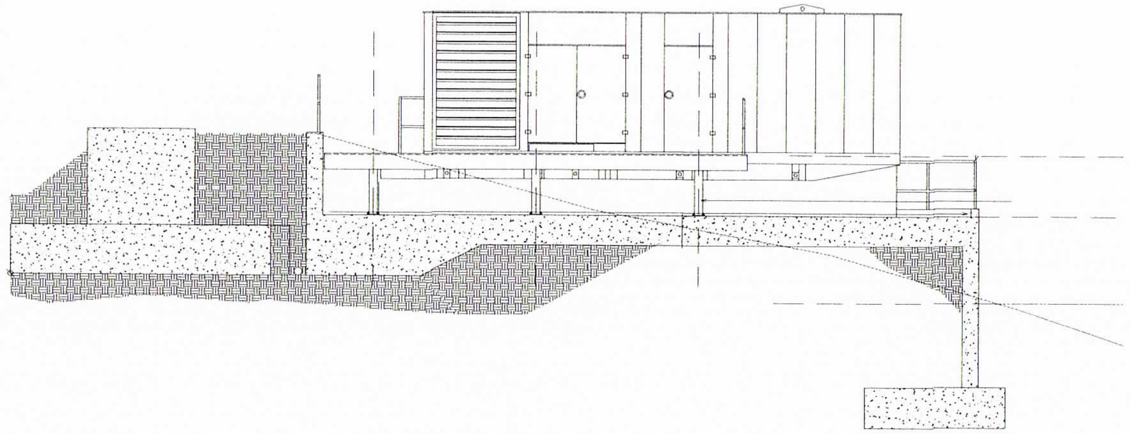
MATERIAL CHARACTERISTICS

- Body: TPE
- Environmental: NEMA 3R
- Temperature Rating: -40° C to 105° C

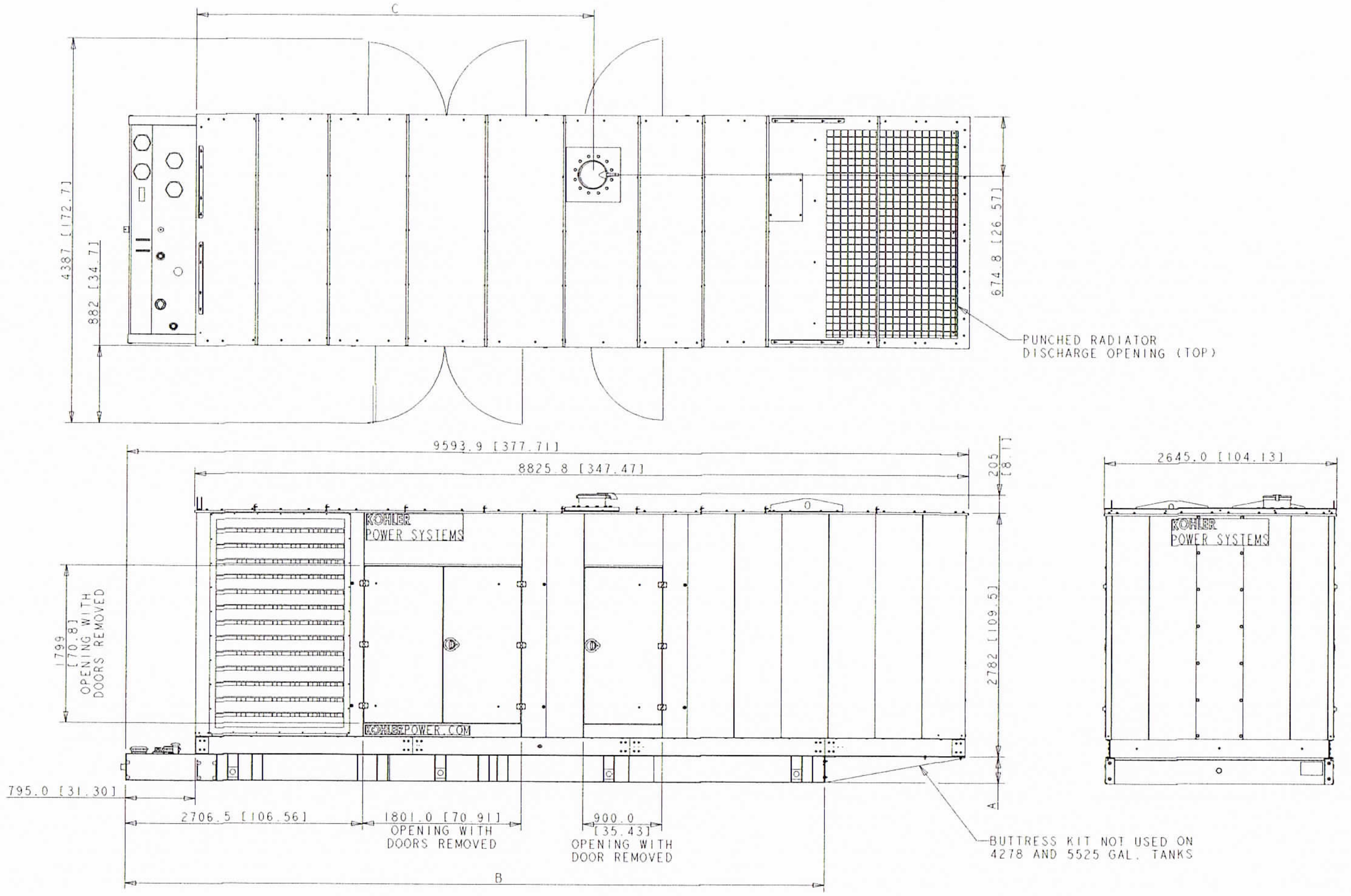
4 – SEISMIC ANCHORING

4.1 **DRAWING ES-01**

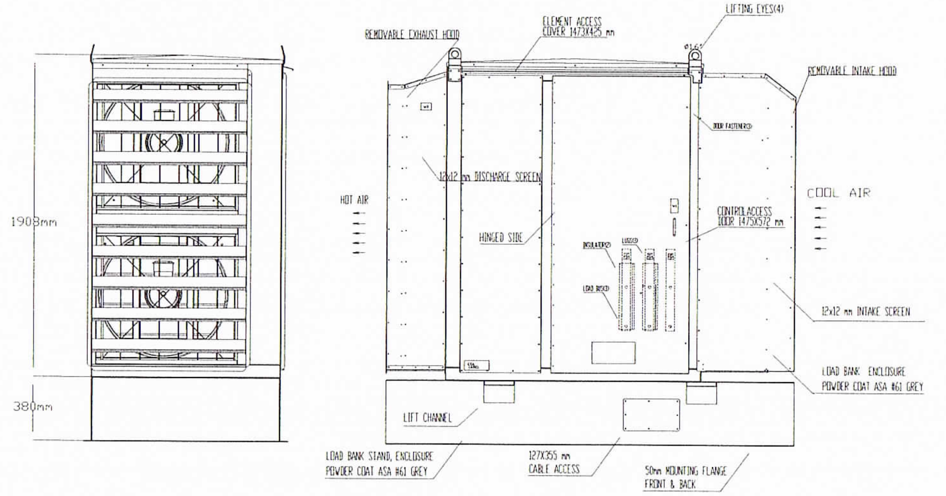
4.2 **DRAWING ES-02**



1
SE - 01
ELEVATION
TYP. OF 3 - 750 kW GENERATORS

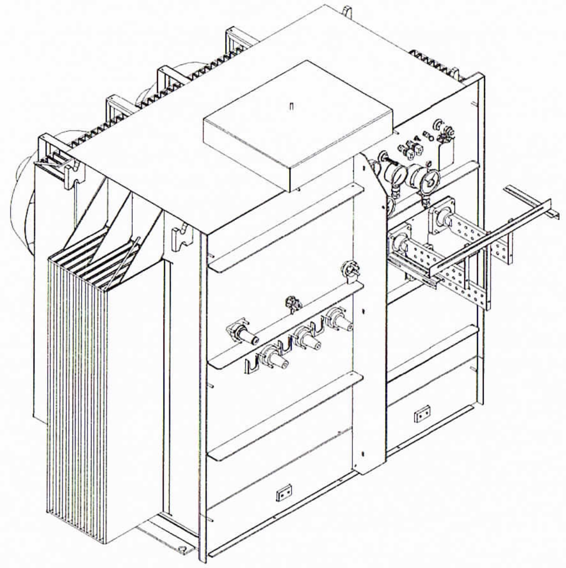


2
SE - 01
PLAN AND ELEVATION
TYP. OF 3 - 750 kW GENERATORS



3
SE - 01
ELEVATION
LOAD BANK

EQ.	WEIGHT (kg)	DIMENSIONS LxWxH (mm)	ANCHORS REQ'D
750 kW - GENERATORS	22700	2640 x 7975 x 3048	14 - $\frac{5}{8}$" DIA. x 6" EMBED.
3000 kVA - TRANSFORMER	8011	1900 x 1925x 2135	4 - $\frac{5}{8}$" DIA. x 6" EMBED.
LOAD BANK	1200	1122 x 2430 x 2300	8 - $\frac{1}{2}$" DIA. x 4" EMBED.



4
SE - 01
ELEVATION
TRANSFORMER - 3000 kVA

C:\Users\CCC\Desktop\AutoCAD\2017_Projects\16 - 287 Esquimalt Graving Dock\Graving dock.dwg, ES-01A-pdf

city engineering inc.
professional engineers - project managers

Vancouver, BC (604) 420 5250
Victoria, BC (250) 883 3831

GENERAL NOTES:

1. SEISMIC DATA:
   S_a (0.2) = 1.2
   F_a = 1.0
   MIN. LAT. LOAD 0.5g
   I_e = 1.5
   S_p = 2.4
   Site Class C
2. ANCHOR SPEC.:
   - Epoxy: HILTI RE 500
   - Anchors: $\frac{5}{8}$" dia. SUPER HAS ROD (Grade B7)
   - Install as per HILTI instructions

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
JOHN H. VAN DYK
2017.03.14

PROJECT:
ESQUIMALT
GRAVING DOCK

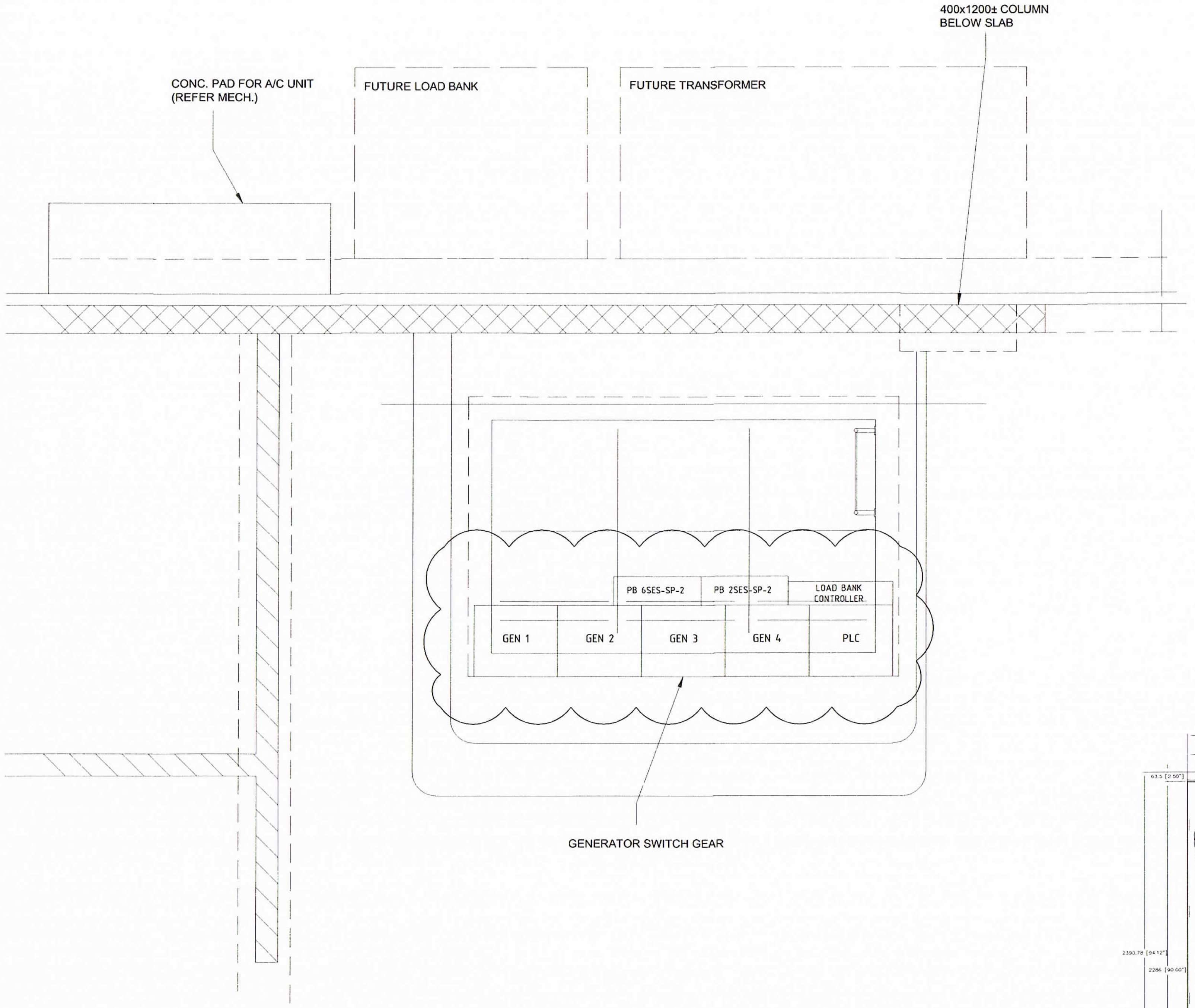
825 Admirals Rd.,
Victoria, BC V9A 2P1

TITLE:
Electrical Safety
Upgrade

CLIENT:
Western Pacific Enterprises
Ltd.

DRAWN:	CHECKED:	DATE:
SM	JVD	9-Mar-17

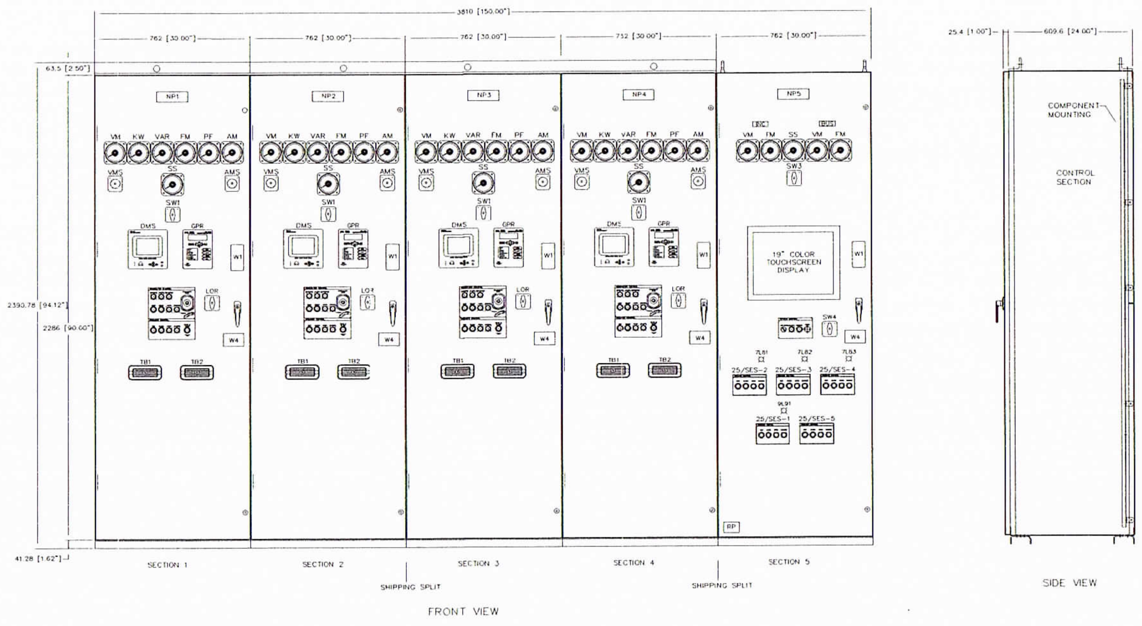
PROJECT No.: 16 - 287
REVISION No.: A
DRAWING No.: ES - 01



1
SE - 02

PLAN
GENERATORS, PLC, SES AND CONTROLLER

EQ.	WEIGHT (lbs)	DIMENSIONS LxWxH (mm)	ANCHORS REQ'D
GEN 1	590	762 x 609.6 x 2286	4
GEN 2	590	762 x 609.6 x 2286	4
GEN 3	590	762 x 609.6 x 2286	4
GEN 4	590	762 x 609.6 x 2286	4
PLC	507	762 x 609.6 x 2286	4
PB 6SES-SP-2	602	1067L x 241W	4
PB 2SES-SP-2	602	1067L x 241W	4
LOAD BANK CONTROLLER	290	660L x 220W	4



2
SE - 02

ELEVATION
GENERAL CONTROL SYSTEM SERIES 2200

C:\Users\CCC\Desktop\AutoCAD\2017_Projects\16 - 287 Esquimalt Graving Dock\Graving dock.dwg, ES-02A-pdf

city engineering inc.
professional engineers - project managers

Vancouver, BC (604) 420 5250
Victoria, BC (250) 883 3831

GENERAL NOTES:

1. SEISMIC DATA:
   (See ES - 01)

2. ANCHOR SPEC.:
- HILTI KWIK BOLT TZ $\frac{1}{2}$" dia. x 3" embedment
- Install as per HILTI instructions
- Bolts through steel wide flange beam $\frac{1}{2}$" dia. A325

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
JOHN H. VAN DYK
2017.03.14

PROJECT:
ESQUIMALT
GRAVING DOCK

825 Admirals Rd.,
Victoria, BC V9A 2P1

TITLE:
Electrical Safety
Upgrade

CLIENT:
Western Pacific Enterprises
Ltd.

DRAWN:	CHECKED:	DATE:
SM	JVD	10-Mar-17

PROJECT No.: 16 - 287
DRAWING No.: ES - 02
REVISION No.: A

5 – INSPECTIONS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Fuel Tank Certicfication in accordance with Specification 26 32 10 article 2.16.16

Generator Unit No. 1
Serial # SGM32HWDD
Permit No. EC#00043187

Diesel Fuel Tank type: Generator Base Tank
Double Walled: Yes
Tank Leak or Rupture Detection: Yes
Diesel Fuel Tank Capacity: 10824 Liters
Run time: 72hours at 50% loading
CSA Compliance: ULC/ORD-C142.23-1991, ULC-S601-00, ULC-630-00

Tank Fill connections:
- Exterior of Enclosure: Yes
- Interior of Inclosure: Yes
- Spill Contianment Device: Yes
- Visual Tank Level Gauge: Yes
- Audible Over Fill Protection @ 90%: Yes
- Visual Over Fill Protection @ 90%: Yes
- Overfill Positive Shut Off @ 95%: Yes

Vent Piping terminate outdoors:
- Normal: Yes
- Emergency: Yes

Tank complete with 2 spare 50mm capped scully flange: Yes

Tank complete with suction and return capped scully flange: Yes

Stamped "As-Built" record drawing provided: Yes

Spill Response Kit provided (capacity 350 liters): Yes

Tank Installation Reveiwed by Certified Patroleum Equipment Installer: Yes

Name: Michael William Croft
Certificate #00012-PE-11
Date: April 6, 2017

Signature:

Environment Canada Environnement Canada

Canada

Back to home page

Report

Tank System Information

Tank System Description

EC #:
00043187
Internal Number

Description:
Emergency Generator Base Tank (#1)

Contact Information

Owner
Public Service and Procurement Canada (Corporate)
11 Laurier Street, PDP III
Gatineau
Quebec
K1A 0S5
Tank Operator
PWGSC Esquimalt
825 Admirals Road
Esquimalt
British Columbia
V9A 2P1
Tel: (250) 363-6985
Fax: (250) 363-8059

Contact
Joe Lezetc
825 Admiral Road
Victoria
British Columbia
V9A2P1
Tel: (250) 363-3991
Tel: (250) 363-3739

Contact
Joe Lezetc
825 Admiral Road
Victoria
British Columbia
V9A 2P1
Tel: (250) 363-3991
Tel: (250) 363-3739

Land Owner

Months of service

January
February
March
April

May
June
July
August
September
October
November
December

System Location

Tank System Location
825 Admiral Road
Victoria
British Columbia

System Record Location
825 Admiral Road
Victoria
British Columbia

Emergency Plan Location
825 Admiral Road
Victoria
British Columbia
Details:

Miscellaneous Information

Tank Use:

Name of Tank Manufacturer:
Sauk Technologies
Year of Manufacture:
2016
Certification # of System Installer:
Richard Pocock 00005-PI-11
Certification # of System Remover:

Tank 1 of 1

Tank Information

Tank Description:

Tank Internal Number:

Type of Tank:
Aboveground
ULC or API Standard Number:
ULC-S601
Year of installation:
2017
Material of construction:
Steel
Overfill Protection:

- Overfill Alarm
- Method – trained personnel in attendance at all times

- Other (specify), CA/ULC-S661 (overfill protection devices storage tanks)

Type of pump:
No oil-water separator
Spill Containment:
Aboveground tank ULC-S663 (superses ORD-C142.19)
Product Stored:
Diesel
Tank Capacity:
10824 L
Transfer area:
Curbed concrete fuel truck off-loading areas sloped to direct spills to curbed concrete generator tank pad with shut off valves in drain holes. Spill containment capacity of 25,000L. Spill container at tank fill connections. Tanks equipped with 90% high level alarm and 95% overfill protection valve. SOP for fuel deliveries with procedure signs posted at fill points, Owner's rep to be present during deliveries, EERP available on site. PTA Risk Assessment completed.
Tank Leak Detection:

- Visual inspection
- Interstitial monitoring - double walled tank

Corrosion Protection:

- Painted

Secondary Containment:

- Double Walled
- Containment tank assembly

Piping for tank 1

Type of Piping:
None

WESTERN PACIFIC ENTERPRISES GP

PROJ EGD PWGSC
WPE# C847
Date: April 5, 2017
AS-Built _GW_

③

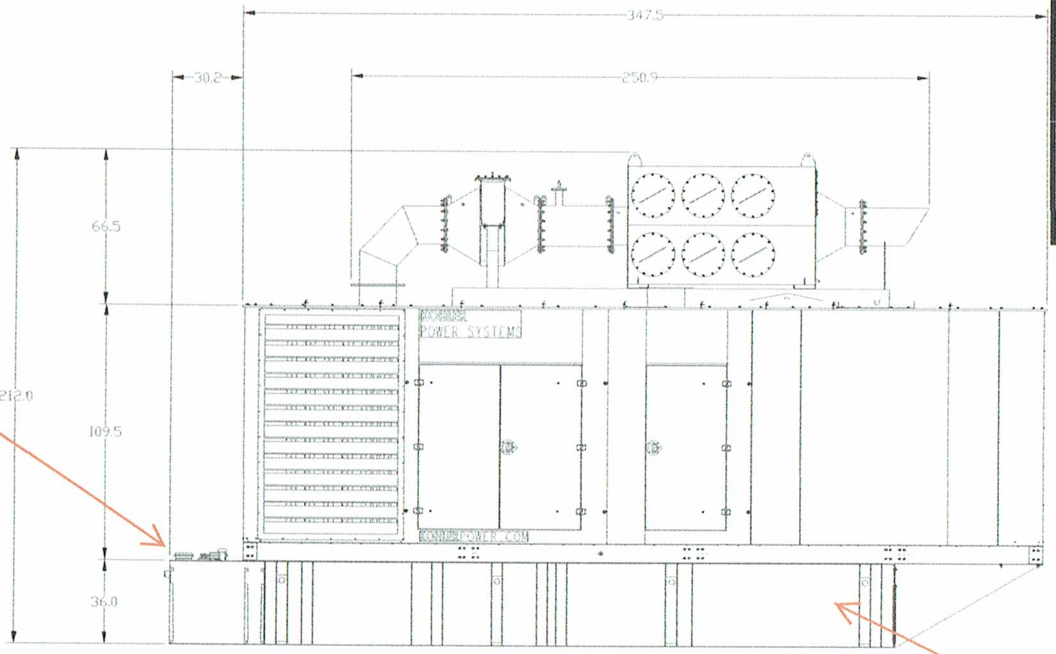
SITE INSPECTION
April 4, 2017

Comments:

1. 3 Kohler Generators have been installed at Esq. Graving Dock Facility.
2. Generator units are in general conformance with the manufacturer's shop drawings.
3. Fuel tanks and vents are installed.
4. Anchors bolts have been installed.

Inspected by: John van Dyk, PEng.
Per: City Engineering Inc.

2017-APR-04



TANK INFORMATION				
LITERS [GALLONS] MIN HOURS	GENSETS	DIM A MM [INCH]	DIM B MM [INCH]	TANK WEIGHT KG [LBS] (NO FUEL)
LIFT BASE ONLY	700-1000REOZDE / MD	254 [10.0]	8773 [345.4]	934 [2060]
3682 [973] 12 HOURS	700-1000REOZDE / MD	304.8 [12.0]	7967 [313.6]	3512 [7743]
6679 [1791] 24 HOURS	700-1000REOZDE / 750-800REOZMD	508.0 [20.0]	7967 [313.6]	3938 [8681]
8215 [2170] 24 HOURS	900-1000REOZMD	609.6 [24.0]	7967 [313.6]	4139 [9125]
8215 [2170] 36 HOURS	700 800REOZDE	609.6 [24.0]	7967 [313.6]	4139 [9125]
10824 [2859] 36 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4500 [9920]
10824 [2859] 48 HOURS	700-800REOZDE	914.4 [36.0]	7967 [313.6]	4500 [9920]
13970 [3690] 48 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4832 [10653]
16193 [4278] 72 HOURS	700-800REOZDE	914.4 [36.0]	9567 [376.6]	5498 [12120]
20914 [5525] 72 HOURS	900-1000REOZDE / 750-1000REOZMD	914.6 [36.0]	11430 [450.0]	6322 [13938]

TANK/LIFT BASE WEIGHT
+ENCLOSURE WEIGHT
=TOTAL WEIGHT

700-1000 KW SOUND ENCLOSURE
WITH SUB BASE TANK
OR LIFTING BASE OPTION

NOTE: DIMENSIONS IN INCHES, DIMENSIONS AND FEATURES ARE SUBJECT TO CHANGE WITHOUT NOTICE

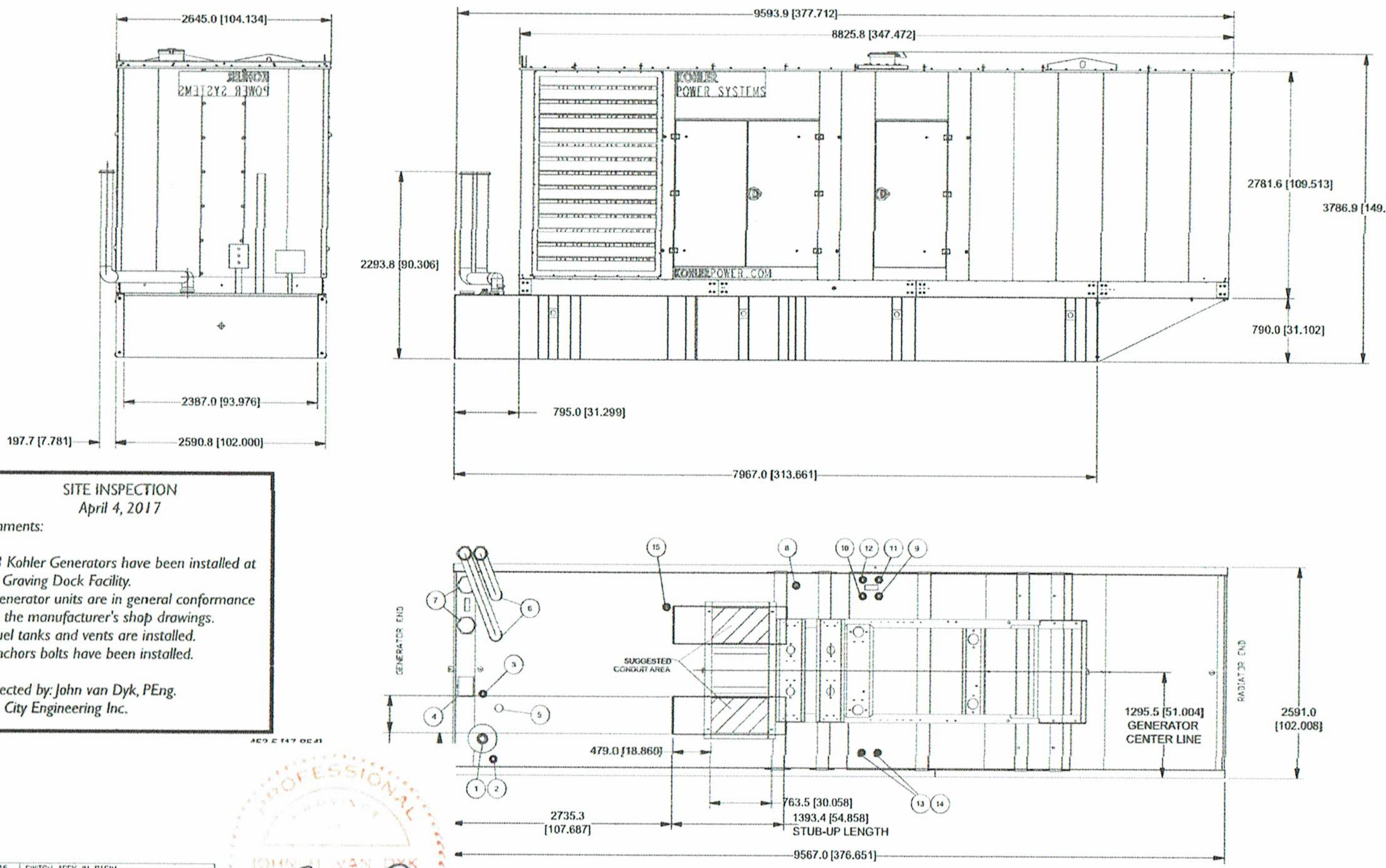
REV	DATE	ON COMPOSITE DWGS. SEE PART NO. FOR REVISION LEVEL	BY
E	03-19-14	SEE SHEET 4 [CT75098]	SSH
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT85282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 1 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 3 OF 6. (D-6) VIEW OF E-VENTS UPDATED. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE DIMENSION PRINT
SCALE 0.04 CAD NO. SHEET 2 of 6
DWG NO. ADV-8249 D



SITE INSPECTION
April 4, 2017

Comments:

1. 3 Kohler Generators have been installed at Esq. Graving Dock Facility.
2. Generator units are in general conformance with the manufacturer's shop drawings.
3. Fuel tanks and vents are installed.
4. Anchors bolts have been installed.

Inspected by: John van Dyk, PEng.
Per: City Engineering Inc.

15	SWITCH ASSY IN BASIN
14	CHECK VALVE W/ CLOSE NIPPLE, 1" NPT
13	DIP TUBE ASSY, 1" NPT
12	OPTIONAL FUEL RETURN, 2"
11	OPTIONAL FUEL SUPPLY, 2"
10	FUEL RETURN, 2"
9	FUEL SUPPLY, 2"
8	FUEL LEVEL SENDING UNIT
6	MAIN TANK EMERGENCY VENT, 5" C/W CAP
5	MAIN TANK NORMAL VENT, 2" C/W RISER
4	ANNUNCIATOR FOR HIGH FUEL LEVEL SWITCH
3	HIGH FUEL LEVEL SWITCH, 95%, 2" NPT
2	FUEL LEVEL GAUGE, MECHANICAL
1	FUEL FILL, 2" LOCKABLE C/W SPILL BOX
ITEM	DESCRIPTION

2017-APR-04

NOTE:
ALL DIMENSIONS IN IN MM (INCHES)

WESTERN PACIFIC ENTERPRISES GP

PROJ EGD PWGSC
WPE# C847
Date: April 5, 2017

AS-Built _GW_

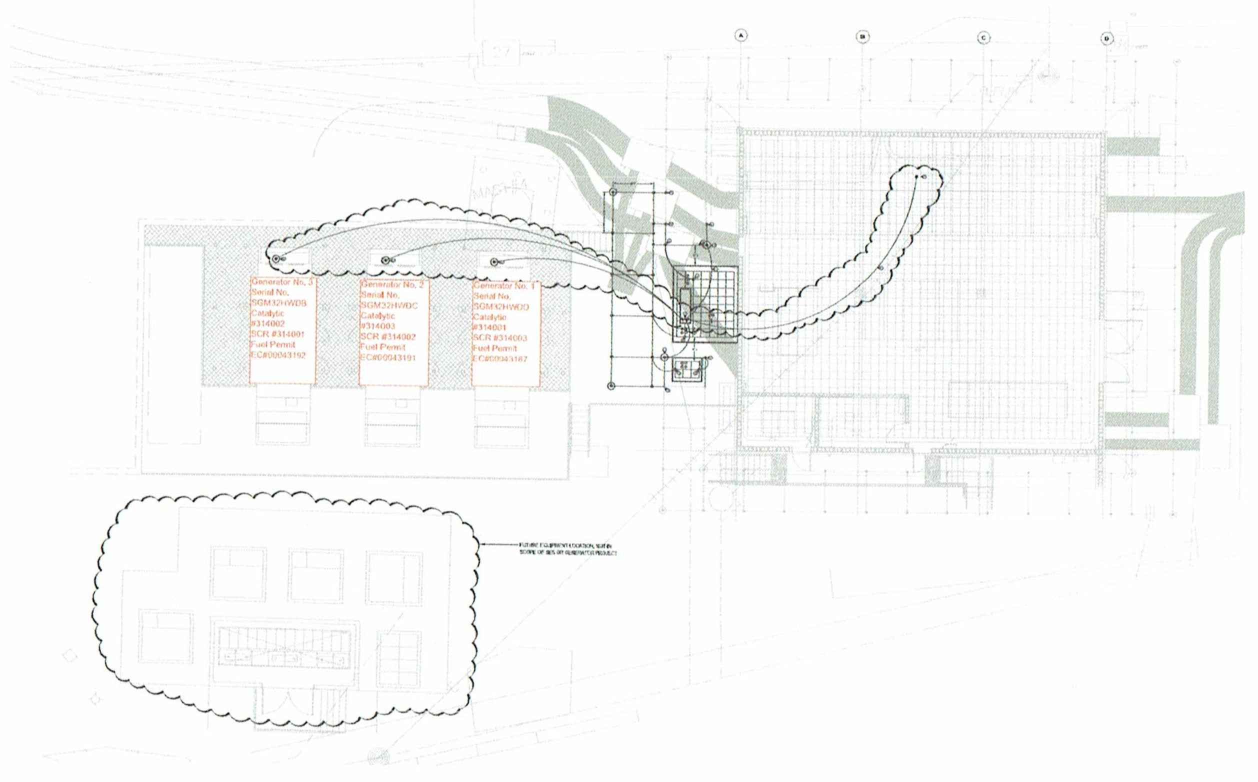
Information in this document is proprietary and is not to be reproduced, distributed, or disclosed except as specifically authorised in writing by Frontier Power Products Ltd.

ALL DIMENSIONS IN INCHES
UNLESS OTHERWISE NOTED
TOLERANCE ±$\frac{1}{16}$"

Frontier POWER PRODUCTS
www.frontierpower.com
Delta, BC, Canada 1-877-946-5531 ☑
Edmonton, AB, Canada 1-877-455-2260 ☐
Calgary, AB, Canada 1-877-720-3735 ☐
Winnipeg, MB, Canada 1-877-949-1526 ☐

TITLE: 2859 USG SUBBASE FUEL TANK
CUSTOMER: WESTERN PACIFIC
DRAWN: TT
DATE: 2017-03-24
CHECK: GW
DATE: 2017-03-24
DWG. NO. 10512
SCALE: N.T.S.
REV: B

Save Date: 2017-03-27 - 11:49 AM (tedt)
Print Date: 2017-03-27 - 1:12 PM



1
8421
GENERATOR TRANSFORMER GROUNDING LAYOUT (EXISTING)
1:100

LEGEND

◉	GROUND ROD C/W INSPECTION WELL
⊛	GROUND ROD WITHOUT ACCESS
⊗	GROUND ROD CONDUCTOR RISER
•	COMPRESSION CONNECTOR
—	#4/0 GROUND CONDUCTOR
—	ELECTRICALLY CONTINUOUS 15M REBAR @ 300mm O.C.

GENERAL NOTES:

1. GROUNDING SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE.
2. SLAB REBAR SHALL BE ELECTRICALLY CONTINUOUS. USE COMPRESSION CONNECTIONS TO ENSURE ALL REBAR IS BONDED TOGETHER.
3. GROUND RODS TO BE SPACED NO LESS THAN ONE ROD LENGTH APART.
4. REBAR SHALL BE BONDED TO COPPER CONDUCTOR AT MAXIMUM 3m SPACING. WHERE REBAR IS NOT ELECTRICALLY CONTINUOUS, A COPPER JUMPER SHALL BE INSTALLED.
5. GROUND CONDUCTOR TO BE BURIED 500mm BELOW FINISHED GRADE.
6. ALL CONNECTIONS TO BE PRE-FILLED WITH OXIDE INHIBITOR PRIOR TO COMPRESSING.
7. ALL GROUNDING CONNECTORS SHALL BE CSA AND IEEE 837 APPROVED.

KEYNOTES:

① INTERCEPT EXISTING SES GROUNDING GRID AND EXTEND TO SURROUND NEW GENERATOR TRANSFORMER PAD VIA NEW COMPRESSOR CONNECTORS.

② ENSURE TRANSFORMER IS CONNECTED TO GROUND GRID VIA TWO SEPARATE CONNECTIONS.

③ ENSURE REBAR IN PADS IS GROUNDED TO GROUND GRID VIA TWO SEPARATE CONNECTIONS.

④ 1c#2/0 CU. INSULATED GENERATOR ALTERNATOR GROUND WIRE FROM GENERATOR ALTERNATOR TO TRANSFORMER GROUND BUS (TYPICAL)

⑤ TRANSFORMER T25/125ES-2 GROUND BUS FOR GROUNDING OF TRANSFORMER, GENERATORS, AND LOAD BANK.

⑥ 2x1c#2/0 CU. INSULATED GROUND WIRE FROM TRANSFORMER GROUND BUS TO EXISTING SERVICE ENTRANCE GROUND BUS IN EXISTING 25kV SES MAIN SWITCHBOARD.

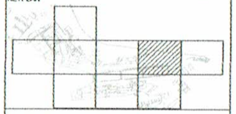
⑦ EXISTING SERVICE ENTRANCE GROUND BUS TO REMAIN. CONNECT GROUND WIRES USING IRREVERSIBLE CRIMP STYLE CONNECTORS

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Pacific Region
SERVICES IMMOBILIERS
Region de Pacifique

AES
CALGARY | VANCOUVER | VICTORIA
Designing A Better Tomorrow

KEYPLAN



Revision/Revision	Description/Description	Date/Date
6	ISSUED FOR ADDENDUM	16/08/30
5	ISSUED FOR TENDER	16/05/06
4	ISSUED FOR 100% REVIEW	16/05/05
3	ISSUED FOR 75% REVIEW	16/04/15
2	ISSUED FOR CIVIL COORDINATION	16/03/16
1	ISSUED FOR SCHEMATIC DESIGN	16/02/19
0		

Client/client

ESQUIMALT GRAVING DOCK

825 ADMIRALS ROAD
VICTORIA, BC, V9A 2P1

Project title/Titre du projet

825 ADMIRALS ROAD VICTORIA BC
ESQUIMALT GRAVING DOCK

EGD-SSES
STANDBY POWER
GENERATION SYSTEM

Consultant Signature Box Only

Designed by/Concept par
I. BARNES

Drawn by/Dessiné par
J. BIELING / S. SEYMOUR

PWGSC Project Manager/Administrateur de Projets TPSGC
Jamie LeBlanc

PWGSC, Regional Manager, Architectural and Engineering Services/ Gestionnaire régionale, Services d'architecture et de génie, TPSGC
Preetipal Paul

Drawing title/Titre du dessin

GENERATOR TRANSFORMER
GROUNDING LAYOUT
(EXISTING)

WESTERN PACIFIC ENTERPRISES GP
PROJ EGD PWGSC
WPE# C047
Date: April 5, 2017
AS-Built GW

0 1 2 3 4m
1:50

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.057890.003	8421	5

PWGSC - 91 - 10000707

W
P
WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Fuel Tank Certicfication in accordance with Specification 26 32 10 article 2.16.16

Generator Unit No. 2
Serial # SGM32HWDC
Permit No. EC#00043191

Diesel Fuel Tank type: Generator Base Tank
Double Walled: Yes
Tank Leak or Rupture Detection: Yes
Diesel Fuel Tank Capacity: 10824 Liters
Run time: 72hours at 50% loading
CSA Compliance: ULC/ORD-C142.23-1991, ULC-S601-00, ULC-630-00

Tank Fill connections:
- Exterior of Enclosure: Yes
- Interior of Inclosure: Yes
- Spill Contianment Device: Yes
- Visual Tank Level Gauge: Yes
- Audible Over Fill Protection @ 90%: Yes
- Visual Over Fill Protection @ 90%: Yes
- Overfill Positive Shut Off @ 95%: Yes

Vent Piping terminate outdoors:
- Normal: Yes
- Emergency: Yes

Tank complete with 2 spare 50mm capped scully flange: Yes

Tank complete with suction and return capped scully flange: Yes

Stamped "As-Built" record drawing provided: Yes

Spill Response Kit provided (capacity 350 liters): Yes

Tank Installation Reveiwed by Certified Patroleum Equipment Installer: Yes

Name: Michael William Croft
Certificate #00012-PE-11
Date: April 6, 2017

Signature:

Environment Canada Environnement Canada Canada

Back to home page

Report

Tank System Information

Tank System Description

EC #:
00043191
Internal Number

Description:
Emergency Generator Base Tank (#2)

Contact Information

Owner
Public Service and Procurement Canada (Corporate)
11 Laurier Street, PDP III
Gatineau
Quebec
K1A 0S5
Tank Operator
PWGSC Esquimalt
825 Admirals Road
Esquimalt
British Columbia
V9A 2P1
Tel: (250) 363-6985
Fax: (250) 363-8059

Contact
Joe Lezetc
825 Admiral Road
Victoria
British Columbia
V9A2P1
Tel: (250) 363-3991
Tel: (250) 363-3739

Contact
Joe Lezetc
825 Admiral Road
Victoria
British Columbia
V9A 2P1
Tel: (250) 363-3991
Tel: (250) 363-3739

Land Owner

Months of service

January
February
March
April

May
June
July
August
September
October
November
December

System Location

Tank System Location
825 Admirals Road
Vicotira
British Columbia

System Record Location
825 Admirals Road
Vicotira
British Columbia

Emergency Plan Location
825 Admirals Road
Vicotira
British Columbia
Details:

Miscellaneous Information

Tank Use:

Name of Tank Manufacturer:
Sauk Technologies
Year of Manufacture:
2016
Certification # of System Installer:
Richard Pocock 00005-PI-11
Certification # of System Remover:

Tank 1 of 1

Tank Information

Tank Description:
Base tank for emergency generator fuel storage.
Tank Internal Number:

Type of Tank:
Aboveground
ULC or API Standard Number:
ULC-S601
Year of installation:
2017
Material of construction:
Steel
Overfill Protection:
- Overfill Alarm
- Method – trained personnel in attendance at all times

- Other (specify), CAN/ULC-S661

Type of pump:
No oil-water separator
Spill Containment:
Aboveground tank ULC-S663 (superses ORD-C142.19)
Product Stored:
Diesel
Tank Capacity:
10824 L
Transfer area:
Curbed concrete fuel truck off-loading areas sloped to direct spills to curbed concrete generator tank pad with shut off valves in drain holes. Spill containment capacity of 25,000L. Spill container at tank fill connections. Tanks equipped with 90% high level alarm and 95% overfill protection valve. SOP for fuel deliveries with procedure signs posted at fill points, Owner's rep to be present during deliveries, EERP available on site. PTA Risk Assessment completed.
Tank Leak Detection:

- Visual inspection
- Interstitial monitoring – double walled tank

Corrosion Protection:

- Painted

Secondary Containment:

- Double Walled
- Containment tank assembly

Piping for tank 1

Type of Piping:
None

WESTERN PACIFIC ENTERPRISES GP

PROJ EGD PWGSC

WPE# C847

Date: April 5, 2017

AS-Built _GW_

SITE INSPECTION
April 4, 2017

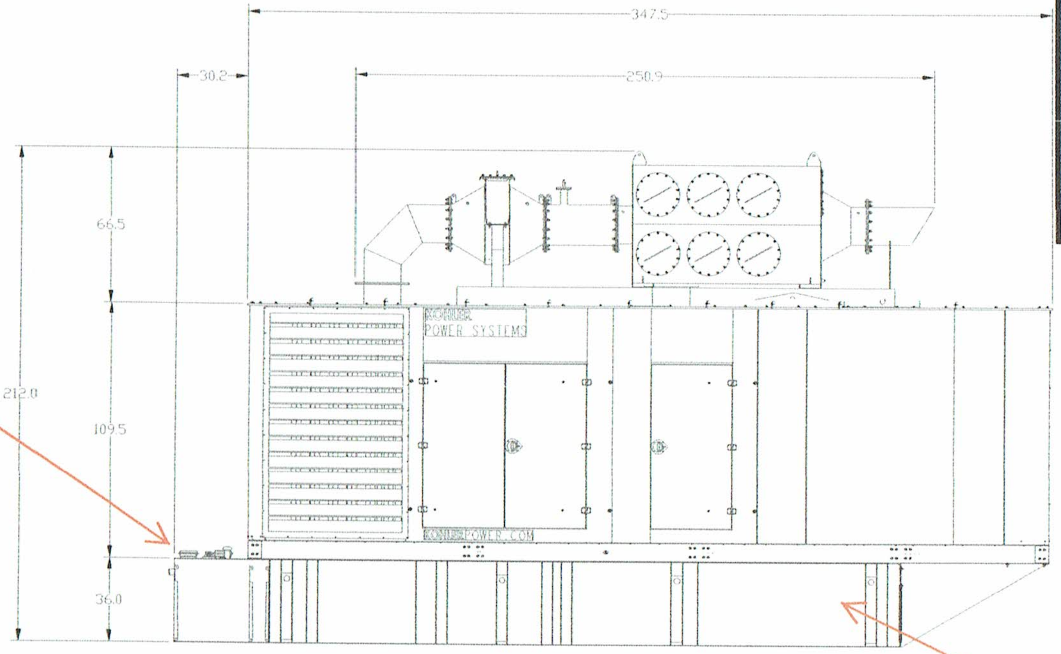
Comments:

1. 3 Kohler Generators have been installed at Esq. Graving Dock Facility.
2. Generator units are in general conformance with the manufacturer's shop drawings.
3. Fuel tanks and vents are installed.
4. Anchors bolts have been installed.

Inspected by: John van Dyk, PEng.
Per: City Engineering Inc.

JOHN H. VAN DYK

2017-APR-04



filling and vents

Belly Fuel

TANK INFORMATION				
LITERS [GALLONS] MIN HOURS	GENSETS	DIM A MM [INCH]	DIM B MM [INCH]	TANK WEIGHT KG [LBS] (NO FUEL)
LIFT BASE ONLY	700-1000REOZDE / MD	254 [10.0]	8773 [345.4]	934 [2060]
3682 [973] 12 HOURS	700-1000REOZDE / MD	304.8 [12.0]	7967 [313.6]	3512 [7743]
6679 [1791] 24 HOURS	700-1000REOZDE / 750-800REOZMD	508.0 [20.0]	7967 [313.6]	3938 [8681]
8215 [2170] 24 HOURS	900-1000REOZMD	609.6 [24.0]	7967 [313.6]	4139 [9125]
0215 [2170] 36 HOURS	700 800REOZDE	609.6 [24.0]	7967 [313.6]	4139 [9125]
10824 [2859] 36 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4500 [9920]
10824 [2859] 48 HOURS	700-800REOZDE	914.4 [36.0]	7967 [313.6]	4500 [9920]
13970 [3690] 48 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4832 [10653]
16193 [4278] 72 HOURS	700-800REOZDE	914.4 [36.0]	9567 [376.6]	5498 [12120]
20914 [5525] 72 HOURS	900-1000REOZDE / 750-1000REOZMD	914.6 [36.0]	11430 [450.0]	6322 [13938]

TANK/LIFT BASE WEIGHT
+ENCLOSURE WEIGHT
=TOTAL WEIGHT

700-1000 KW SOUND ENCLOSURE
WITH SUB BASE TANK
OR LIFTING BASE OPTION

NOTE: DIMENSIONS IN INCHES, DIMENSIONS AND FEATURES ARE SUBJECT TO CHANGE WITHOUT NOTICE

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
E	03-19-14	SEE SHEET 4 [CT75098]	SSH
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT65282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 1 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 3 OF 6, (D-6) VIEW OF E-VENTS UPDATED. [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± .025
X.X ± .10
X ± .15
ANGLES ± 0° 30'

SURFACE FINISH MAX

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

KOHLER CO. METRIC PRO-E

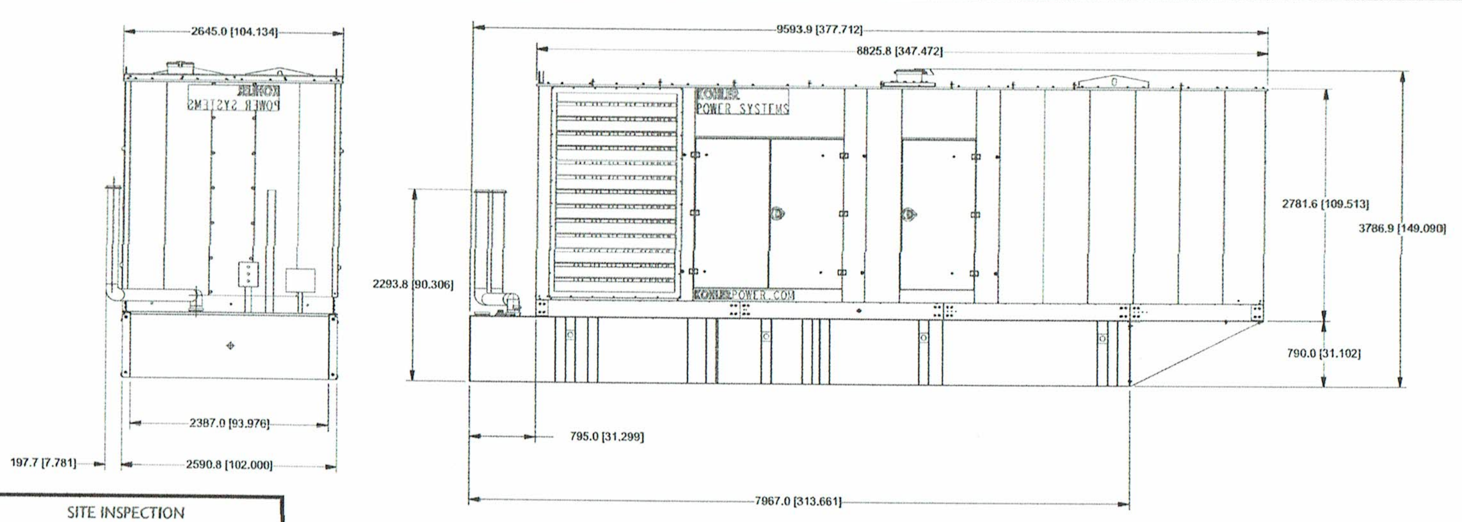
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

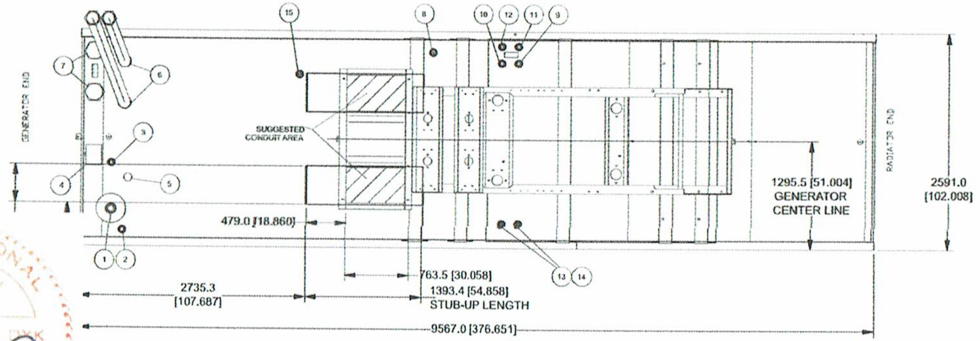
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE DIMENSION PRINT

SCALE 0.04 CAD NO SHEET 2 of 6

DWG NO ADV-8249 D





SITE INSPECTION
April 4, 2017

Comments:

1. 3 Kohler Generators have been installed at Esq. Graving Dock Facility.
2. Generator units are in general conformance with the manufacturer's shop drawings.
3. Fuel tanks and vents are installed.
4. Anchors bolts have been installed.

Inspected by: John van Dyk, PEng.
Per: City Engineering Inc.

15	SWITCH ASSY IN BASIN
14	CHECK VALVE W/ CLOSE NIPPLE, 1" NPT
13	DIP TUBE ASSY, 1" NPT
12	OPTIONAL FUEL RETURN, 2"
11	OPTIONAL FUEL SUPPLY, 2"
10	FUEL RETURN, 2"
9	FUEL SUPPLY, 2"
8	FUEL LEVEL SENDING UNIT
6	MAIN TANK EMERGENCY VENT, 5" C/W CAP
5	MAIN TANK NORMAL VENT, 2" C/W RISER
4	ANNUNCIATOR FOR HIGH FUEL LEVEL SWITCH
3	HIGH FUEL LEVEL SWITCH, 95%, 2" NPT
2	FUEL LEVEL GAUGE, MECHANICAL
1	FUEL FILL, 2" LOCKABLE C/W SPILL BOX
ITEM	DESCRIPTION

2017-APR-04

NOTE:
ALL DIMENSIONS IN IN MM (INCHES)

WESTERN PACIFIC ENTERPRISES GP
PROJ EGD PWGSC
WPE# C847
Date: April 5, 2017
AS-Built _GW_

Information in this document is proprietary and is not to be reproduced, distributed, or disclosed except as specifically authorised in writing by Frontier Power Products Ltd.

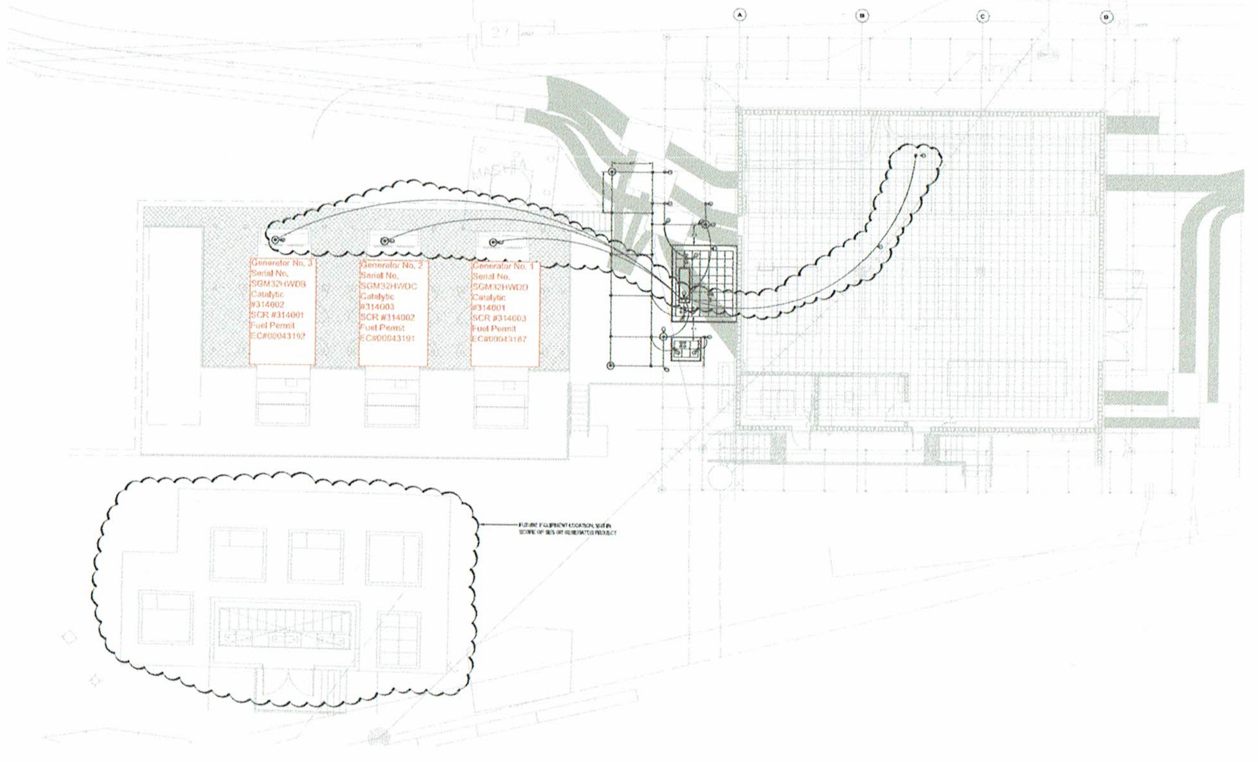
ALL DIMENSIONS IN INCHES
UNLESS OTHERWISE NOTED
TOLERANCE $\pm\frac{1}{16}"$

Frontier POWER PRODUCTS
www.frontierpower.com

Delta, BC, Canada 1-877-946-5531 ☑
Edmonton, AB, Canada 1-877-455-2260 ☐
Calgary, AB, Canada 1-877-720-3735 ☐
Winnipeg, MB, Canada 1-877-949-1526 ☐

TITLE:	2859 USG SUBBASE FUEL TANK		
CUSTOMER:	WESTERN PACIFIC		
DRAWN: TT		DATE: 2017-03-24	
CHECK: GW		DATE: 2017-03-24	
DWG. NO. 10512		SCALE: N.T.S.	REV: B

Save Date: 2017-03-27 - 11:49 AM (tedt)
Print Date: 2017-03-27 - 1:12 PM



1
8421
1:100
GENERATOR TRANSFORMER GROUNDING LAYOUT (EXISTING)

LEGEND	
⊙	GROUND ROD C/W INSPECTION WELL
⊛	GROUND ROD WITHOUT ACCESS
⊗	GROUND ROD CONDUCTOR RISER
•	COMPRESSION CONNECTOR
—	#4/0 GROUND CONDUCTOR
—	ELECTRICALLY CONTINUOUS 15M REBAR @ 300mm O.C.

GENERAL NOTES:

1. GROUNDING SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE.
2. SLAB REBAR SHALL BE ELECTRICALLY CONTINUOUS. USE COMPRESSION CONNECTIONS TO ENSURE ALL REBAR IS BONDED TOGETHER.
3. GROUND RODS TO BE SPACED NO LESS THAN ONE ROD LENGTH APART.
4. REBAR SHALL BE BONDED TO COPPER CONDUCTOR AT MAXIMUM 3m SPACING. WHERE REBAR IS NOT ELECTRICALLY CONTINUOUS, A COPPER JUMPER SHALL BE INSTALLED.
5. GROUND CONDUCTOR TO BE BURIED 500mm BELOW FINISHED GRADE.
6. ALL CONNECTIONS TO BE PRE-FILLED WITH OXIDE INHIBITOR PRIOR TO COMPRESSING.
7. ALL GROUNDING CONNECTORS SHALL BE CSA AND IEEE 837 APPROVED.

KEYNOTES:

①➤ INTERCEPT EXISTING SES GROUNDING GRID AND EXTEND TO SURROUND NEW GENERATOR TRANSFORMER PAD VIA NEW COMPRESSOR CONNECTORS.

②➤ ENSURE TRANSFORMER IS CONNECTED TO GROUND GRID VIA TWO SEPARATE CONNECTIONS.

③➤ ENSURE REBAR IN PADS IS GROUNDED TO GROUND GRID VIA TWO SEPARATE CONNECTIONS.

④➤ 1c#2/0 CU. INSULATED GENERATOR ALTERNATOR GROUND WIRE FROM GENERATOR ALTERNATOR TO TRANSFORMER GROUND BUS. (TYPICAL)

⑤➤ TRANSFORMER T25/12SES-2 GROUND BUS FOR GROUNDING OF TRANSFORMER, GENERATORS, AND LOAD BANK.

⑥➤ 2x1c#2/0 CU. INSULATED GROUND WIRE FROM TRANSFORMER GROUND BUS TO EXISTING SERVICE ENTRANCE GROUND BUS IN EXISTING 25kV SES MAIN SWITCHBOARD.

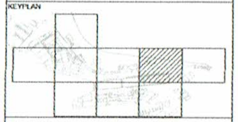
⑦➤ EXISTING SERVICE ENTRANCE GROUND BUS TO REMAIN. CONNECT GROUND WIRES USING IRREVERSIBLE CRIMP STYLE CONNECTORS.

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Pacific Region
SERVICES IMMOBILIERS
Region de Pacifique

AES
CALGARY | VANCOUVER | VICTORIA
Designing A Better Tomorrow

KEYPLAN



Revision/Révision	Description/Description	Date/Date
6	ISSUED FOR ADDENDUM	16/06/30
5	ISSUED FOR TENDER	16/05/06
4	ISSUED FOR 100% REVIEW	16/05/05
3	ISSUED FOR 75% REVIEW	16/04/15
2	ISSUED FOR CIVIL COORDINATION	16/03/16
1	ISSUED FOR SCHEMATIC DESIGN	16/02/19
0		

Client/client

ESQUIMALT
GRAVING DOCK

825 ADMIRALS ROAD
VICTORIA, BC, V9A 2P1

Project title/Titre du projet

825 ADMIRALS ROAD VICTORIA BC
ESQUIMALT GRAVING DOCK

EGD-SSES
STANDBY POWER
GENERATION SYSTEM

Consultant Signature Box Only

Designed by/Concept par
I. BARNES

Drawn by/Dessiné par
J. CIELONG / S. SEYMOUR

PWGSC Project Manager/Administrateur de Projets TPSGC
Jamie LeBlanc

PWGSC, Regional Manager, Architectural and Engineering Services/ Gestionnaire régionale, Services d'architecture et de génie, TPSGC
Preetipal Paul

Drawing title/Titre du dessin

GENERATOR TRANSFORMER
GROUNDING LAYOUT
(EXISTING)

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.057890.003	8421	5

WESTERN PACIFIC ENTERPRISES GP
PROJ EGD PWGSC
WPE# C847
Date: April 5, 2017
AS-Built GW

0 1 2 3 4m 1:50

PWGSC - 81 - 1000X707

W
P
WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Fuel Tank Certicfication in accordance with Specification 26 32 10 article 2.16.16

Generator Unit No. 3
Serial # SGM32HWDB
Permit No. EC#00043192

Diesel Fuel Tank type:		Generator Base Tank
Double Walled:		Yes
Tank Leak or Rupture Detection:		Yes
Diesel Fuel Tank Capacity:		10824 Liters
Run time:		72hours at 50% loading
CSA Compliance:		ULC/ORD-C142.23-1991, ULC-S601-00, ULC-630-00
Tank Fill connections:	Exterior of Enclosure	Yes
	Interior of Inclosure	Yes
	Spill Contianment Device	Yes
	Visual Tank Level Gauge	Yes
	Audible Over Fill Protection @ 90%	Yes
	Visual Over Fill Protection @ 90%	Yes
	Overfill Positive Shut Off @ 95%	Yes
Vent Piping terminate outdoors:	Normal	Yes
	Emergency	Yes
Tank complete with 2 spare 50mm capped scully flange:		Yes
Tank complete with suction and return capped scully flange		Yes
Stamped "As-Built" record drawing provided:		Yes
Spill Response Kit provided (capacity 350 liters):		Yes
Tank Installation Reveiwed by Certified Patroleum Equipment Installer:		Yes

Name: Michael William Croft
Certificate #00012-PE-11

Date: April 6, 2017

Signature:

Environment Canada Environnement Canada Canada

Back to home page

Report

Tank System Information

Tank System Description

EC #:
00043192
Internal Number

Description:
Emergency Generator Base Tank (#3)

Contact Information

Owner
Public Service and Procurement Canada (Corporate)
11 Laurier Street, PDP III
Gatineau
Quebec
K1A 0S5
Tank Operator
PWGSC Esquimalt
825 Admirals Road
Esquimalt
British Columbia
V9A 2P1
Tel: (250) 363-6985
Fax: (250) 363-8059

Contact
Joe Lezetc
825 Admiral Road
Victoria
British Columbia
V9A2P1
Tel: (250) 363-3991
Tel: (250) 363-3739

Contact
Joe Lezetc
825 Admiral Road
Victoria
British Columbia
V9A 2P1
Tel: (250) 363-3991
Tel: (250) 363-3739

Land Owner

Months of service

January
February
March
April

May
June
July
August
September
October
November
December

System Location

Tank System Location
825 Admirals Road
Victoria
British Columbia

System Record Location
825 Admirals Road
Victoria
British Columbia

Emergency Plan Location
825 Admirals Road
Victoria
British Columbia
Details:

Miscellaneous Information

Tank Use:

Name of Tank Manufacturer:
Sauk Technologies
Year of Manufacture:
2016
Certification # of System Installer:
Richard Pocock 00005-PI-11
Certification # of System Remover:

Tank 1 of 1

Tank Information

Tank Description:
Base tank for emergency generator fuel storage.
Tank Internal Number:

Type of Tank:
Aboveground
ULC or API Standard Number:
ULC-S601
Year of installation:
2017
Material of construction:
Steel
Overfill Protection:
- Overfill Alarm
- Method – trained personnel in attendance at all times

- Other (specify), CAN/ULC-S661 (overfill protection devices storage tanks)

Type of pump:
No oil-water separator
Spill Containment:
Aboveground tank ULC-S663 (superses ORD-C142.19)
Product Stored:
Diesel
Tank Capacity:
10824 L
Transfer area:
Curbed concrete fuel truck off-loading areas sloped to direct spills to curbed concrete generator tank pad with shut off valves in drain holes. Spill containment capacity of 25,000L. Spill container at tank fill connections. Tanks equipped with 90% high level alarm and 95% overfill protection valve. SOP for fuel deliveries with procedure signs posted at fill points, Owner's rep to be present during deliveries, EERP available on site. PTA Risk Assessment completed.
Tank Leak Detection:

- Visual inspection
- Interstitial monitoring – double walled tank

Corrosion Protection:

- Painted

Secondary Containment:

- Double Walled
- Containment tank assembly

Piping for tank 1

Type of Piping:
None

WESTERN PACIFIC ENTERPRISES GP
PROJ EGD PWGSC
WPE# C847
Date: April 5, 2017
AS-Built _GW_

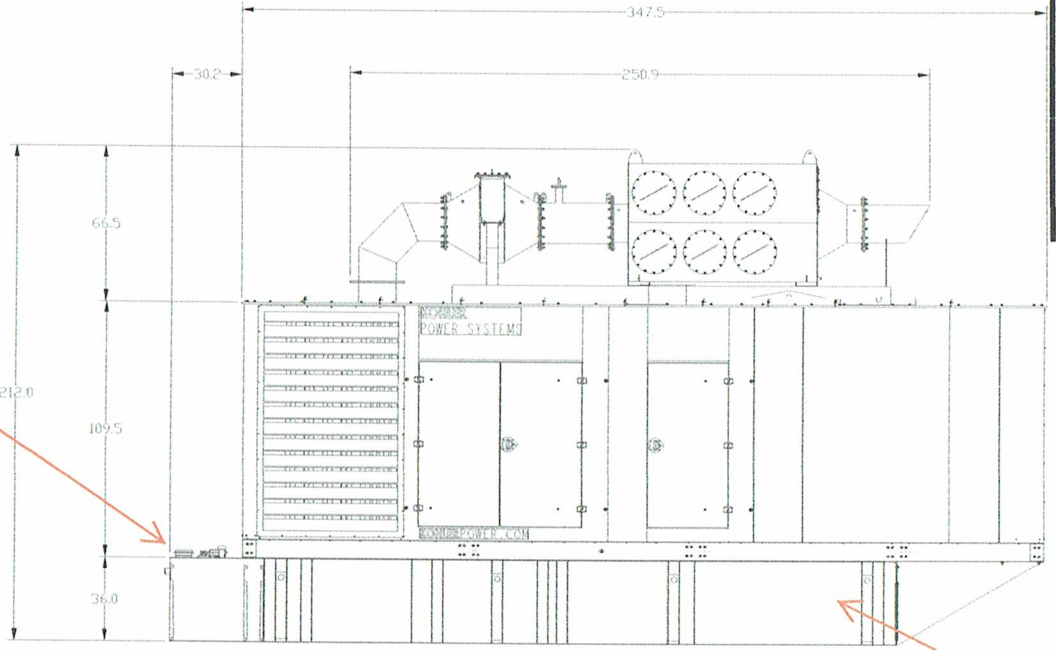
SITE INSPECTION
April 4, 2017

Comments:

1. 3 Kohler Generators have been installed at Esq. Graving Dock Facility.
2. Generator units are in general conformance with the manufacturer's shop drawings.
3. Fuel tanks and vents are installed.
4. Anchors bolts have been installed.

Inspected by: John van Dyk, PEng.
Per: City Engineering Inc.

JOHN H. VAN DYK
2017-APR-04



TANK INFORMATION				
LITERS [GALLONS] MIN HOURS	GENSETS	DIM A MM [INCH]	DIM B MM [INCH]	TANK WEIGHT KG [LBS] (NO FUEL)
LIFT BASE ONLY	700-1000REOZDE / MD	254 [10.0]	8773 [345.4]	934 [2060]
3682 [973] 12 HOURS	700-1000REOZDE / MD	304.8 [12.0]	7967 [313.6]	3512 [7743]
6679 [1791] 24 HOURS	700-1000REOZDE / 750-800REOZMD	508.0 [20.0]	7967 [313.6]	3938 [8681]
8215 [2170] 24 HOURS	900-1000REOZMD	609.6 [24.0]	7967 [313.6]	4139 [9125]
8215 [2170] 36 HOURS	700-800REOZDE	609.6 [24.0]	7967 [313.6]	4139 [9125]
10824 [2859] 36 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4500 [9920]
10824 [2859] 48 HOURS	700-800REOZDE	914.4 [36.0]	7967 [313.6]	4500 [9920]
13970 [3690] 48 HOURS	900-1000REOZDE / 750-1000REOZMD	914.4 [36.0]	7967 [313.6]	4832 [10653]
16193 [4278] 72 HOURS	700-800REOZDE	914.4 [36.0]	9567 [376.6]	5498 [12120]
20914 [5525] 72 HOURS	900-1000REOZDE / 750-1000REOZMD	914.6 [36.0]	11430 [450.0]	6322 [13938]

TANK/LIFT BASE WEIGHT
+ENCLOSURE WEIGHT
=TOTAL WEIGHT

700-1000 KW SOUND ENCLOSURE
WITH SUB BASE TANK
OR LIFTING BASE OPTION

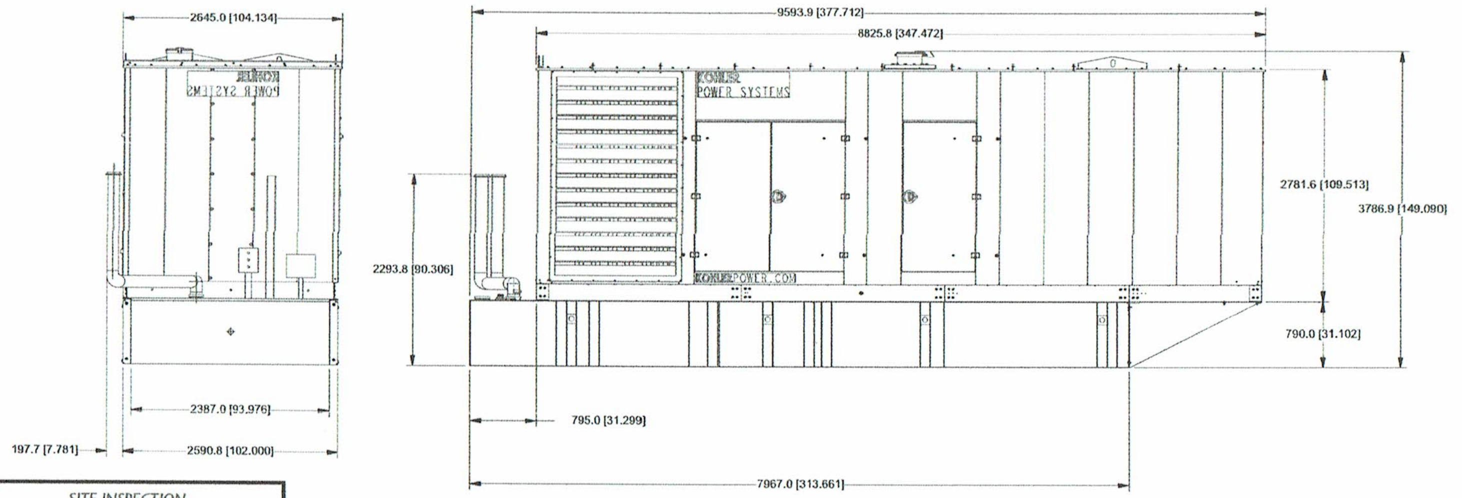
NOTE: DIMENSIONS IN INCHES, DIMENSIONS AND FEATURES ARE SUBJECT TO CHANGE WITHOUT NOTICE

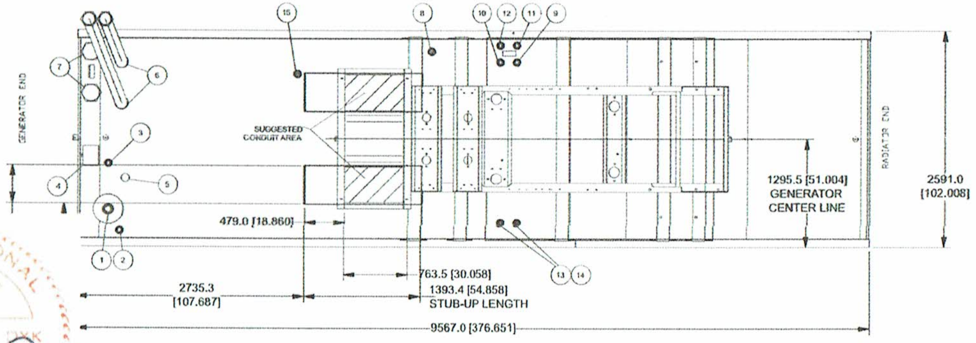
REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
E	03-19-14	SEE SHEET 4 [CT75098]	SSH
F	6-24-14	SEE SHEET 6 FOR CHANGE [CT85282]	JMR
G	10-09-14	SEE SHEET 6 FOR CHANGE [CT92730]	JMR
H	12-11-14	SEE SHEET 3 [CT100596]	PRM
J	4-21-15	(C, D-5) DOOR LOCATION CORRECTED, SEE SHEETS 1 & 3 [CT111226]	SAM
K	7-22-15	SEE SHEET 4 [CT119088]	SAK
L	10-27-15	SEE SHEETS 1 AND 3 OF 6, (D-6) VIEW OF E-VENTS UPDATED [CT128608]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	JMR	6-28-11
CHECKED	AJD	6-28-11
APPROVED	AJD	6-28-11

KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.
TITLE DIMENSION PRINT
SCALE 0.04 CAD NO. SHEET 2 of 6
DWG NO. ADV-8249 D





SITE INSPECTION
April 4, 2017

Comments:

1. 3 Kohler Generators have been installed at Esq. Graving Dock Facility.
2. Generator units are in general conformance with the manufacturer's shop drawings.
3. Fuel tanks and vents are installed.
4. Anchors bolts have been installed.

Inspected by: John van Dyk, PEng.
Per: City Engineering Inc.

15	SWITCH ASSY IN BASIN
14	CHECK VALVE W/ CLOSE NIPPLE, 1" NPT
13	DIP TUBE ASSY, 1" NPT
12	OPTIONAL FUEL RETURN, 2"
11	OPTIONAL FUEL SUPPLY, 2"
10	FUEL RETURN, 2"
9	FUEL SUPPLY, 2"
8	FUEL LEVEL SENDING UNIT
6	MAIN TANK EMERGENCY VENT, 5" C/W CAP
5	MAIN TANK NORMAL VENT, 2" C/W RISER
4	ANNUNCIATOR FOR HIGH FUEL LEVEL SWITCH
3	HIGH FUEL LEVEL SWITCH, 95%, 2" NPT
2	FUEL LEVEL GAUGE, MECHANICAL
1	FUEL FILL, 2" LOCKABLE C/W SPILL BOX
ITEM	DESCRIPTION

JOHN H. VAN DYK
2017-APR-04

NOTE:
ALL DIMENSIONS IN IN MM (INCHES)

WESTERN PACIFIC ENTERPRISES GP
PROJ EGD PWGSC
WPE# C847
Date: April 5, 2017
AS-Built _GW_

Information in this document is proprietary and is not to be reproduced, distributed, or disclosed except as specifically authorised in writing by Frontier Power Products Ltd.

ALL DIMENSIONS IN INCHES
UNLESS OTHERWISE NOTED
TOLERANCE $\pm\frac{1}{16}$"

Delta, BC, Canada	1-877-946-5531 ☑
Edmonton, AB, Canada	1-877-455-2260 ☐
Calgary, AB, Canada	1-877-720-3735 ☐
Winnipeg, MB, Canada	1-877-949-1526 ☐

www.frontierpower.com

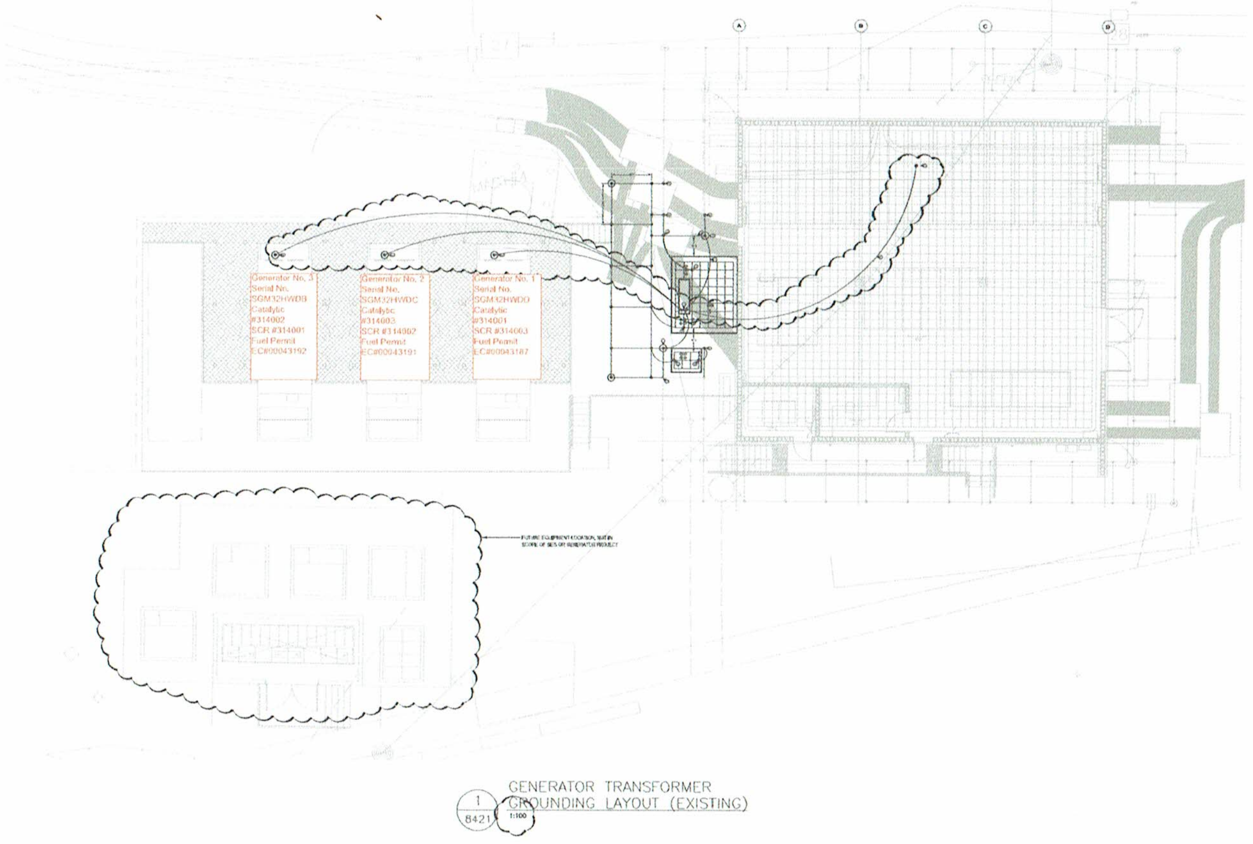
TITLE: 2859 USG SUBBASE FUEL TANK

CUSTOMER: WESTERN PACIFIC

DRAWN:	TT	DATE:	2017-03-24		
CHECK:	GW	DATE:	2017-03-24		
DWG. NO.	10512	SCALE	N.T.S.	REV:	B

Save Date: 2017-03-27 - 11:49 AM (tedt)
Print Date: 2017-03-27 - 1:12 PM

3



1 8421 GENERATOR TRANSFORMER GROUNDING LAYOUT (EXISTING) 1:100

LEGEND	
⦿	GROUND ROD C/W INSPECTION WELL
⊛	GROUND ROD WITHOUT ACCESS
⊗	GROUND ROD CONDUCTOR RISER
•	COMPRESSION CONNECTOR
——	#4/0 GROUND CONDUCTOR
——	ELECTRICALLY CONTINUOUS 15M REBAR @ 300mm O.C.

GENERAL NOTES:

1. GROUNDING SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE.
2. SLAB REBAR SHALL BE ELECTRICALLY CONTINUOUS. USE COMPRESSION CONNECTIONS TO ENSURE ALL REBAR IS BONDED TOGETHER.
3. GROUND RODS TO BE SPACED NO LESS THAN ONE ROD LENGTH APART.
4. REBAR SHALL BE BONDED TO COPPER CONDUCTOR AT MAXIMUM 3m SPACING. WHERE REBAR IS NOT ELECTRICALLY CONTINUOUS, A COPPER JUMPER SHALL BE INSTALLED.
5. GROUND CONDUCTOR TO BE BURIED 500mm BELOW FINISHED GRADE.
6. ALL CONNECTIONS TO BE PRE-FILLED WITH OXIDE INHIBITOR PRIOR TO COMPRESSING.
7. ALL GROUNDING CONNECTORS SHALL BE CSA AND IEEE 837 APPROVED.

KEYNOTES:

① INTERCEPT EXISTING SES GROUNDING GRID AND EXTEND TO SURROUND NEW GENERATOR TRANSFORMER PAD VIA NEW COMPRESSOR CONNECTORS.

② ENSURE TRANSFORMER IS CONNECTED TO GROUND GRID VIA TWO SEPARATE CONNECTIONS.

③ ENSURE REBAR IN PADS IS GROUNDED TO GROUND GRID VIA TWO SEPARATE CONNECTIONS.

④ 1c#2/0 CU. INSULATED GENERATOR ALTERNATOR GROUND WIRE FROM GENERATOR ALTERNATOR TO TRANSFORMER GROUND BUS. (TYPICAL)

⑤ TRANSFORMER T25/12SES-2 GROUND BUS FOR GROUNDING OF TRANSFORMER, GENERATORS, AND LOAD BANK.

⑥ 2x1c#2/0 CU. INSULATED GROUND WIRE FROM TRANSFORMER GROUND BUS TO EXISTING SERVICE ENTRANCE GROUND BUS IN EXISTING 25kV SES MAIN SWITCHBOARD.

⑦ EXISTING SERVICE ENTRANCE GROUND BUS TO REMAIN, CONNECT GROUND WIRES USING IRREVERSIBLE CRIMP STYLE CONNECTORS

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Pacific Region
SERVICES IMMOBILIERS
Région du Pacifique

AES
CALGARY | VANCOUVER | VICTORIA
Designing A Better Tomorrow

KEYPLAN

Revision/Révision	Description/Description	Date/Date
6	ISSUED FOR ADDENDUM	16/06/30
5	ISSUED FOR TENDER	16/05/06
4	ISSUED FOR 100% REVIEW	16/05/03
3	ISSUED FOR 75% REVIEW	16/04/15
2	ISSUED FOR CIVIL COORDINATION	16/03/16
1	ISSUED FOR SCHEMATIC DESIGN	16/02/19
0		

Client/client

ESQUIMALT GRAVING DOCK

825 ADMIRALS ROAD
VICTORIA, BC, V9A 2P1

Project title/Titre du projet

825 ADMIRALS ROAD VICTORIA BC
ESQUIMALT GRAVING DOCK

EGD-SSES
STANDBY POWER
GENERATION SYSTEM

Consultant Signature Box Only

Designed by/Concept par
I. BARNES

Drawn by/Dessiné par
J. EBELING / S. SEYMOUR

PWGSC Project Manager/Administrateur de Projets TPSGC
Jamie LeBlanc

PWGSC, Regional Manager, Architectural and Engineering Services/ Gestionnaire régionale, Services d'architectural et de génie, TPSGC
Prestigiel Paul

Drawing title/Titre du dessin

GENERATOR TRANSFORMER
GROUNDING LAYOUT
(EXISTING)

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.057890.003	8421	5

WESTERN PACIFIC ENTERPRISES GP
PROJ EGD PWGSC
WPE# C847
Date: April 5, 2017
AS-Built GW

0 1 2 3 4m 1:50

PWGSC - 91 - 1000X707

city engineering inc.

FIELD REVIEW REPORT

Project:	Esquimalt Graving Dock Electrical Safety Upgrade (C847)	**Date:**	19-May-2017
Contractor:	Western Pacific Enterprises Ltd.	**Client:**	Western Pacific Enterprises
Onsite Rep:	Chris Heesterman	**Attn:**	Gord Webster
From:	John van Dyk, P.Eng.	**Job #**	16-~~268~~ 287.

Comments / Recommendations:

To confirm our inspection of April 4, 2017 :

1. Electrical equipment seismically restrained as per Dwg. ES-01
2. Electrical equipment seismically restrained as per Dwg. ES-02

John van Dyk, P.Eng.

Per: CITY ENGINEERING INC.

JOHN H. VAN DYK

19 MAY 2017

Issue Date: August 02, 2016
Installation Permit Number: EL-417208-2016
(When inquiring always refer to this number.)

ELECTRICAL INSTALLATION PERMIT

CONTRACTOR COMMERCIAL / INDUSTRIAL

August 02, 2016

Western Pacific Enterprises GP
1321 KETCH COURT
COQUITLAM BC V3K 6X7

SITE OF INSTALLATION

825 ADMIRALS ROAD
VICTORIA BC V9A 2P1

Contractor Information:
Contractor Name - Western Pacific Enterprises GP
Licence Class - Contractor Licence
Licence No. - LEL0003730

Designated FSR Information:
FSR Name - Brian Beddow
FSR Class - FSR Class B

Designated FSR Information:
FSR Name - Brian Beddow
FSR Class - FSR Class A

INSTALLATION DESCRIPTION

Building Occupancy: Industrial			
Main Service Switch:	**Volts:** 24900	**Amps:** 125	**Phase:** 3
High Voltage:	**Low Energy:**	**Hazardous Area:**	**Patient Care:**

Scope of Work: Installation of Stand By Generator

The Permit holder is permitted to install electrical equipment at this site of installation within the listed scope of work above, subject to listed Terms & Conditions.

TERMS & CONDITIONS

The following Terms & Conditions are attached to this Installation Permit:

1. The Field Safety Representative named on the permit must physically examine the work described, including any amendments, for regulatory compliance prior to submission of an inspection request.
2. To obtain authorization to cover rough wiring for a Contractor Installation Permit, the Permit holder must request an inspection and submit a declaration of compliance with the Safety Standards Act ("the Act") and regulations at least two full business days prior to cover. This may be done online. Please post a copy of this declaration in a conspicuous manner at the site of installation."

GENERAL REQUIREMENTS & INFORMATION

The Following General Requirements apply to all Installation permits:

1. All electrical work is to be discontinued immediately if the installation permit is suspended, revoked, or otherwise rendered invalid by the BC Safety Authority.
2. Only qualified individuals may perform regulated work as defined by the Act and Regulations.
3. When an Operating Permit is required, the installation owner has 60 days to obtain a valid Operating Permit following a Passed Final Assessment.
4. The BC Safety Authority is to be notified of any incident that results in an injury to any person or damage to the regulated equipment. To report an incident, go to www.safetyauthority.ca (search: "report an incident").
5. Variances must be obtained prior to commencement of installation work. For installations already commenced, all applicable regulated work must be discontinued until the request for variance, where required, has been approved by the BC Safety Authority.
6. Failure to disclose additional work or alterations to the work authorized under this installation permit may result in additional fees and assessments being levied and/or the suspension or revocation of the installation permit.
7. On final completion of the regulated work authorized by a permit, the holder of the permit must immediately complete a Notification of Completion, Installation Repair or Alteration Form online, or mail the completed form and data reports to the BC Safety Authority. Permits will be suspended after a period of 180 days unless an inspection request has been submitted. Contact your Safety Officer if you need an extension, prior to suspension of the permit.
8. When making an inspection request, information on how to access the site must be provided to the Safety Officer performing the inspection and must also indicate how the property is marked at the driveway.
9. Failure to comply with the regulatory inspection requirements may result in an order to the supply authority to disconnect electrical power to the premises.

The Following General Requirements apply to Contractor Installation Permits:

10. To obtain authorization for service connection or upon completion of installation, a request for an inspection and a declaration of compliance with the Act and regulation must be submitted. This may be done online. Please post a copy of this declaration in a conspicuous manner at the site of installation.

The Following General Requirements apply to Homeowner Installation Permits:

11. A homeowner must request an electrical inspection under this permit by submitting an online request or by submitting the "Homeowner Inspection Request" form.
12. After an inspection is requested (prior to covering of wiring or prior to connection of power) work must not proceed until authorized by a Safety Officer.

If you disagree with a term or condition applied to this permit, you may request, in writing, a Safety Manager review within 30 days from the date of issue. A Review Request Form can be obtained from any BC Safety Authority office or online at: www.safetyauthority.ca (search: "manager review").

For information on the Safety Standards Act, Regulations, and the Review/Appeal process, please visit www.safetyauthority.ca.

Permit Number: EL-417208-2016
Inspection Number: ELIN-738481-2017
(When inquiring always refer to these numbers.)

ELECTRICAL CERTIFICATE OF INSPECTION

EL Installation: Work-in-Progress Assessment

ACTIVITY DATE: January 16, 2017

CONTACT INFORMATION:

Western Pacific Enterprises GP
1321 KETCH COURT
COQUITLAM BC V3K 6X7

CONTRACTOR / FSR INFORMATION:

Brian Beddow

SITE ADDRESS:

825 ADMIRALS ROAD
VICTORIA BC V9A 2P1

Inspection Result: **Passed**

Applicable when checked

☐ Do Not Energize
☐ Do Not Cover
☐ Authorized for Connection
☐ Authorized for Cover
☐ Existing Service Connection

Items	Comments	Compliant	Not Compliant
Other	Access not available at the time of inspection. FSR declaration of compliance is accepted for interior portion of installation.	☑	☐

SAFETY OFFICER NOTES

Passed/compliant. Project is ongoing, permit extended 180 days.

GENERAL REQUIREMENTS & INFORMATION

1. All non-compliances must be resolved by the date indicated on this Certificate Of Inspection.
2. The BC Safety Authority is to be notified of any incident that results in an injury to any person or damage to the regulated equipment.
   To report an incident, go to www.safetyauthority.ca (search: "report an incident")
3. When an Operating Permit is required, the installation owner has 60 days to obtain a valid Operating Permit following a Passed Final Assessment

Safety Officer Name:	Neil Banman
Safety Officer Phone:	250-480-9124
Safety Officer Email:	Neil.Banman@safetyauthority.ca

If you disagree with this Certificate of Inspection, you may request, in writing, a Safety Manager review within 30 days from the date of issue. A Review Request Form can be obtained from any BC Safety Authority office or online at: www.safetyauthority.ca (search: "manager review")

For information on the Safety Standards Act, Regulations, and the Review/Appeal process, please visit www.safetyauthority.ca

Permit Number: EL-417208-2016
Inspection Number: ELIN-809650-2017
(When inquiring always refer to these numbers.)

ELECTRICAL CERTIFICATE OF INSPECTION

EL - Installation

ASSESS: EL: Service Connection

Contact Information

Western Pacific Enterprises GP

Contractor / FSR Information

Beddow, Brian H

Activity Date: 9 May, 2017

Site Address

825 Admirals Road
Victoria BC V9A 2P1

Inspection Result: Passed

Applicable when checked with [X]

Do Not Energize	[ ]
Do Not Cover	[ ]
Authorized for Connection	[X]
Authorized for Cover	[ ]
Existing Service Connection	[ ]

Checklist

Item	Comments	Result
Equipment	Thomson Transfer Control	Compliant
Transformers	12,500/25,000 Volt HV Transformers (by others)	Compliant
Generators	3x 750KVA Kohler Generators 600V 3PH	Compliant

Followup Date

All Non-Compliances must be resolved by the followup date unless specified otherwise in Safety Officer Notes.

Safety Officer Notes

Passed/compliant. Approved for connection.

General Requirements and Information

1. All non-compliances must be resolved by the date indicated on this Certificate Of Inspection.
2. The BC Safety Authority is to be notified of any incident that results in an injury to any person or damage to the regulated equipment. To report an incident, go to www.safetyauthority.ca (search: "report an incident")
3. When an Operating Permit is required, the installation owner has 60 days to obtain a valid Operating Permit following a Passed Final Assessment

Safety Officer Name: Neil Banman
Safety Officer Phone: 250-480-9124
Safety Officer Email: Neil.Banman@safetyauthority.ca

If you disagree with a safety officer decision noted on this Certificate of Inspection, you may request, in writing, a Safety Manager review within 30 days from the date of issue. A Review Request Form can be obtained from any BC Safety Authority office or online at: www.safetyauthority.ca (search: "manager review")

For information on the Safety Standards Act, Regulations, and the Review/Appeal process, please visit www.safetyauthority.ca

Permit Number: EL-417208-2016
Inspection Number: ELIN-900760-2017
(When inquiring always refer to these numbers.)

ELECTRICAL CERTIFICATE OF INSPECTION

EL - Installation

ASSESS: EL: Final

Contact Information

Beddow, Brian H

Contractor / FSR Information

Beddow, Brian H

Activity Date: 7 September, 2017

Site Address

825 Admirals Road
Victoria BC V9A 2P1

Inspection Result: Passed

Applicable when checked with [X]

Do Not Energize	[ ]
Do Not Cover	[ ]
Authorized for Connection	[X]
Authorized for Cover	[ ]
Existing Service Connection	[ ]

Checklist

Item	Comments	Result
Generators	3x 750KVA Kohler 3PH Generators to be commissioned September 16th and 17th. As discussed, send commissioning documents once work is complete.	Compliant

Followup Date

All Non-Compliances must be resolved by the followup date unless specified otherwise in Safety Officer Notes.

Safety Officer Notes

Passed/compliant. Complete and final once commissioning documents submitted.

General Requirements and Information

1. All non-compliances must be resolved by the date indicated on this Certificate Of Inspection.

2. The BC Safety Authority is to be notified of any incident that results in an injury to any person or damage to the regulated equipment. To report an incident, go to www.safetyauthority.ca (search: "report an incident")

3. When an Operating Permit is required, the installation owner has 60 days to obtain a valid Operating Permit following a Passed Final Assessment

Safety Officer Name: Neil Banman
Safety Officer Phone: 250-480-9124
Safety Officer Email: Neil.Banman@safetyauthority.ca

If you disagree with a safety officer decision noted on this Certificate of Inspection, you may request, in writing, a Safety Manager review within 30 days from the date of issue. A Review Request Form can be obtained from any BC Safety Authority office or online at: www.safetyauthority.ca (search: "manager review")

For information on the Safety Standards Act, Regulations, and the Review/Appeal process, please visit www.safetyauthority.ca

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

6 – INSTALLED EQUIPMENT REPORTS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Termination & Splicing of Cables

Report No:
Date: 13-Apr-17
No. of Pages:

Client: EGD PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation

Additional Information: Dwg 8423
Reference Document: Spec 26 05 22

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Compare the name plate information with equipment record. Note any deviations under "Remarks"			CH	
2.0	Check for any apparent damage or missing parts including auxiliary parts			CH	
3.0	Establish and Record the Following:				
3.1	Equipment/Circuit Identification			CH	
3.2	Area clean & dry prior to work			CH	
3.3	Lighting is adequate			CH	
3.4	Racking installed & complete			CH	
3.5	Cable cut to proper length using proper cutting methods			CH	
3.6	Cable dry when cut			CH	
4.0	Splicing:				
4.1	Proper splice kits to be installed			CH	
4.2	Cable dry when end cap was removed			CH	
4.3	Use manufacturers directions for splice installation			CH	
4.4	Bonding & Grounding installed to specifications			CH	
4.5	Area left clean & free of debris			CH	

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEERTEMAN
Signature:
Date: APRIL 13TH/2017

Comments

Lee Smith
QA Manager

Format: WPE-CHK-HVC025
Revision: # 1
Date(mm,dd,yy): 10/26/12, 17/01/2015
BB

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Torquing of Bolts

Report No:
Date: 18-Apr-17
No. of pages

Client: EGD - PWGSC
Project No.: C847
Project Name: SSES- Standby Power Generation
Additional information: Dwg 8423
Reference Document: Specification 26 12 13
25KV FEEDER TERM @ 12.5KV BUS

	Items to Inspect	Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Bold length & class installed to specifications	CH			1/2" x 2 1/2" SS BOLTS
2.0	Correct amount of threads extending out of nut	CH			TORQUED @ 80 lbf
3.0	All required washers installed	CH			
4.0	Required marking of nut & bold completed	CH			

Attachments, No. of pages:

Accepted for Western Pacific Enterprises GP	Check sheet Authorized for use by:
Name: CHRIS HEERTOLMAN	
Signature: CH	Lee Smith
Date: APRIL 18TH / 2017	QA Manager

Format: WPE-CHK-HV009	Revision # 0	Date: 12/18/12

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for HV Elbow Terminations

Report No:
Date: 13-Apr-17
No. of Pages:

Client: EGD PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: Dwg 8423
Reference Document: Spec 26 05 22

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Compare the name plate information with equipment record. Note any deviations under "Remarks"			CH	
2.0	Check for any apparent damage or missing parts including auxiliary parts			CH	
3.0	Establish and Record the Following:				
3.1	Equipment/Circuit Identification	APR 13		CH	
3.2	Work space clean & dry prior to work	APR13		CH	
3.3	Lighting is adequate	APR13		CH	
3.4	Racking installed & complete	APR13		CH	
3.5	Cable cut to proper length using proper cutting methods	APR13		CH	
3.6	Cable dry when cut	APR13		CH	
4.0	Installation Check:				
4.1	Jacket removed to specification	APR17		CH	
4.2	Conductor cut to spec. length	APR13		CH	
4.3	Sem-con stripped to length	APR13		CH	
4.4	Insulation cut to length	APR13		CH	
4.5	Insulation bevelled & cleaned	APR13		CH	
4.6	Compression cap installed	APR13		CH	ELASTIMOLD KIT LUG NOT OF CORRECT LENGTH AS PER THEIR SPECS / MEASUREMENTS CONDUCTOR TO BE TRIMMED DOWN 3/8"
4.7	Housing & heat shrink installed	APR13		CH	
5.0	Post-Termination:				
5.1	Manufacturers directions were used when installing kits	APR13		CH	
5.2	Bonding & grounding installed to specifications			CH	

Accepted for Western Pacific Enterprises GP

Name: Chris HERSTELMAN
Signature:
Date: APRIL 13th/17

Comments

Lee Smith
QA Manager

Format: WPE-CHK-HVC040
Revision: # 0
Date(mm,dd,yy): 08/10/16
LS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8424 SES Bldg
Reference Document: 26 05 33

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				1000KW 600Volt Load Bank
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			
6.0	Check breaker for clearances	N/A			BREAKER AT 6SES-0
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	CH			
11.0	Check all wires and cables terminated into terminal blocks are labelled	CH			
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: Chris Heesterman
Signature:
Date: April 18th/2017

Check sheet authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Transformer Installation

Report No:

Date: 06-Apr-17

No. of pages

Client: PWGSC EGD

Project No.: C847

Project Name: EGD - SSES Stand-by Power Generation

Additional Information: 3/4MVA Step Up Transformer

Reference Document:

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Ensure factory testing has been completed	CH			
2.0	Inspect transformer upon receiving; Inspect for damage or missing parts	CH			
3.0	Remove all shipping blocks and supports	CH			
4.0	Install as per project specifications and drawings	CH			
5.0	Ensure installation is as per seismic engineered drawings	CH			ENGINEERED DWG'S ATTACHED
6.0	Torque all connections as per manufacturers specifications	CH			
7.0	Perform and record all tests as applicable; Form 16030-T	CH			
8.0	Submit independent test results to electrical engineer for review	CH			

Accepted for Western Pacific Enterprises GP

Name: Chris Hoesterman

Signature:

Date: APRIL 18TH / 2017

Check sheet authorized for use by:

Lee Smith

QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Oil Filled Transformer Installation

Report No:

Date: 06-Apr-17

No. of pages

Client: PWGSC EGD

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: 3/4MVA 25/12.5KV Step Up

Reference Document: Spec 26 12 13 DWG 8423

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Check complete assembly for damage and missing parts. Temporary shipping blocks and protective crating removed	CH			
2.0	Check lubrication & freedom of motion of tap changers & other operating accessories	CH			
3.0	Record transformer tap settings	CH			winding 12.47 tap C
4.0	Check oil level gauge & inspect for oil leak	CH			
5.0	Alarm & control circuits connected & checked	CH			Factory Programmed Qualitrol 505ITM-100
6.0	Make sure temperature gauge indicates proper temperature	CH			
7.0	Primary/secondary cable properly supported, connected & insulated	CH			
8.0	Check transformer name plate and components against purchase specifications	CH			
9.0	Check conductor size insulation class & type	CH			
10.0	Check conductor phasing & identification	CH			
11.0	Measure insulation resistance of windings	CH			5 GΩ
12.0	Case grounding & grounding resistor correctly installed & connected to main ground system per drawings	CH			
13.0	Check correct operation of cooling fans	CH			
14.0	Check all connections are tight & secure	CH			
15.0	Paint scratches refinished				
16.0	Check there is continuity on all windings	CH			
17.0	Measure secondary voltage with tap changer in each position & verify per name plate				

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEESTERMAN

Signature: CH

Date: APRIL 6TH/17

Check sheet authorized for use by:

Lee Smith

QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 06-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD SSES Standby Power Generation
Additional Information: 3/4 MVA 25/12.5KV Step up
Reference Document: Spec 26 13 13 DWG 8423

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Qualitrol 505ITM-100
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	GW			factory installed
3.0	Remove shipping supports	N/A			
4.0	Torque bolted joints as per manufacturer's instructions	N/A			
5.0	Check for proper grounding at both ends of assembly	N/A			
6.0	Check breaker for clearances	N/A			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	GW			
8.0	Terminals and connections tight and secure. Torque bolted connections.	GW			
9.0	Check Equipment is Grounded	GW			
10.0	Check all spare conductors are tagged and grounded	GW			
11.0	Check all wires and cables terminated into terminal blocks are labelled	GW			
12.0	Verify termination points as per drawings				See DWG 8412

Accepted for Western Pacific Enterprises GP

Name: GORD WEBSTER
Signature:
Date: APRIL 19, 2017

Check sheet authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

CORRECTIVE ACTION REPORT

Project Name: EGD SES Standby Power Generation **Contract #:** R.057890.03 **WPE Job #:** C847

1. WPE/Subcontractor:

2. CAR No. : 001

3. Application Document (*e.g. ISO 9001*) WPE-QAF-025 & WPE-QAF-045

4. Reason for Corrective Action (*e.g. Drawings not controlled or registered*):

Inadequate exterior coating applied to Radiator cooling fins

Name: Gord Webster **Signature:** **Date: March 28, 2017**

Date CAR to be returned: As Soon As Possible, Scheduling to be confirmed .

5. Action Taken: Field cleaning, application of epoxy primer, application of additional exterior coating.

a. Immediate (*e.g. Drawings controlled by Register*):

None

b. Details of Root Cause *(e.g. Inadequate supervision during unloading operation)*

Inadequate factory coating applied

c. Action taken to prevent recurrence: Rusting of transformer Cooling fin exterior surfaces

1. Radiator cooling fins will be manually sanded to remove surface rust between radiator fins
2. This will be followed by cleaning the area with de-natured alcohol.
3. A two part epoxy primer will be applied to the cooling fin surfaces using paint rollers
4. After adequate drying time a top coat of 2 part epoxy ANSI 70 Grey paint will be applied to the primed surfaces.

Photos taken

Name: EDUARDO GARCIA **Signature:** **Date:** JULY 5, 2017

6. Verification (e.g. Sighted Register with correct drawing status): Rust surfaces have been prepped by sanding and cleaning with alcohol, epoxy primer coating applied, top coating of epoxy grey applied

Name: Gord Webster **Signature:** **Date:** JULY 5, 2017

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

CORRECTIVE ACTION REPORT

Project Name: EGD SES Standby Power Generation **Contract #:** R.057890.03 **WPE Job #:** C847

7. Closing (to be signed by the Quality Representative):

Upon signature WPE considers this issue closed.

Name: GORD WEBSTER

Signature:

Date: JULY 5, 2017

W P
WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Non-Conformance Report (NCR)

Project: EGD SES Standby Power Generation **Contract #:** R.057890.003 **WPE Job #:** C847

1.WPE/Subcontractor:	**2. NCR Report Serial No: 001**

3. Description & Location of Noncompliance *(E. g. Concrete panels damaged during unloading):*
3 MVA Transformer evidence of rusting on transformer radiator fins

3a. Document Ref. No. :

Name of Originator: Gord Webster	**Date: March 28, 2017**	**Response Required by: Supplier MAC's II**

4. Disposition *(Tick one box)*: **Use as-is/Concession** ☆ **Rework** ☐ **Scrap** ☐

a. Details of Action *(E.g. Concrete repair to approved procedure):*
None required at this time

b. Details of Root Cause *(E.g. Inadequate supervision during unloading operation)*:
Inadequate Surface Coating on Radiator Fins

c. Corrective Action taken to prevent recurrence *(E.g. Foreman to supervise unloading): Supplier notified*

Name: Gord Webster	**Signature:**	**Date:** March 28, 2017

5. Client/Design Representative Acceptance: **Yes** ☐ **No** ☐

Name:	**Signature:**	**Date:**

6. Re-Inspection/Verification: **Compliant** ☐

Name:	**Signature:**	**Date:**

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

FIELD OBSERVATION REPORT

Project: EGD SES Standby Power Generation **Contract #:** R.057890.003 **WPE Job #:** C847

1. WPE/Subcontractor:	**2. FOR No. : 001**

3. Reference Document (*e.g. drawing, etc.*)

DWG 8423 Spec 26 12 13

4. Description of Field Observation: (*e.g. Inadequate training/education*):

Indication of rusting on transformer radiators

Name: Gord Webster	**Signature:**	**Date: March 28, 2017**

Date FOR observed : March 28, 2017

5. Action Taken:

a. Immediate (*e.g. Stop work/*): No immediate threat to workers or environment, Notified supplier for remedial solution

b. Details of Root Cause *(e.g. Inadequate supervision during unloading operation)*

Inadequate coating applied to exterior surfaces of radiator fins

c. Action taken to prevent recurrence (*e.g. Staff briefed on requirement*):

Supplier notified for field remedial action.

Name: GORD WEBSTER	**Signature:**	**Date:** MARCH 28, 2017

6. Verification (e.g. correct location and drawings, correct drawing status – PWGSC to confirm): Remedial coating application completed at transformer radiator cooling fins.

Name:	**Signature:**	**Date:**

7. Closing (to be signed by the Customers Quality Representative): Field corrective action and remedial coating application completed.

Upon signature WPE considers this issue closed.

Name:	**Signature:**	**Date:**

Project: EGD SES Standby Power Generation **Contract #:** R.057890.003 **WPE Job #:** C847

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation

Additional Information: DWG 8423 SES Bldg
Reference Document: N/A

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Panel 6SES-SP-0
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			GROUNDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	N/A			NO SPARES
11.0	Check all wires and cables terminated into terminal blocks are labelled	CH-			TERMINAL BLOCKS AT TOP OF PANEL
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEESTEMAN
Signature: CH
Date: APRIL 18TH/17

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E014 Revision: # 2 Date(mm,dd,yy): 10/26/12, 01/20/14, 21/02/2014 LS, BB

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Installation of Circuit Breakers

Report No:

Date: 19-Apr-17

No. of Pages:

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: Panel 6SES- SP-0

Reference Document: Spec 26 28 21 DWG 8410

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	General				
1.1	Compare name plate data with drawing and specifications	CH			
1.2	Inspect physical & mechanical condition	CH			
1.3	Check proper breaker installation, clearance distances	CH			
1.4	Check all connections of current path with a torque wrench	CH			
1.5	Check grounding of frame and cabinet	CH			
1.6	Check all control cables are correctly installed & connected	N/A			
1.7	Verify equipment ID number is correct and is installed	CH			
1.8	Verify phasing labels are correct and is installed	CH			
1.9	Remove any packing/shipping materials (from interior & exterior)	CH			
2.0	Insulators	N/A			
2.1	Check insulators condition: free of cracks, no chips or burns	N/A			
2.2	Clean insulators in accordance with manufacturers instructions	N/A			

Accepted for Western Pacific Enterprises GP

Name: Chris Hoesterman

Signature: CH

Date: April 19th/17

Check sheet authorized for use by:

Lee Smith

QA Manager

Format: WPE-CHK-E018 Revision: # 1 Date(mm, dd, yy): 10/26/12, 01/20/14 LS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8425 SES Bldg
Reference Document: N/A

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Panel 6SES-SP-2 ✓
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			GROUNDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	N/A			NO SPARES
11.0	Check all wires and cables terminated into terminal blocks are labelled	N/A			NO TB's
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: Chris HOESTOLMAN
Signature:
Date: APRIL 18TH/17

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E014 | Revision: # 2 | Date(mm,dd,yy): 10/26/12, 01/20/14, 21/02/2014 | LS, BB

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Installation of Circuit Breakers

Report No:

Date: 19-Apr-17

No. of Pages:

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: Panel 6SES- SP-2

Reference Document: Spec 26 28 21 DWG 8411

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	General				
1.1	Compare name plate data with drawing and specifications	CH			
1.2	Inspect physical & mechanical condition	CH			
1.3	Check proper breaker installation, clearance distances	CH			
1.4	Check all connections of current path with a torque wrench	CH			
1.5	Check grounding of frame and cabinet	CH			
1.6	Check all control cables are correctly installed & connected	N/A			
1.7	Verify equipment ID number is correct and is installed	CH			
1.8	Verify phasing labels are correct and is installed	CH			
1.9	Remove any packing/shipping materials (from interior & exterior)	CH			
2.0	Insulators	N/A			
2.1	Check insulators condition: free of cracks, no chips or burns	N/A			
2.2	Clean insulators in accordance with manufacturers instructions	N/A			

Accepted for Western Pacific Enterprises GP

Name: Chris Heertenman

Signature: CH

Date: April 19th/17

Check sheet authorized for use by:

Lee Smith

QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:

Date: 17-Apr-17

No. of Pages:

Client: PWGSC

Project No.: C847

Project Name: EGD - SSES Standby Power Generation

Additional Information: DWG 8425 SES Bldg

Reference Document: N/A

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Panel 2SES-SP-2
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			GROUNDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	N/A			NO SPARES → SPARE BREAKERS TAGGED
11.0	Check all wires and cables terminated into terminal blocks are labelled	N/A			NO TB's
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEESTERMAN

Signature: CH

Date: APRIL 18TH/17

Check sheet authorized for use by:

Lee Smith

QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Installation of Circuit Breakers

Report No:

Date: 19-Apr-17

No. of Pages:

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: Panel 2SES- SP-2

Reference Document: Spec 26 28 21 DWG 8425

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	General				
1.1	Compare name plate data with drawing and specifications	CH			
1.2	Inspect physical & mechanical condition	CH			
1.3	Check proper breaker installation, clearance distances	CH			
1.4	Check all connections of current path with a torque wrench	CH			
1.5	Check grounding of frame and cabinet	CH			
1.6	Check all control cables are correctly installed & connected	N/A			
1.7	Verify equipment ID number is correct and is installed	CH			
1.8	Verify phasing labels are correct and is installed	CH			
1.9	Remove any packing/shipping materials (from interior & exterior)	CH			
2.0	Insulators	N/A			
2.1	Check insulators condition: free of cracks, no chips or burns	N/A			
2.2	Clean insulators in accordance with manufacturers instructions	N/A			

Accepted for Western Pacific Enterprises GP	Check sheet authorized for use by:
Name: Chris Heesterman	
Signature: CH	Lee Smith
Date: APRIL 19TH/17	QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8430 Operations Bldg
Reference Document: N/A

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Panel 6C
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	N/A			GROUNDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	N/A			NO SPARES
11.0	Check all wires and cables terminated into terminal blocks are labelled	N/A			NO TB's
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP	Check sheet authorized for use by:
Name: Chris Heesterman	
Signature: CH	Lee Smith
Date: April 18th/2017	QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Installation of Circuit Breakers

Report No:

Date: 19-Apr-17

No. of Pages:

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: Panel 6C Operations Bldg

Reference Document: Spec 26 28 21 DWG 8430

Items to Inspect		Western Pacific Enterprises GP			**Remarks:**
		inspected initials/date	hold point	inspected* initials/date	
1.0	General				
1.1	Compare name plate data with drawing and specifications	CH			
1.2	Inspect physical & mechanical condition	CH			
1.3	Check proper breaker installation, clearance distances	CH			
1.4	Check all connections of current path with a torque wrench	CH			
1.5	Check grounding of frame and cabinet	CH			
1.6	Check all control cables are correctly installed & connected	N/A			
1.7	Verify equipment ID number is correct and is installed	CH			
1.8	Verify phasing labels are correct and is installed	CH			
1.9	Remove any packing/shipping materials (from interior & exterior)	CH			
2.0	Insulators	N/A			
2.1	Check insulators condition: free of cracks, no chips or burns	N/A			
2.2	Clean insulators in accordance with manufacturers instructions	N/A			

Accepted for Western Pacific Enterprises GP	Check sheet authorized for use by:
Name: CHRIS HEESTERMAN	
Signature:	Lee Smith
Date: APRIL 19TH/17	QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8430 Operations Bldg
Reference Document: N/A

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Main Breaker - Panel 6C
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	N/A			GROUNDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEET
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	N/A			NO SPARES
11.0	Check all wires and cables terminated into terminal blocks are labelled	N/A			NO TB's
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HOSTERMAN
Signature: CH
Date: APRIL 19TH / 2017

Check sheet authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation

Additional Information: DWG 8430 Operations Building
Reference Document: Specification 26 36 23.01

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Panel 6C Manual transfer switch
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			
6.0	Check breaker for clearances	N/A			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	N/A			
11.0	Check all wires and cables terminated into terminal blocks are labelled	N/A			MANUAL TRANSFER
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: Chris Heertelman
Signature: CH
Date: April 17th/17

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E014 Revision: # 2 Date(mm,dd,yy): 10/26/12, 01/20/14, 21/02/2014 LS, BB

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8430 Operations Building
Reference Document: Specification 26 36 23.02

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Panel 6C Temp Power Connection Box
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	N/A			
11.0	Check all wires and cables terminated into terminal blocks are labelled	CH			
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEESTERMAN
Signature:
Date: APRIL 17TH/17

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E014 Revision: # 2 Date(mm,dd,yy): 10/26/12, 01/20/14, 21/02/2014 LS, BB

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:

Date: 17-Apr-17

No. of Pages:

Client: PWGSC

Project No.: C847

Project Name: EGD - SSES Standby Power Generation

Additional Information: DWG 8426

Reference Document: 26 32 10

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				750KW Generator No. 1
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			ASSEMBLY BONDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	CH			
11.0	Check all wires and cables terminated into terminal blocks are labelled	CH			
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEETTERMAN

Signature:

Date: APRIL 18TH/17

Check sheet authorized for use by:

Lee Smith

QA Manager

Format: WPE-CHK-E014 Revision: # 2 Date(mm,dd,yy): 10/26/12, 01/20/14, 21/02/2014 LS, BB

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Battery Operated Emergency Lighting Checklist

Report No:
Date: 10-Apr-17
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGS-SSES Standby Power Generation
Additional Information: Generator 1
Reference Document: Spec 26 32 10

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Install in locations as per project specifications & drawings	CH			See Supplier Shop Drawings
2.0	Ensure beams are not obstructed by other equipment or walls	CH			
3.0	Test battery operations with simulations of outage via test button	CH			
4.0	Test battery operation by removing power supply via receptacle: 30 minute batter run test performed	CH			
5.0	Perform actual test by de-energizing area lighting circuits	CH			

Accepted for Western Pacific Enterprises GP

Name: CHris HEESTERMAN
Signature: CH
Date: APRIL 10TH/17

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-IC047 Revision: # 3 (mm/dd/yy) Date: 03/26/2013, 05/16/14, 02/15/2016

LS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation

Additional Information: DWG 8426
Reference Document: 26 32 10

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				750KW Generator No. 2
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	RH			ASSEMBLY BONDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	CH			
11.0	Check all wires and cables terminated into terminal blocks are labelled	CH			
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HERZTELMAN
Signature:
Date: APRIL 18TH/2017

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E014 Revision: # 2 Date(mm,dd,yy): 10/26/12, 01/20/14, 21/02/2014 LS, BB

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Battery Operated Emergency Lighting Checklist

Report No:

Date: 10-Apr-17

No. of pages

Client: PWGSC

Project No.: C847

Project Name: EGS-SSES Standby Power Generation

Additional Information: Generator 2

Reference Document: Spec 26 32 10

Items to Inspect		Western Pacific Enterprises GP			**Remarks:**
		inspected initials/date	hold point	inspected* initials/date	
1.0	Install in locations as per project specifications & drawings	CH			See Supplier Shop Drawings
2.0	Ensure beams are not obstructed by other equipment or walls	CH			
3.0	Test battery operations with simulations of outage via test button	CH			
4.0	Test battery operation by removing power supply via receptacle: 30 minute batter run test performed	CH			
5.0	Perform actual test by de-energizing area lighting circuits	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEESTERMAN

Signature:

Date: APRIL 10th/17

Check sheet authorized for use by:

Lee Smith

QA Manager

Format: WPE-CHK-IC047 Revision: # 3 (mm/dd/yy) Date: 03/26/2013, 05/16/14, 02/15/2016

LS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8426
Reference Document: 26 32 10

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				750KW Generator No. 3
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			ASSEMBLY BONDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	CH			
11.0	Check all wires and cables terminated into terminal blocks are labelled	CH			
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: Chris Heesterman
Signature: CH
Date: APRIL 18TH/2017

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E014 Revision: # 2 Date(mm,dd,yy): 10/26/12, 01/20/14, 21/02/2014 LS, BB

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Battery Operated Emergency Lighting Checklist

Report No:
Date: 10-Apr-17
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGS-SSES Standby Power Generation
Additional Information: Generator 3
Reference Document: Spec 26 32 10

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Install in locations as per project specifications & drawings	CH			See Supplier Shop Drawings
2.0	Ensure beams are not obstructed by other equipment or walls	CH			
3.0	Test battery operations with simulations of outage via test button	CH			
4.0	Test battery operation by removing power supply via receptacle: 30 minute batter run test performed	CH			
5.0	Perform actual test by de-energizing area lighting circuits	CH			

Accepted for Western Pacific Enterprises GP

Name: CHRIS HOERTEMAN
Signature: CH
Date: APRIL 10TH/2017

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-IC047 Revision: # 3 (mm/dd/yy) Date: 03/26/2013, 05/16/14, 02/15/2016 LS

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 14-Jun-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation

Additional Information: DWG 8427
Reference Document: Spec 26 32 10.01

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation	GW		GW	Towable Generator
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	GW		GW	Good
3.0	Remove shipping supports	GW		GW	N/A
4.0	Torque bolted joints as per manufacturer's instructions	/			N/A
5.0	Check for proper grounding at both ends of assembly	/			N/A
6.0	Check breaker for clearances	/			N/A
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	/			N/A
8.0	Terminals and connections tight and secure. Torque bolted connections.	GW		GW	25ft lbs
9.0	Check Equipment is Grounded	GW.		GW	ground cable connected
10.0	Check all spare conductors are tagged and grounded	/			none
11.0	Check all wires and cables terminated into terminal blocks are labelled	/			none
12.0	Verify termination points as per drawings	GW		GW	good
				GW	DLO CABLE BOX INSTALLED
				GW	DOCUMENT BOX INSTALLED

Accepted for Western Pacific Enterprises GP

Name: Gord Webster
Signature:
Date: 14-Jun-17

Check sheet authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Electrical Equipment Installation

Report No:
Date: 17-Apr-17
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8425
Reference Document: 26 29 23.02

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment Designation				Generator Power and Control Board
2.0	Inspect entire assembly including auxiliary part for apparent damage or missing parts	CH			
3.0	Remove shipping supports	CH			
4.0	Torque bolted joints as per manufacturer's instructions	CH			
5.0	Check for proper grounding at both ends of assembly	CH			BONDED AT CONDUIT ENTRY
6.0	Check breaker for clearances	CH			
7.0	All P&C and power cables connected and tested (megger & continuity test prior to terminating)	CH			SEE MEGGER SHEETS
8.0	Terminals and connections tight and secure. Torque bolted connections.	CH			
9.0	Check Equipment is Grounded	CH			
10.0	Check all spare conductors are tagged and grounded	CH			
11.0	Check all wires and cables terminated into terminal blocks are labelled	CH			
12.0	Verify termination points as per drawings	CH			

Accepted for Western Pacific Enterprises GP

Name: Chris HEESTERMAN
Signature: CH
Date: APRIL 18/2017

Check sheet authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Communication Cables

Report No:

Date: 20-Apr-17

No. of pages

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: TCS to SCADA

Reference Document: Spec 27 05 14

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Check cables for damage, proper terminations, neatness of installation & labelling completed	CH			
2.0	Check communication cables color code and labeling; refer to electrical specification HL	CH			
3.0	Check bonding of equipment	N/A			
4.0	Test cabling to the Techinical Specifications for Structured Wiring design and installation. Base Information Services System Engineering Group. Test levels confirmed to meet CAN/CSA-T529-M91 Standards	CH			
5.0	Confirm name plate information provided for outlets	CH			
6.0	Provide hard copy and digital copy of all test results. Insert in O & M Manuals	CH			

Accepted for Western Pacific Enterprises GP	Check sheet is authorized for use by:
Name: CHRIS HEESTERMAN Signature: CH Date: APRIL 20TH/17	Lee Smith QA Manager

7 – TRAINING ATTENDANCE

7.1 Standby Generator and Tier 4 Emissions – April 21, 2017
7.2 Towable Generator – June 14, 2017
7.3 SCADA SYSTEM (PSS) – May 18, 2017
7.4 SES Electrical, TCS, Loadbank - May 19, 2017

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Date: 21-Apr-17

Time: 8:00AM

Meeting; Teir 4 Emissions and Generator Training

Name	Company	Signature
Gurib Warthmann	Frontier Power	
GIVENS WEBSTER	WPE	
Rajesh Parmar	DEL International	
Andy Collins	AeriNOx	Andy Colli
David Golia	EGD	
JOE LEZETC	E.G.D.	
JORDIE GOLDSMITH	EGD ELEC. DEPT	
Charles Whitehouse Parker	EGD Pumphouse	CJ W Parker
ANDREW PETERSEN	MECH SHOP/PUMPHOUSE	
CRAIG DYSON	EGD PUMPHOUSE	Craig Dyson
GIORDANO BRUNO	EGD PUMPHOUSE	G. Bruno
MIKE LEPSON	EGD ELECTRICAL	
Jesse Curtis	EGD Electrical	

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Date: 21-Apr-17

Time: 1 PM. ~~8:00AM~~

Meeting; Teir 4 Emissions and Generator Training

Name	Company	Signature
Guido Varthmann	Frontier Powe	
Brian Blagdon	Frontier Power	
Preston Li	Frontier Power	
Rajesh D. Parmar	DCL InternationalIn	
Andy Collins	AeriNOx	Andy Colli
Dave Golia	EGD	
Charles Whitehouse-Parker	EGD Pumphouse	
ANDREW PETERSEN	MECH SHOP/PUMPHOUSE	
JOE LEZETC	EGD	Joe
CRAIG DYSON	EGD PUMPHOUSE	
GIORDANO BRUNO	EGD PUMPHOUSE	G. Bruno
MIKE LEDSON	EGD ELECTRICAL	
Jesse Curtis	EGD Electrical	

Meeting Attendance Sign in Sheet

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Date: 14-Jun-17

Time: 10:30AM

Meeting; Towable Generator

Name	Company	Signature
Jordie Goldsmith	PWGSC	
Mark Cammiade	PWGSC	M Cammiade
MIKE LEDSON	PWGSC	
Jesse Curtis	PWGSC	
ANDREW PETERSEN	PWGSC	
CRAIG DYSON	PWGSC	Craig Dyson

Meeting Attendance Sign in Sheet

Training Attendance Sheet

Project: Esquimalt Graving Dock: Standby Generation SCADA Integration and Priority Load Control

Job #: Q2C 39022265

Training Session: Standby Generation SCADA over view for Operators / Electricians Session 1

Attendee list

Full Name	Email	Company / Job Title	Signature
CRAIG DYSON		EGD ASSISTANT PUMPHOUSE	Craig Dyson
Charles-Whitehouse-Parker		EGD Pumphouse Assistant	C W Parker
ANDREW PETERSEN		MECHANIC	
TIM AIKIN		EGD	

Schneider Electric

Revision Date: 05/2017

Training Attendance Sheet

Project: Esquimalt Graving Dock: Standby Generation SCADA Integration and Priority Load Control

Job #: Q2C 39022265

Training Session: Standby Generation SCADA over view for Operators / Electricians Session 2

Attendee list

Full Name	Email	Company / Job Title	Signature
David Golia		EGD	
TONY PIASTA		EGD	
JIM REID		EGD	
GIORDANO BRUNO		EGD	G. Bruno

Branch office:

Schneider Electric Canada Inc.
2195 Keating Cross Road
Saanichton, BC
Canada V8M 2A5
Tel: 1250 652 7100

Schneider Electric

Training Attendance Sheet

Project: Esquimalt Graving Dock: Standby Generation SCADA Integration and Priority Load Control

Job #: Q2C 39022265

Training Session: Standby Generation SCADA over view for Operators / Electricians Session 3

Attendee list

Full Name	Email	Company / Job Title	Signature
Mark Cammiade	Mark.cammiade@pwgsc.gc.ca	PWGSC	M. Cammiade
JORDIE GOLDSMITH	Jordan.goldsmith@PWGSC.GC.CA	PWGSC/ELEC	
Jesse Curtis	jesse.curtis@pwgsc.gc.ca	Pwgsc/Elec	
MIKE LEDSON	MIKE.LEDSON@PWGSC.GC.CA	PWGSC/ELECT	
JOE LEZETC	Joe.Lezetc@pwgse.gc.ca	EGD op's Mgr.	Joe [illegible]

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Date: 19-May-17

Time: 9:30AM to 12:00AM

Meeting; Electrical and Generator Switch Board (TCS) - Training

Name	Company	Signature
JORDIE GOLDSMITH	PWGSC ELEC DEPT	
Jesse Curtis	PWGSC Elec Dept	
MIKE LEDSON	PWGSC ELEC DEPT	
JOE LEZETC	EGD	Joe
Mark Cammiade	PWGSC EGD	M Cammiade
Marco Nordio	Thomson Power Systems	
David Engleman	Thomson Power Systems	Dave

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

8 – TEST REPORTS

8.1 POWER WIRING MEGGER REPORTS

8.2 P&C WIRING MEGGER REPORTS

8.3 MEDIUM VOLTAGE TRANSFORMER TEST REPORT

8.4 LOAD BANK TEST REPORT

8.5 GENERATOR SWITCH BOARD TEST REPORT

8.6 STANDBY GENERATOR TEST REPORTS

8.7 TEIR 4 EMISSIONS TEST REPORT

8.8 TOWABLE STANDBY GENERATOR COMMISSIONING REPORT

8.9 PSS AND TCS TESTING AND DEMONSTRATION REPORTS

8.10 MANUAL TRANSFER SWITCH COMMISSIONING REPORT

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No: 01
Date: Jan 31, 2017
No. of pages 1

Client: PWGSC
Project No.: ESQUIMALT GENERATORS
Project Name:
Equipment number
Test Instrument used MTP 4010 INSULATION TESTER

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
OPS. BLDG.	N/A	A PHASE	#2/0	CONN. BOX	TRANS. SW.	2000	
PB 6C		B PHASE	#2/0	"	"	2000	
		C PHASE	#2/0	"	"	2000	
		IDENTIFIED	#2/0	"	"	2000	

Western Pacific Enterprises GP
Name: Adam Lange
Signature: Adam Lange
Date: Jan. 31, 2017

Check Sheet Authorized for use by:
Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No: 002
Date: MARCH 24/17
No. of pages

Client: PNGSC
Project No.: C847
Project Name: ESQ. GENERATORS

Equipment number
Test Instrument used MEGGER

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
	1	RED	400kcmil	TX	6SES-0	1	
		BLACK	↓	↓	↓	1	
		BLUE				1	
	2	RED				1	
		BLACK				1	
		BLUE				1	
	3	RED				1	
		BLACK				1	
		BLUE				1	
	4	RED				1	
		BLACK				1	
		BLUE				1	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: CHRIS HEERSTELMAN Signature: Date: MARCH 31ST/17	Lee Smith QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No: 003
Date: March 27/17
No. of pages

Client: PWGSC
Project No.: C847
Project Name: Esq. Generators

Equipment number: 150305695
Test instrument used: MEGGER

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
			400kcmil	Gen	XFMR		@1000V
Gen 1	A	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	B	Red				>2000MΩ	✓ out of order on bus - where G3B Red should be
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	C	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	D	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
Gen 2	A	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	B	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	C	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	D	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: CHRIS HOESTERMAN	Lee Smith
Signature:	QA Manager
Date: MARCH 31ST/17	

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No: 004
Date: MARCH 29/17.
No. of pages

Client: PWSGC
Project No.: C847
Project Name:

Equipment number 150305695
Test Instrument used MEGGER

TO Panel No. Circuit No. Feeder No.	FROM ~~Wire Tagging~~	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
6SE3-0	6SE1-1	RED	400Kcmil			>2000MΩ	@1000V
		BLK				>2000MΩ	
		BLUE				>2000MΩ	
GEN 1	2SES-1	RED	#6			>200 MΩ	@500V
		BLK				>200 MΩ	
		BLU				>200 MΩ	
		WHT				>200 MΩ	
GEN 2	2SE3-1	RED				>200MΩ	@500V
		BLK				>200 MΩ	
		BLU				>200 MΩ	
		WHITE				>200 MΩ	
GEN 3	2SE3-1	RED				>200 MΩ	@500V
		BLK				>200 MΩ	
		BLUE				>200MΩ	
		WHT				>200 MΩ	
2SE2-11	EXISTING 2SE3	RED	#4			>2000MΩ	@1000V
		BLACK				>2000MΩ	
		BLUE				>2000 MΩ	
		WHITE				>2000MΩ	
TX CONTROL	2SE3-1	RED	#12			>200MΩ	@500V
		BLACK				>200MΩ	
		WHITE (Blue)				>200MΩ	

Western Pacific Enterprises GP

Name: Chris Hoestenman
Signature:
Date: MARCH 31st/17

Check Sheet Authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No: 005
Date: March 27/17
No. of pages:

Client: PWGSC
Project No.: C847
Project Name: Esq. Generators
Equipment number: 150305695
Test Instrument used: MEGGER

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable No.	Wire or Cable Size	Wire or Cable From	Wire or Cable To	Megohms GREATER THAN	Remarks
			400kcmil	Gen	XFMR		@1000V
Gen 3	A	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	B	Red				>2000MΩ	✓ out of order on XFMR Bus - Where 2B Red should be
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
	C	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				412MΩ	✓ raining
	D	Red				>2000MΩ	✓
		Black				>2000MΩ	✓
		Blue				>2000MΩ	✓
LOADBANK							
CONDUIT							
#							@1000V
1	RED					<2000MΩ	
	BLACK					<2000MΩ	
	BLUE					<2000MΩ	
2	RED					<2000MΩ	
	BLACK					<2000MΩ	
	BLUE					<200MΩ	
3	RED					<2000MΩ	
	BLACK					<2000MΩ	
	BLUE					<200MΩ	
4	RED					<2000MΩ	
	BLACK					<2000MΩ	
	BLUE					<2000MΩ	

Western Pacific Enterprises GP

Name: Chris Heesterman
Signature:
Date: March 31st/17

Check Sheet Authorized for use by:
Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Hi-Pot Test

Report No:

Date: 13-Apr-17

No. of pages

Client: EGD PWGSC

Project No.: C847

Project Name: EGD - SSES Standby Power Generation

Additional Information: Dwg 8410

Reference Document: Spec 26 05 14

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Test equipment calibration is up to date	APR 13		CH	DUE SEPTEMBER 2017
2.0	Cable terminations are complete	APR 13		CH	
3.0	Set up barriers around test areas to protect workers	APR 13		CH	
4.0	5 kV DC applied for 2 minute(s) to cable's aluminum sheath & grounded cable jacket	APR 13		CH	5 kV 2 minutes
5.0	Cable test results:			CH	Results: [✓ PASS] FAIL
6.0	Temperature:			CH	10 C°
7.0	Humidity:			CH	71 %
8.0	After testing, cable grounded to ground of manhole for approximately 1 minute	N/A		CH	HIPOT SELF DRAINS
9.0	Reconnect terminations to equipment & torque bolts			CH	

Accepted for Western Pacific Enterprises GP

Name: CHRIS HEESTERMAN

Signature:

Date: APRIL 13TH/17

Check sheet authorized for use by:

Lee Smith

QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#14	24VDC Control	1	14	Sec 1	Gen 1	>1MΩ	@300V
		2	14	↓	↓	>1MΩ	
		3	14	↓	↓	>1MΩ	
		4	14	↓	↓	>1MΩ	
		5	14	↓	↓	>1MΩ	
		6	14	↓	↓	>1MΩ	
		7	14	↓	↓	>1MΩ	
		8	14	↓	↓	>1MΩ	
		9	14	↓	↓	>1MΩ	
		10	14	↓	↓	>1MΩ	
		11	14	↓	↓	>1MΩ	
		12	14	↓	↓	>1MΩ	
		13	14	↓	↓	>1MΩ	
		14	14	↓	↓	>1MΩ	
		15	14	↓	↓	>1MΩ	
		16	14	↓	↓	>1MΩ	
		17	14	↓	↓	>1MΩ	
		18	14	↓	↓	>1MΩ	
		19	14	↓	↓	>1MΩ	
		20	14	↓	↓	>1MΩ	
		21	14	↓	↓	>1MΩ	
		22	14	↓	↓	>1MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: CHRIS HEESTERMAN Signature: Date: APRIL 5TH/17	Lee Smith QA Manager

Format: WPE-CHK-E009 Revision: # 3 (mm/dd/yyyy) Date: 10/26/12, 07/01/2014,09/25/14 LS, BB

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:

Date:

No. of pages

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695

Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
6c#10	CT	1	10	Sec 1	Gen 1	>1 MΩ	@ 300V
		2	10			>1 MΩ	
		3	10			>1 MΩ	
		4	10			>1 MΩ	
		5	10			>1 MΩ	
		6	10			>1 MΩ	
6c#12	PT	1	12			>1 MΩ	
		2	12			>1 MΩ	
		3	12			>1 MΩ	
		4	12			>1 MΩ	
2c#10	24VDC Suply	Black	10			>1 MΩ	
		White	10			>1 MΩ	
2pr#18	4-20mA	Black	18			>1 MΩ	
		White	18			>1 MΩ	
		Black	18			>1 MΩ	
		White	18			>1 MΩ	
Belden 3106A	MODBUS	Orange	22			>1 MΩ	
		White	22			>1 MΩ	
Belden 3106A	kW Load	Orange	22			>1 MΩ	
		White	22			>1 MΩ	

Western Pacific Enterprises GP | **Check Sheet Authorized for use by:**

Name: CHRIS HEESTERMAN

Signature:

Date: APRIL 5TH/17

Lee Smith
QA Manager

Format: WPE-CHK-E009 Revision: # 3 (mm/dd/yyyy) Date: 10/26/12, 07/01/2014,09/25/14 LS, BB

W P

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#14	24VDC Control	1	14	Sec 3	Gen 3	>1 MΩ	@ 300V
		2	14	↓	↓	>1 MΩ	
		3	14	↓	↓	>1 MΩ	
		4	14	↓	↓	>1 MΩ	
		5	14	↓	↓	>1 MΩ	
		6	14	↓	↓	>1 MΩ	
		7	14	↓	↓	>1 MΩ	
		8	14	↓	↓	>1 MΩ	
		9	14	↓	↓	>1 MΩ	
		10	14	↓	↓	>1 MΩ	
		11	14	↓	↓	>1 MΩ	
		12	14	↓	↓	>1 MΩ	
		13	14	↓	↓	>1 MΩ	
		14	14	↓	↓	>1 MΩ	
		15	14	↓	↓	>1 MΩ	
		16	14	↓	↓	>1 MΩ	
		17	14	↓	↓	>1 MΩ	
		18	14	↓	↓	>1 MΩ	
		19	14	↓	↓	>1 MΩ	
		20	14	↓	↓	>1 MΩ	
		21	14	↓	↓	>1 MΩ	
		22	14	↓	↓	>1 MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: CHRIS HEESTERMAN	
Signature:	Lee Smith
Date: APRIL 5TH/17	QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
6c#10	CT	1	10	Sec 3	Gen 3	71 MΩ	@ 300 V
		2	10			71 MΩ	
		3	10			71 MΩ	
		4	10			71 MΩ	
		5	10			71 MΩ	
		6	10			71 MΩ	
6c#12	PT	1	12			71 MΩ	
		2	12			71 MΩ	
		3	12			71 MΩ	
		4	12			71 MΩ	
2c#10	24VDC Suply	Black	10			71 MΩ	
		White	10			71 MΩ	
2pr#18	4-20mA	Black	18			71 MΩ	
		White	18			71 MΩ	
		Black	18			71 MΩ	
		White	18			71 MΩ	
Belden 3106A	MODBUS	Orange	22			71 MΩ	
		White	22			71 MΩ	
Belden 3106A	kW Load	Orange	22			71 MΩ	
		White	22			71 MΩ	

Western Pacific Enterprises GP

Name: CHRIS HEESTERMAN
Signature:
Date: APRIL 5TH / 17

Check Sheet Authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation

Equipment number
Test Instrument used

Serial No. 150305695
MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#14	24VDC Control	1	14	Sec 2	Gen 2	>1 MΩ	@ 300V
		2	14	↓	↓	>1 MΩ	
		3	14			>1 MΩ	
		4	14			>1 MΩ	
		5	14			>1 MΩ	
		6	14			>1 MΩ	
		7	14			>1 MΩ	
		8	14			>1 MΩ	
		9	14			>1 MΩ	
		10	14			>1 MΩ	
		11	14			>1 MΩ	
		12	14			>1 MΩ	
		13	14			>1 MΩ	
		14	14			>1 MΩ	
		15	14			>1 MΩ	
		16	14			>1 MΩ	
		17	14			>1 MΩ	
		18	14			>1 MΩ	
		19	14			>1 MΩ	
		20	14			>1 MΩ	
		21	14			>1 MΩ	
		22	14			>1 MΩ	

Western Pacific Enterprises GP

Name: Chris Heesterman
Signature:
Date: April 5th/17

Check Sheet Authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation
Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
6c#10	CT	1	10	Sec 2	Gen 2	> 1MΩ	@ 300V
		2	10			> 1MΩ	
		3	10			> 1MΩ	
		4	10			> 1MΩ	
		5	10			> 1MΩ	
		6	10			> 1MΩ	
6c#12	PT	1	12			> 1MΩ	
		2	12			> 1MΩ	
		3	12			> 1MΩ	
		4	12			> 1MΩ	
2c#10	24VDC Suply	Black	10			> 1MΩ	
		White	10			> 1MΩ	
2pr#18	4-20mA	Black	18			> 1MΩ	
		White	18			> 1MΩ	
		Black	18			> 1MΩ	
		White	18			> 1MΩ	
Belden 3106A	MODBUS	Orange	22			> 1MΩ	
		White	22			> 1MΩ	
Belden 3106A	kW Load	Orange	22			> 1MΩ	
		White	22			> 1MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: CHRIS HEESTERMAN Signature: Date: APRIL 5TH / 17	Lee Smith QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client:	PWGSC	Equipment number	Serial No. 150305695
Project No.:	C847	Test Instrument used	MTP Intruments Model No. 4010
Project Name:	EGD-SSES Standby Power Generation		

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#14	Load Bank Control	1	14	Sec 5	LB Control	71 MΩ	@ 300V
		2	14			71 MΩ	
		3	14			71 MΩ	
		4	14			71 MΩ	
		5	14			71 MΩ	
		6	14			71 MΩ	
		7	14			71 MΩ	
		8	14			71 MΩ	
		9	14			71 MΩ	
		10	14			71 MΩ	
		11	14			71 MΩ	
		12	14			71 MΩ	
		13	14			71 MΩ	
		14	14			71 MΩ	
		15	14			71 MΩ	
		16	14			71 MΩ	
		17	14			71 MΩ	
		18	14			71 MΩ	
		19	14			71 MΩ	
		20	14			71 MΩ	
		21	14			71 MΩ	
		22	14			71 MΩ	
		23	14			71 MΩ	
		24	14			71 MΩ	
		25	14			71 MΩ	
		26	14			71 MΩ	
		27	14			71 MΩ	
		28	14			71 MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: Chris Heeteman	
Signature:	Lee Smith
Date: April 11th/17	QA Manager

Format: WPE-CHK-E009 Revision: # 3 (mm/dd/yyyy) Date: 10/2 LS, BB

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#12	DND/GEN/BCH1/BCH2/Tie Break Status'	1	12	Sec 5	SES 25/12	>1 MΩ	@ 600V
		2	12			>1 MΩ	
		3	12			>1 MΩ	
		4	12			>1 MΩ	
		5	12			>1 MΩ	
		6	12			>1 MΩ	
		7	12			>1 MΩ	
		8	12			>1 MΩ	
		9	12			>1 MΩ	
		10	12			>1 MΩ	
		11	12			>1 MΩ	
		12	12			>1 MΩ	
		13	12			>1 MΩ	
		14	12			>1 MΩ	
		15	12			>1 MΩ	
		16	12			>1 MΩ	
		17	12			>1 MΩ	
		18	12			>1 MΩ	
		19	12			>1 MΩ	
		20	12			>1 MΩ	
		21	12			>1 MΩ	
		22	12			>1 MΩ	
		23	12			>1 MΩ	
		24	12			>1 MΩ	
		25	12			>1 MΩ	
		26	12			>1 MΩ	
		27	12			>1 MΩ	
		28	12			>1 MΩ	
		29	12			>1 MΩ	
		30	12			>1 MΩ	

Western Pacific Enterprises GP

Name: Chris Heertelman
Signature:
Date: April 24th/17

Check Sheet Authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#12	DND/GEN/BCH1/BCH2/Tie Break Status'	1	12	Sec 5	SES 25/12	>1 MΩ	@ 600V
		2	12			>1 MΩ	
		3	12			>1 MΩ	
		4	12			>1 MΩ	
		5	12			>1 MΩ	
		6	12			>1 MΩ	
		7	12			>1 MΩ	
		8	12			>1 MΩ	
		9	12			>1 MΩ	
		10	12			>1 MΩ	
		11	12			>1 MΩ	
		12	12			>1 MΩ	
		13	12			>1 MΩ	
		14	12			>1 MΩ	
		15	12			>1 MΩ	
		16	12			>1 MΩ	
		17	12			>1 MΩ	
		18	12			>1 MΩ	
		19	12			>1 MΩ	
		20	12			>1 MΩ	
		21	12			>1 MΩ	
		22	12			>1 MΩ	
		23	12			>1 MΩ	
		24	12			>1 MΩ	
		25	12			>1 MΩ	
		26	12			>1 MΩ	
		27	12			>1 MΩ	
		28	12			>1 MΩ	
		29	12			>1 MΩ	
		30	12			>1 MΩ	

Western Pacific Enterprises GP

Name: Chris Heeztenman
Signature: CH
Date: April 24th/17

Check Sheet Authorized for use by:

Lee Smith
QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client:	PWGSC	Equipment number	Serial No. 150305695
Project No.:	C847	Test Instrument used	MTP Intruments Model No. 4010
Project Name:	EGD-SSES Standby Power Generation		

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#12	DND/GEN/BCH1/BCH2/Tie Break PT's	1	12	Sec 5	SES 25/12	71 MΩ	@ 600V
		2	12			71 MΩ	
		3	12			71 MΩ	
		4	12			71 MΩ	
		5	12			71 MΩ	
		6	12			71 MΩ	
		7	12			71 MΩ	
		8	12			71 MΩ	
		9	12			71 MΩ	
		10	12			71 MΩ	
		11	12			71 MΩ	
		12	12			71 MΩ	
		13	12			71 MΩ	
		14	12			71 MΩ	
		15	12			71 MΩ	
		16	12			71 MΩ	
		17	12			71 MΩ	
		18	12			71 MΩ	
		19	12			71 MΩ	
		20	12			71 MΩ	
		21	12			71 MΩ	
		22	12			71 MΩ	
		23	12			71 MΩ	
		24	12			71 MΩ	
		25	12			71 MΩ	
		26	12			71 MΩ	
		27	12			71 MΩ	
		28	12			71 MΩ	
		29	12			71 MΩ	
		30	12			71 MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: Chris Heesterman	
Signature: CH	Lee Smith
Date: April 24th/17	QA Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation
Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
20c#10	DND/GEN/BCH1/BCH2/Tie Break CT's	1	10	Sec 5	SES 25/12	>1 MΩ	@ 600V
		2	10			>1 MΩ	
		3	10			>1 MΩ	
		4	10			>1 MΩ	
		5	10			>1 MΩ	
		6	10			>1 MΩ	
		7	10			>1 MΩ	
		8	10			>1 MΩ	
		9	10			>1 MΩ	
		10	10			>1 MΩ	
		11	10			>1 MΩ	
		12	10			>1 MΩ	
		13	10			>1 MΩ	
		14	10			>1 MΩ	
		15	10			>1 MΩ	
		16	10			>1 MΩ	
		17	10			>1 MΩ	
		18	10			>1 MΩ	
		19	10			>1 MΩ	
		20	10			>1 MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: CHRIS HEESTERMAN	
Signature:	Lee Smith
Date: APRIL 24th/17	QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:

Date:

No. of pages

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695

Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
6c#14	Generator Bus PT	1	14	Sec 5	600V TX	>1MΩ	@ 600V
		2	14			>1MΩ	
		3	14			>1MΩ	
		4	14			>1MΩ	
		5	14			>1MΩ	
		6	14			>1MΩ	
20c#14	600-24/12 TX Control	19	14	Sec 5	TX Control	>1MΩ	
		20	14			>1MΩ	
6c#14	6SES-0 CB Status	1	14	Sec 5	6SES-0 CB	>1MΩ	
		2	14			>1MΩ	
		3	14			>1MΩ	
		4	14			>1MΩ	
6c#14	LB Breaker Status	1	14	Sec 5	Load Bank CB	>1MΩ	
		2	14			>1MΩ	
		3	14			>1MΩ	
		4	14			>1MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: Chris Heesterman	
Signature:	Lee Smith
Date: April 20th/2017	QA Manager

Format: WPE-CHK-E009 Revision: # 3 (mm/dd/yyyy) Date: 10/2 LS, BB

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation
Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable No.	Size	From	To	Megohms GREATER THAN	Remarks
7c#10	Load Bank CT	1	10	LB Control	Load Bank	>1 MΩ	@ 600V
		2	10			>1 MΩ	
		3	10			>1 MΩ	
		4	10			>1 MΩ	
		5	10			>1 MΩ	
		6	10			>1 MΩ	
2c#14	LB Heater	Black	14	2SES-2	Load Bank	>1 MΩ	
		White	14			>1 MΩ	
2c#14	LB 125VDC	Black	14	Sec 5	LB Control	>1 MΩ	
		White	14			>1 MΩ	
2c#4	TCS PLC 125VDC	Black	4	DC-1	Sec 5	>1 MΩ	
		White	4			>1 MΩ	
6c#10	Generator Bus CT	1	10	25/12 CB#2	600V TX	>1 MΩ	
		2	10			>1 MΩ	
		3	10			>1 MΩ	
		4	10			>1 MΩ	
		5	10			>1 MΩ	
		6	10			>1 MΩ	
3c#12	600-25/12kV TX 120V	Red	12	2SES-2	TX Controller	>1 MΩ	
		Black	12			>1 MΩ	
		Blue	12			>1 MΩ	

Western Pacific Enterprises GP

Name: Chris Heerteman
Signature:
Date: April 20th/17

Check Sheet Authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E009 Revision: # 3 (mm/dd/yyyy) Date: 10/2 LS, BB

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Test Record for Megger Readings (Power, Control Wire & Cable)

Report No:
Date:
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation

Equipment number: Serial No. 150305695
Test Instrument used: MTP Intruments Model No. 4010

Panel No. Circuit No. Feeder No.	Wire Tagging	Wire or Cable				Megohms GREATER THAN	Remarks
		No.	Size	From	To		
30c#14	Load Bank Control	1	14	LB Control	Load Bank	>1 MΩ	@ 300V
		2	14			>1 MΩ	
		3	14			>1 MΩ	
		4	14			>1 MΩ	
		5	14			>1 MΩ	
		6	14			>1 MΩ	
		7	14			>1 MΩ	
		8	14			>1 MΩ	
		9	14			>1 MΩ	
		10	14			>1 MΩ	
		11	14			>1 MΩ	
		12	14			>1 MΩ	
		13	14			>1 MΩ	
		14	14			>1 MΩ	
		15	14			>1 MΩ	
		16	14			>1 MΩ	
		17	14			>1 MΩ	
		18	14			>1 MΩ	
		19	14			>1 MΩ	
		20	14			>1 MΩ	
		21	14			>1 MΩ	
		22	14			>1 MΩ	
		23	14			>1 MΩ	
		24	14			>1 MΩ	
		25	14			>1 MΩ	
		26	14			>1 MΩ	
		27	14			>1 MΩ	
		28	14			>1 MΩ	

Western Pacific Enterprises GP	Check Sheet Authorized for use by:
Name: CHRIS HEESTERMAN	Lee Smith
Signature:	QA Manager
Date: APRIL 11TH/17	

Transformer Products Electrical Test Report

Customer Name: COOPER POWER SYSTEMS (Canada)
Customer PO: 2610-373486
Catalog #: 00022A69XAYA
Primary Voltage: 12470Y/7200X24940Y/14400
Secondary Voltage: 600D
Taps: 26,190/25,560/24,940/24,320/23,690/0/0
Class: KNAN/KNAF(FUT)
Note: No Load Loss data corrected to: 85.0 °C
Load Loss data corrected to: 85.0 °C
No Load Loss data reported at: 105 %

CPS Sales Order #: 209775917
Customer Req #:
Type: PADMOUNT
Customer Material #:
Name Plate KVA: 3000.0
Phase: 3
Cycles: 60 Hz
Rise: 65
Insulating Fluid: ENVIROTEMP FR3 FLUID

Serial Number	Sequence Number	Test Date	No Load Loss	Load Loss	Total Loss	Rep. Eff.	DOE Comp.	%IEX	%IZ	%IX	%IR	%Reg @ 0.8	%Reg @ 1.0
CP1759000129		02/17/2017	4983	18708	23691			0.20	5.97	5.94	0.62	4.15	0.80
	Quantity: 1	Averages:	4983	18708	23691								
		Quoted:	0	0	0								

All transformers manufactured using insulating fluid containing less than 1 PPM PCB. ASTM D4059 Test Certification available. DOE efficiency is based on 50% load losses at 55 degrees C and exclusion of losses associated with accessory devices.
All of the transformers listed have received and passed the following tests:
Continuity, Ratio, Leak, Polarity and Phase-Relation, Routine Impulse, Induced Voltage, and Applied Voltage in accordance with IEEE standard C57.12.00, Latest Edition.

Certified By:

Ship Date: 02/24/2017
Invoice: 0928764189

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Megger Readings (Transformer)

Report No:

Date: 26 - Apr-2017

No. of pages

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: 3/4MVA 25/12.5KV Step up

Reference Document: Spec 26 13 13 DWG 8423

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Voltage:				
1.1	Actual voltage measured at switchgear				volts
2.0	Rotation check:				
2.1	At beginning of test				amps
2.2	At end of test				amps
3.0	Temperature of bearing: check bearing for high temperature				
3.1	Before start				
3.2	10 minutes after start				
3.3	15 minutes after start				
3.4	30 minutes after start				
3.5	1 hour after start				
3.6	2 hours after start				
3.7	3 hours after start				
4.0	Insulation Megger Test				
4.1	High to Ground secondary grounded	5G OHM			H1, H2, H3 @ 5KV
4.2	Low to Ground primary grounded	1G OHM			L1, L2, L3 @ 500V
4.3	High to Low	5G OHM			H1, H2, H3 @ 500V

Attachments, No. of pages:

Accepted for Western Pacific Enterprises GP

Name: ……………………………………

Signature: ……………………………………

Date: ……………………………………

This check sheet is authorized for use by:

Lee Smith

QA Manager

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Inspection Report for Megger Readings (Transformer)

Report No:

Date: 26 - Apr-2017

No. of pages

Client: PWGSC

Project No.: C847

Project Name: EGD-SSES Standby Power Generation

Additional Information: 3/4MVA 25/12.5KV Step up

Reference Document: Spec 26 13 13 DWG 8423

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Voltage:				
1.1	Actual voltage measured at switchgear				volts
2.0	Rotation check:				
2.1	At beginning of test				N/A. amps
2.2	At end of test				amps
3.0	Temperature of bearing: check bearing for high temperature				
3.1	Before start				
3.2	10 minutes after start				
3.3	15 minutes after start				N/A.
3.4	30 minutes after start				
3.5	1 hour after start				
3.6	2 hours after start				
3.7	3 hours after start				
4.0	Insulation Megger Test				
4.1	High to Ground secondary grounded	5G OHM		CH	H1, H2, H3 @ 5KV
4.2	Low to Ground primary grounded	1G OHM		CH	L1, L2, L3 @ 500V
4.3	High to Low	5G OHM		CH	H1, H2, H3 @ 500V
					TEST REPEATED MAY 8/17
					CONFIMED MAY 12, 2017
					TAP SET AT
					12.470 & C
					PHOTO ATTACHED

Attachments, No. of pages:

Accepted for Western Pacific Enterprises GP	This check sheet is authorized for use by:
Name: CHRIS HEESTERMAN	
Signature:	Lee Smith
Date: APRIL 26th/17	QA Manager

Format: WPE-CHK-IC027 | Revision: #0 | Date: MMM/DD/YYYY

24940
12470
H1
H2
H3
CAUTION
TAPCHANGER
DE-ENERGIZED
OPERATION ONLY
ATTENTION
WARNING

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Quality Assurance / Quality Control

Report No:
Date: May 20, 2017
No. of Pages:

Client: PWGSC
Project No.: C847
Project Name: EGD-SSES Standby Power Generation
Additional Information:
Reference Document: DWG 8410

	Items to Inspect	Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point	inspected* initials/date	
1.0	Equipment tag No.	GW			3/4 MVA Transformer Feeder to Existing 25/12SES Bus 1
2.0	Equipment description	GW			25KV Feeder CB 2 HV Cabinet
3.0	Visual Examination	GW			OK
4.0	Control Cables Meggered	GW			OK
5.0	Terminations (Control Wiring)	GW			
6.0	Cable Tagging	GW			
7.0	Control Cabinets Cleaned	GW			NEW INSTALLATION BY OTHERS
8.0	Terminations (High Voltage)	GW			
9.0	Proper Phasing	GW			Clockwise Rotation tested at secondary cut out blocks Confirmed by Prime Eng
10.0	Grounding	GW			NEW INSTALLATION BY OTHERS
11.0	Equipment Level	N/A			
12.0	Bolts Torqued	GW			
13.0	Signage	N/A			
14.0	Exterior of Equipment Cleaned	GW			
				**	Existing Bus Phase Rotation Clockwise Rotation tested at
				**	CB-19 secondary cut out blocks confirmed by Prime Eng

Accepted for Western Pacific Enterprises GP

Name: Gord Webster
Signature:
Date: May 20, 2017

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-HVC033 Revision: # 1 Date(mm,dd,yy): 01/08/13, 01/20/14 LS

marathon
Thomson Power Systems

FIELD SERVICE TRAVELLER CARD

(Work Instructions SV006, SV007)

A. IDENTIFICATION

C/O Number: C 054107
Product Type: LOAD BANK LBO.C
W/O Number: W 095114
Project Name/Desc.: ESQUIMALT GRAVING DOCKS
Serial Number(s): W 095113

NUMBER OF UNITS: ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

Type of Field Service Work (Refer to Work Order Acknowledgment and Service Report for specific details):

☒ New Equipment Site Commissioning ☐ Field Service Warranty Repair
☐ Other:

B. TEST PERSONNEL

Name: MARCO-ABEL NORDIO
Company/Title: THOMSON POWER SYSTEMS FIELD SERVICE TECH
Name: CHRIS HEESTERMAN
Company/Title: WESTERN PACIFIC ENT. - PROJECT SUPERINT.
Name:
Company/Title:
Name:
Company/Title:
Name:
Company/Title:

C. TEST EQUIPMENT USED

	DESCRIPTION:		SERIAL NO.:
1.	Digital Multimeter:	FLUKE 289	25480006 / T0309
2.	Other:		
3.	Other:		
4.	Other:		
5.	Other:		

D. VISUAL INSPECTION (EQUIPMENT AND INSTALLATION)

		VERIFIED (Tester Initials)
1.	All control interconnection wiring is complete	MAN
2.	All power cabling (as applicable) is complete	MAN
3.	Separate conduit runs used for AC/DC & shielded conductors	MAN
4.	All equipment grounding/bonds are connected	MAN
5.	DC negative conductor is adequately grounded	MAN
6.	Any essential missing equipment is installed	MAN
7.	Any loose control wiring is isolated	MAN
8.	All nameplates on and straight	MAN
9.	CSA label is on equipment with correct ratings	MAN
10.	Major devices checked for type, rating, size	MAN
11.	Breakers/switches checked (amperage, trips)	MAN
12.	Panel is clean from excessive dirt *	MAN
13.	"Wire for Only" devices are properly installed	MAN
14.	Other:	
15.	Other: * OUTSIDE INSTALLATION	

COMMENTS:

* NORMAL DUST FOR OUTDOOR USE

E. MECHANICAL INSPECTION (CONTROL PANEL)

		VERIFIED (Tester Initials)
1.	All field wiring connections on ***terminal** blocks* to be checked for tightness by pulling sharply with needle nose pliers	MAW
2.	Check control panel door hinges, latch and lock mechanisms for free operation	MAW
3.	Other:	
4.	Other:	
5.	Other:	

COMMENTS:

F. ELECTRICAL INSPECTION (CONTROL PANEL SWITCHGEAR)

i) PRELIMINARY

		VERIFIED (Tester Initials)
1.	Test equipment (as applicable) is connected correctly	MAW
2.	All control switches are easily accessible	MAW
3.	Any exposed high voltage connections are clearly identified	MAW
4.	Confirm engine is ready to start	N/A
5.	Confirm generator is ready to energize	N/A
6.	Confirm all site personnel and associated equipment are ready	MAW

ii) VERIFICATION OF TEST (GENERATOR CONTROLS)

UNIT 1 OF 1 *(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)*

☑ *This section NOT applicable*

☐ **DC STATION SERVICE INSTALLED** ☐ *This section NOT applicable*

BATTERY CHARGER

☐ *This section NOT applicable*

	TESTER (Initials)
Charger type: ________	
Charger operating correctly	
Charger float voltage: ________ VDC	
Charger equalize volt: ________ VDC	
Charger current limit: ________ ADC	
Other: ________	
Other: ________	

ENGINE CONTROLLER

☐ *This section NOT applicable*

	TESTER (Initials)
Controller model: ________	
Software version: ________	
Programming sheets verified	
Calibration of analog inputs	
Display contrast verified	

METERING

☐ *This section NOT applicable*

	TESTER (Initials)
A.M. & A.M. selector switch	
F.M.	
V.M. & V.M. selector switch	
KWM	
PFM	
Transducers	
Other: ________	

ENGINE GAUGES

☐ *This section NOT applicable*

	TESTER (Initials)
D.C. AM	
D.C. VM	
Oil pressure	
Water temperature	
Hourmeter	
Other: ________	

GOVERNOR EQUIPMENT

☐ *This section NOT applicable*

	TESTER (Initials)
Speed Control	
SAR	
Load Sharing Module	
Other: ________	

PROTECTIVE RELAYS

☐ *This section NOT applicable*

	TESTER (Initials)
Overvoltage: ________ VAC	
Undervoltage: ________ VAC	
Overcurrent: ________ AMPS	
Other: ________	
Other: ________	
Other: ________	
Other: ________	

VOLTAGE REGULATION

☐ *This section NOT applicable*

	TESTER (Initials)
Regulator	
VAR	
Var / Power factor controller	
Other: ________	

MISCELLANEOUS

	TESTER (Initials)
________	
________	
________	
________	

iii) VERIFICATION OF TEST (TRANSFER SWITCH)

UNIT 1 **OF** 1 ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

☑ ***This section NOT applicable***

		VERIFIED (Tester Initials)
1.	T/S motor operation	
2.	Limit switches	
3.	Breaker toggles	
4.	Indication lights	
5.	Test switches	
6.	Auxiliary contacts	
7.	Linkage adjustments (if required)	
8.	Manual operation handle	
9.	Controller program settings verified per Programming Sheets	
10.	Display contrast verified	
11.	Other: ______	
12.	Other: ______	

iv) VERIFICATION OF TEST (SYNCHRONIZING / PARALLELING)

UNIT 1 **OF** 1 ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

☑ ***This section NOT applicable***

		VERIFIED (Tester Initials)
1.	Phase rotation check	
2.	Sync scope phasing correct	
3.	Sync lights phasing correct	
4.	Sync check relay operation	
5.	Sync check relay setting: ______ % V	
6.	Unit selector (25CS)	
7.	Auto synchronizer functional	
8.	Manual sync control	
9.	Dead bus bypass	
10.	KW loadsharing functional	
11.	KVAR loadsharing functional	
12.	KVAR (droop bypass) for single unit functional	
13.	Reverse power relay trip setting: ______ kW	
14.	Reverse power relay time setting: ______ Sec	
15.	Other: ______	
16.	Other: ______	
17.	Other: ______	

v) VERIFICATION OF TEST (PROGRAMMABLE LOGIC CONTROLLER)

UNIT _____ **OF** _____ ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

☑ ***This section NOT applicable***

		VERIFIED (Tester Initials)
1.	Software loaded and verified	
2.	Software revision number: ____________	
3.	Data communication	
4.	Analog I/O cards	
5.	Verify transducer input calibrations	
6.	UPS (battery backup)	
7.	Sequence of operation (verified)	
8.	Operator interface: Display	
9.	Keypad	
10.	Cables/connectors (supplied)	
11.	Other: ____________________________	

vi) VERIFICATION OF TEST (CIRCUIT INTERRUPTERS)

☑ ***This section NOT applicable***

Unit No.	Model No.	Trip Unit (Initials/A)	Charge Motor (Initials/V)	Shunt Trip (Initials/V)	Settings	TRIP/CLOSE Manual (Initials)	TRIP/CLOSE Auto (Initials)	Lugs (Initials)	Fixed or Drawout (Specify)
1. GEN 1									
2. GEN 2									
3. GEN 3									
4.									
5.									
6.									
7.									

8. Interlocks: Electrical (Initials) ☐ Mechanical (Initials) ☐ Key No. ☐

9. Breakers set as per Coordination Study (Initials) ☐

☑ *This item NOT applicable*

COMMENTS:

* PLC PART OF W 095118 GCS 2200 SWITCHGEAR.

G. VERIFICATION OF FINAL TEST PROCEDURE

	VERIFIED	
	(Tester Initials)	(Date)
1. Standard Testing Procedure: (☐ Refer to attached Testing Procedure Form)		
☐ PT 007 (GCS)		
☐ PT 004 (UCS)		
☐ PT 001 (TS 850)		
☐ PT 001 (TS 890)		
2. Other: TESTED FAN ROTATION W. 3 GEN	MAW	APRIL 28, 2017
3. Other: TESTED HI TEMP SHUTDOWN	MAW	APRIL 28, 2017
4. Other: TESTED LOW FLOW SHUTDOWN	MAW	APRIL 28, 2017
5. Other:		
6. Other:		
7. Other:		

H. CONTROL DEVICE SETTINGS

	VERIFIED	
	(Tester Initials)	(Date)
All control device settings verified (☐ Refer to attached Device Setting Form)	MAW	APRIL 28, 2017

SETTINGS:

I. CERTIFICATION

	VERIFIED	
CONFIRMATION of EQUIPMENT CERTIFICATION: (check appropriate box)	(Tester Initials)	(Date)
☐ CSA Standard:		
☐ NRTL/C Standard:		
☑ Other: CSA LR 65859	MAW	APRIL 28, 2017

J. SPECIAL REQUIREMENTS VERIFICATION

REQUIREMENTS:

	VERIFIED	
	(Tester Initials)	(Date)

COMMENTS:

K. FINAL INSPECTION

VERIFIED

	(Tester Initials)	(Date)
Traveler card completed correctly	MAN	APRIL 28, 2017
No deficiencies (unless listed below)	MAN	APRIL 28, 2017

DEFICIENCIES: (☐ Refer to attached Deficiency List)
☐ **None**

Item No.	Description	Action By	Due Date	RECTIFIED (Tester Initials)	RECTIFIED (Date)

COMMENTS / RECOMMENDATIONS: (☐ Refer to attached detailed Service Report)
* ALL AUTO FUNCTIONS OF THE LOAD BANK TESTED VIA
HMI FOR PROJECT W 095112

L. CUSTOMER WITNESS TEST / VALIDATION

VERIFIED

	(Tester Signature)	(Date)
Commissioning / STARTUP By: MARCO-ABEL NORDLO FIELD SERVICE TECHNICIAN *(Technician Name/Title)*		APRIL 28, 2017

	(Witness Signature)	(Date)
Witness Tested By: CHRIS HEESTERMAN *(Customer Name/Title)*	CH	APRIL 28th/17

marathon
Thomson Power Systems

FIELD SERVICE TRAVELLER CARD

(Work Instructions SV006, SV007)

A. IDENTIFICATION

C/O Number: C-054107
Product Type: GCS 2200
W/O Number: W 095114
Project Name/Desc.: ESQUIMALT GRAVING DOCKS
Serial Number(s): W 095712

NUMBER OF UNITS: ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

Type of Field Service Work (Refer to Work Order Acknowledgment and Service Report for specific details):

☒ New Equipment Site Commissioning ☐ Field Service Warranty Repair
☐ Other:

B. TEST PERSONNEL

Name: MARCO-ABEL NORDIO
Company/Title: THOMSON POWER SYSTEMS
Name: CHRIS HEESTERMAN
Company/Title: WESTERN PACIFIC ENTERPRISE - PROJECT SUPERINT.
Name:
Company/Title:
Name:
Company/Title:
Name:
Company/Title:

C. TEST EQUIPMENT USED

DESCRIPTION:		SERIAL NO.:
1.	Digital Multimeter: FLUKE 289	25480006 / TO 309
2.	Other:	
3.	Other:	
4.	Other:	
5.	Other:	

D. VISUAL INSPECTION (EQUIPMENT AND INSTALLATION)

		VERIFIED (Tester Initials)
1.	All control interconnection wiring is complete	MAN
2.	All power cabling (as applicable) is complete	MAN
3.	Separate conduit runs used for AC/DC & shielded conductors	MAN
4.	All equipment grounding/bonds are connected	MAN
5.	DC negative conductor is adequately grounded	MAN
6.	Any essential missing equipment is installed	MAN
7.	Any loose control wiring is isolated	MAN
8.	All nameplates on and straight	MAN
9.	CSA label is on equipment with correct ratings	MAN
10.	Major devices checked for type, rating, size	MAN
11.	Breakers/switches checked (amperage, trips)	MAN
12.	Panel is clean from excessive dirt	MAN
13.	"Wire for Only" devices are properly installed	N/A
14.	Other:	
15.	Other:	

COMMENTS:

E. MECHANICAL INSPECTION (CONTROL PANEL)

	VERIFIED (Tester Initials)
1. All field wiring connections on ***terminal** blocks* to be checked for tightness by pulling sharply with needle nose pliers	HAN
2. Check control panel door hinges, latch and lock mechanisms for free operation	HAN
3. Other:	
4. Other:	
5. Other:	

COMMENTS:

F. ELECTRICAL INSPECTION (CONTROL PANEL SWITCHGEAR)

i) PRELIMINARY

	VERIFIED (Tester Initials)
1. Test equipment (as applicable) is connected correctly	HAN
2. All control switches are easily accessible	HAN
3. Any exposed high voltage connections are clearly identified	N/A
4. Confirm engine is ready to start	HAN
5. Confirm generator is ready to energize	HAN
6. Confirm all site personnel and associated equipment are ready	HAN

ii) VERIFICATION OF TEST (GENERATOR CONTROLS)

UNIT 1 **OF** 1 ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

☐ ***This section NOT applicable***

☐ **DC STATION SERVICE INSTALLED** ☑ ***This section NOT applicable***

BATTERY CHARGER

☐ ***This section NOT applicable***

	TESTER (Initials)
Charger type: ______	
Charger operating correctly	
Charger float voltage: ______ VDC	
Charger equalize volt: ______ VDC	
Charger current limit: ______ ADC	
Other: ______	
Other: ______	

ENGINE CONTROLLER

☐ ***This section NOT applicable***

	TESTER (Initials)
Controller model: ______	
Software version: ______	
Programming sheets verified	
Calibration of analog inputs	
Display contrast verified	

METERING

☐ ***This section NOT applicable***

	TESTER (Initials)
A.M. & A.M. selector switch	MAW
F.M.	MAW
V.M. & V.M. selector switch	MAW
KWM	MAW
PFM	MAW
Transducers	
Other: ______	

ENGINE GAUGES

☐ ***This section NOT applicable***

	TESTER (Initials)
D.C. AM	MAW
D.C. VM	MAW
Oil pressure	N/A
Water temperature	N/A
Hourmeter	N/A
Other: ______	

GOVERNOR EQUIPMENT

☐ ***This section NOT applicable***

	TESTER (Initials)
Speed Control	MAW
SAR	N/A
Load Sharing Module	MAW
Other: ______	

PROTECTIVE RELAYS

☑ ***This section NOT applicable***

	TESTER (Initials)
Overvoltage: ______ VAC	
Undervoltage: ______ VAC	
Overcurrent: ______ AMPS	
Other: ______	
Other: ______	
Other: ______	
Other: ______	

VOLTAGE REGULATION

☐ ***This section NOT applicable***

	TESTER (Initials)
Regulator	MAW
VAR	MAW
Var / Power factor controller	MAW
Other: ______	

MISCELLANEOUS

	TESTER (Initials)

iii) VERIFICATION OF TEST (TRANSFER SWITCH)

UNIT 1 **OF** ____ ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

☑ ***This section NOT applicable***

	VERIFIED (Tester Initials)
1. T/S motor operation	
2. Limit switches	
3. Breaker toggles	
4. Indication lights	
5. Test switches	
6. Auxiliary contacts	
7. Linkage adjustments (if required)	
8. Manual operation handle	
9. Controller program settings verified per Programming Sheets	
10. Display contrast verified	
11. Other:	
12. Other:	

iv) VERIFICATION OF TEST (SYNCHRONIZING / PARALLELING)

UNIT 1 **OF** 1 ***(NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)***

☐ ***This section NOT applicable***

	VERIFIED (Tester Initials)
1. Phase rotation check *	MAN
2. Sync scope phasing correct *	MAN
3. Sync lights phasing correct *	MAN
4. Sync check relay operation *	MAN
5. Sync check relay setting: ± 5 % V	MAN
6. Unit selector (25CS)	MAN
7. Auto synchronizer functional *	MAN
8. Manual sync control	MAN
9. Dead bus bypass	MAN
10. KW loadsharing functional	MAN
11. KVAR loadsharing functional	MAN
12. KVAR (droop bypass) for single unit functional	MAN
13. Reverse power relay trip setting: 150 kW	MAN
14. Reverse power relay time setting: 3 Sec	MAN
15. Other:	
16. Other:	
17. Other:	

* PHASE ROTATION / SYNC TESTED GEN TO GEN
UTILITY SYNC/ROTATION STILL NOT AVAILABLE AT
TIME OF TESTING

v) VERIFICATION OF TEST (PROGRAMMABLE LOGIC CONTROLLER)

UNIT 1 OF 1 (*NOTE: For multiple sync panels, attach additional test sheets 3, 4 & 5 as required.)*

☐ *This section NOT applicable*

		VERIFIED (Tester Initials)
1.	Software loaded and verified	MAW
2.	Software revision number: APRIL 28, 2017	MAW
3.	Data communication	MAW
4.	Analog I/O cards	MAW
5.	Verify transducer input calibrations	MAW
6.	UPS (battery backup)	MAW
7.	Sequence of operation (verified) **	MAW
8.	Operator interface: Display	MAW
9.	Keypad	N/A
10.	Cables/connectors (supplied)	MAW
11.	Other:	

vi) VERIFICATION OF TEST (CIRCUIT INTERRUPTERS)

☑ *This section NOT applicable*

Unit No.	Model No.	Trip Unit (Initials/A)	Charge Motor (Initials/V)	Shunt Trip (Initials/V)	Settings	TRIP/CLOSE Manual (Initials)	TRIP/CLOSE Auto (Initials)	Lugs (Initials)	Fixed or Drawout (Specify)
1. GEN 1									
2. GEN 2									
3. GEN 3									
4.									
5.									
6.									
7.									

8. Interlocks: Electrical (Initials) MAW Mechanical (Initials) Key No.

9. Breakers set as per Coordination Study (Initials)

☒ *This item NOT applicable* ***

COMMENTS:

** SEQUENCE OF OPS TESTED ONLY FOR MANUAL OPERATIONS & AUTO LOAD BANK TESTING TESTING INCLUSIVE OF SYNC & LOAD SHARE.

*** COORDINATION STUDY BY OTHERS (THIRD PARTY) PROTECTION RELAY LOADED WITH MINIMUM WORKING PARAMETERS

G. VERIFICATION OF FINAL TEST PROCEDURE

1. Standard Testing Procedure: (☐ Refer to attached Testing Procedure Form)
   - ☒ PT 007 (GCS) ****
   - ☐ PT 004 (UCS)
   - ☐ PT 001 (TS 850)
   - ☐ PT 001 (TS 890)
2. Other:
3. Other:
4. Other:
5. Other:
6. Other:
7. Other:

VERIFIED

(Tester Initials)	(Date)
MAN	APRIL 28, 2014

*** TESTED ONLY IN MANUAL & AUTO LOAD BANK

H. CONTROL DEVICE SETTINGS

All control device settings verified (☐ Refer to attached Device Setting Form)

VERIFIED

(Tester Initials)	(Date)
MAN	APRIL 28, 2014

SETTINGS:

VERIFICATION UNDERGOING WILL
BE COMPLETED WHEN FULL COMMISSIONING
IS COMPLETED

I. CERTIFICATION

CONFIRMATION of EQUIPMENT CERTIFICATION: (check appropriate box)

☒ CSA Standard: 22.2 # 14

☐ NRTL/C Standard:

☐ Other:

VERIFIED

(Tester Initials)	(Date)
MAN	APRIL 28, 2014

J. SPECIAL REQUIREMENTS VERIFICATION

REQUIREMENTS:

VERIFIED

(Tester Initials)	(Date)

COMMENTS:

K. FINAL INSPECTION

VERIFIED

	(Tester Initials)	(Date)
Traveler card completed correctly	APRIL 28, 2017	MAN
No deficiencies (unless listed below)		

DEFICIENCIES: (☐ Refer to attached Deficiency List)
☐ **None**

Item No.	Description	Action By	Due Date	RECTIFIED	
				(Tester Initials)	(Date)
	SEE COMMENTS BELOW	WPE/Thomson			

COMMENTS / RECOMMENDATIONS: (☐ Refer to attached detailed Service Report)

- COMPLETE INTERCONNECTIONS AS PER APPROVED DRWS ARE NOT COMPLETED TO DATE
- COMPLETE SCADA COMMUNICATION IS NOT COMPLETED TO DATE
- MAIN 25 KV INTERCONNECTIONS ARE NOT COMPLETED TO DATE
- MAIN DWD BREAKER CANNOT BE CLOSED AT THIS MOMENT
- TESTED ONLY MANUAL OPERATION OF THE GENERATORS AS WELL AS AUTO FUNCTIONS WITH LOAD BANK
- ROTATION CHECK FOR DWD BREAKER NOT AVAILABLE TO DATE

L. CUSTOMER WITNESS TEST / VALIDATION

VERIFIED

	(Tester Signature)	(Date)
Commissioning / STARTUP By: MARCO-ABEL NORDIO FIELD SERVICE TECHNICIAN *(Technician Name/Title)*		APRIL 28, 2017

	(Witness Signature)	(Date)
Witness Tested By: CHRIS HEESTERMAN *(Customer Name/Title)*		APRIL 28/17

THOMSON
POWER SYSTEMS

Site Test Verification Record – Esquimalt Graving Dock
GCS 2200 Generator Control System

C-054107, W-095112… REV.0 17/06/05

SITE EQUIPMENT TO BE TESTED:

Ref #	Equipment Name	Manufacture
W-095112	GCS 2200 Generator Control Panel	Thomson Power Systems
W-095113	LBO-1000H-600V-3-C Load Bank	Thomson Power Systems
25/12SES	Service Entrance Substation (SES) Switchgear	PRIME ENGINEERING
G1/G2/G3	3 x 725kW, 600V Engine Generator Sets	Kohler

SITE TEST DATE(S): APRIL 7, 2017 – MAY 20, 2017 (SEE SUMMARY PG 2)

TEST WITNESS (*If Applicable*):

NAME	COMPANY	TITLE
Marco Nordio	Thomson Power	Field Service Tech
David Engleman	Thomson Power	Field Service Tech

TEST VALIDATION:

Tests Verified to be Acceptable (except as noted)

NAME	INITIALS

COMMENTS:

Site Test Verification Record – Esquimalt Graving Dock

GCS 2200 Generator Control System

C-054107, W-095112… REV.0 17/06/05

Summary of Site Trip Work:

Date of Visit	Description of Work
• **April 7/2017**	• The purpose of this trip was to perform on site wire tugs and prepare for DC power but status signals were not completed.
• **April 10-13/2017**	• The three days were allotted for Generator control testing, voltage checks and syncing and using the load bank to test load sharing between Generators. Many problems on site due to sync voltage reading were not installed in the correct locations, many wires were left to connect us to the Prime gear.
• **April 24-26/2017**	• This trip was meant to validate all deficiencies integrating the system, some wires going to the BCH-2, Gen tie were pulled short forcing junction points. HMI updates with load names and minor mods to the PLC program occupied the remaining time.
• **April 29/2017**	• Shutdown work was canceled but meetings were arranged for new plan of action. Coordination with Prime regarding the sync signals took the rest of the time.
• **May 19-20**	• During this trip a Marco conducted training with on site operators. After, status checks for all breakers on Primes gear were completed in addition to open close. Discussing terms of facilitating the costumer to do tests off line and how to achieve that concluded our visit.

Table of Contents

1. Physical Inspection

The following sections outline the physical details to be inspected on each piece of equipment.

VERIFIED

1.1. Nameplates on 5 Section GCS 2200 SWBD (per drawing W-095112-010A/020A)

Section 1.. ☑
Section 2.. ☑
Section 3.. ☑
Section 4.. ☑
Section 5.. ☑

VERIFIED

1.2. Controls/Instrumentation on 5 Section GCS 2200 SWBD (per drawing W-095112-010A)

Section 1.. ☑
Analog Metering / Switches
Digital Meter
Gen Protection Relay / 86
Generator Controls
Breaker Open / Close
Sync / Close
Test Blocks TB1/2

Section 2.. ☑
Analog Metering / Switches
Digital Meter
Gen Protection Relay / 86
Generator Controls
Breaker Open / Close
Sync / Close
Test Blocks

Section 3.. ☑
Analog Metering / Switches
Digital Meter
Gen Protection Relay / 86

Generator Controls
Breaker Open / Close
Sync / Close
Test Blocks

Section 4.. ☑
Analog Metering / Switches
Digital Meter
Gen Protection Relay / 86
Generator Controls
Breaker Open / Close
Sync / Close
Test Blocks

Section 5.. ☑
Sync Metering VMs/FMs
Sync Switch (SW3)
System Control Switch (Auto/Man)
Transition Mode Selector (SW4)
Breaker Controls 25/SES-1
Breaker Controls 25/SES-2
Breaker Controls 25/SES-3
Breaker Controls 25/SES-4
Breaker Controls 25/SES-5
Lock Out Relay

D. VISUAL INSPECTION (EQUIPMENT AND INSTALLATION) 1.'

		(Tester Initials)
1.	All control interconnection wiring is complete	DE
2.	All power cabling (as applicable) is complete	DE
3.	Separate conduit runs used for AC/DC & shielded conductors	DE
4.	All equipment grounding/bonds are connected	DE
5.	DC negative conductor is adequately grounded	DE
6.	Any essential missing equipment is installed	DE
7.	Any loose control wiring is isolated	DE
8.	All nameplates on and straight	DE
9.	CSA label is on equipment with correct ratings	DE
10.	Major devices checked for type, rating, size	DE
11.	Breakers/switches checked (amperage, trips)	DE
12.	Panel is clean from excessive dirt	DE

13.	"Wire for Only" devices are properly installed	DG
14.	Other: ______________________	
15.	Other: ______________________	

COMMENTS:

____

____

____

____

____

____

____

E. MECHANICAL INSPECTION (CONTROL PANEL)

		(Tester Initials)
1.	All field wiring connections on ***terminal*** *blocks* to be checked for tightness by pulling sharply with needle nose pliers	DG
2.	Check control panel door hinges, latch and lock mechanisms for free operation	DG
3.	Other: ______________________	
4.	Other: ______________________	
5.	Other: ______________________	

2. Operational Sequences

All automatic control functions shall be site tested using the HMI. All combinations of equipment operation shall be simulated to test the PLC control functions.

2.1. Automatic Logic Test Scenarios

The following sections outline the automatic testing scenarios, with Pass/Fail results and corrective actions or comments where applicable.

Each section refers to the Sequence of Operation section that fully describes the intended operation. For each sequence, enter a check (√) next to each step as it executes successfully.

For all operations, HMI interaction is with the S2400 software.

2.2. AUTO - Utility Failure and Retransfer

Sequence of Operation - System begins as per section 4.1 Utility failure described in Section 4.2. Utility retransfer described in section 4.3.

DND Preferred Utility

Utility Failure .... ☐

Utility Retransfer (Open Transition / Manual Retransfer) .... ☐

Utility Retransfer (Open Transition / Auto Retransfer) .... ☐

Utility Retransfer (Closed Transition / Manual Retransfer) .... ☐

Utility Retransfer (Closed Transition / Auto Retransfer) .... ☐

BCH-1 Preferred Utility

Utility Failure .... ☐

Utility Retransfer (Open Transition / Manual Retransfer) .... ☐

Utility Retransfer (Open Transition / Auto Retransfer) .... ☐

Utility Retransfer (Closed Transition / Manual Retransfer) .... ☐

Utility Retransfer (Closed Transition / Auto Retransfer) .... ☐

BCH-2 Preferred Utility

Utility Failure .... ☐

Utility Retransfer (Open Transition / Manual Retransfer) .... ☐

Utility Retransfer (Open Transition / Auto Retransfer) .... ☐

Utility Retransfer (Closed Transition / Manual Retransfer) .... ☐

Utility Retransfer (Closed Transition / Auto Retransfer) .... ☐

BCH-1 + BCH-2 Preferred Utility

Utility Failure .... ☐

Utility Retransfer (Open Transition / Manual Retransfer) .... ☐

Utility Retransfer (Open Transition / Auto Retransfer) .... ☐

Utility Retransfer (Closed Transition / Manual Retransfer) .... ☐

Utility Retransfer (Closed Transition / Auto Retransfer) .... ☐

2.3. START - Generator Static Test

Sequence of Operation – Section 4.4

Control Switch to START.. ☑

Control Switch to AUTO .... ☑

2.4. TEST- Site Load Test

Sequence of Operation – Section 4.5

2.4.1. Utility DND Preferred

<u>Open Transition</u>

Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

<u>Closed Transition</u>

Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

2.4.2. Utility BCH-1 Preferred

<u>Open Transition</u>

Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

<u>Closed Transition</u>
Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

2.4.3. Utility BCH-2 Preferred

<u>Open Transition</u>
Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

<u>Closed Transition</u>
Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

2.4.4. Utility BCH-1 + BCH-2 Preferred

<u>Open Transition</u>
Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

<u>Closed Transition</u>
Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Control Switch to AUTO .... ☐

Confirm transfer to utility.. ☐

2.4.5. Generator Fail During Test

Control Switch to TEST .... ☐

Confirm transfer to generators.. ☐

Shutdown all generators... ☐

Confirm automatic transfer to utility .... ☐

2.5. Load Bank Control

Sequence of Operation – Section 4.7

2.5.1. PLC 'Manual Steps' Control

Manually run generators to energize the generator bus.

Use the 'CLOSE' buttons to energize load steps.................................. ☑

Use the 'OPEN' buttons to de-energize load steps .... ☑

2.5.2. PLC 'Optimum Load' Control

- Fail a utility so the generators take plant load.
- Set the 'Optimum Gen Load (%)' to 85%.
- Take note of the resolved 'Optimum Load' in kW as noted on the load bank section of the SLD screen.
- Simulate the total generator kW by adjusting the individual generator 4-20mA kW signals
- Steps will be added or removed until the total generator kW is within 50kW of the 'Optimum Load'.

Total generator kW level below 'Optimum Load' kW. Add steps .... ☑

Total generator kW level above 'Optimum Load' kW. Remove steps... ☑

- All load steps will be quickly removed in the following situations:

Load demand begins timing to remove a generator................................ ☐

PSS indicates anticipated load is not online yet...................................... ☐

Utility retransfer initiated .... ☐

2.6. Generator Load Demand

Sequence of Operation – Section 4.8

- Set generator priorities G1=1, G2=2, G3=3, G4=4
- Load Demand – Enable
- N+1 Redundancy – Disable (will enable below)
- Low Fuel Action – Replace Generator
- Gen Alarm Action – Replace Generator

2.6.1. Minimum Run Time

Fail utility (transfer to generators) ☐
Verify that all available generators close to the bus ☑

2.6.2. Reducing Generator Capacity

Decrease generator bus load below the 'stop' setpoint ☑
After delay times out, verify G4 leaves the bus ☑
After another delay times out, verify G3 leaves the bus ☑
After another delay times out, verify G2 leaves the bus ☑
Verify G1 remains on the bus regardless of bus load ☑

2.6.3. Increasing Generator Capacity

Increase generator bus load above the 'start' setpoint ☑
After delay times out, verify G2 comes online ☑
Maintain bus load so that no further generators come online ☑

2.6.4. Total Anticipated Load

Via Modscan, apply 1000kW 'Main Dewatering Pump' load ☐
Verify G2 comes online; G3 may come online if initial load was high ☐
Via Modscan, ensure to remove the 1000kW anticipated load ☐
Repeat for 'Auxiliary Dewatering Pump' load ☐
Repeat for 'Travelling Crane' load ☐
Repeat for 'Air Compressor' load ☐

Repeat for 'Building Load' load... ☐

2.6.5. N+1 Redundancy

Note the number of online generators. Enable N+1 Redundancy.

One additional generator is brought online... ☐

2.6.6. Replacing Failed Generators

Cause a 'common shutdown' on G2.. ☑
Verify G2 breaker opens and generator shuts down .... ☑
Verify that G3 starts and comes online.. ☑
Remove and reset the 'common shutdown' on G2.............................. ☑
Verify G2 starts and comes online.. ☑
Once G2 is online, verify G3 leaves the bus... ☑

2.6.7. Generator Low Fuel Alarm

Simulate the fuel level via Modscan communications.
Cause a low fuel alarm on G2 .... ☐
Verify that G3 starts and comes online.. ☐
Verify G2 breaker opens and generator shuts down .... ☐
Remove and reset the low fuel alarm on G2 .... ☐
Verify G2 starts and comes online.. ☐
Once G2 is online, verify G3 leaves the bus... ☐

2.7. Load Shed

Sequence of Operation – Section 4.9

- Monitor the applicable bits and values via Modscan (Modbus Master)
- Fail utility to force plant load to generators

Shed on Dead Bus .... ☐
Shed on Overload .... ☐
Shed on Under frequency.. ☐

Live analog values .... ☐

3. Communications

3.1. Device Configuration

Confirm all devices have been configured with the proper IP / subnet address. If correct, enter a check (√) in the test form column.

Ethernet HMI			**IP Address**	**Result Pass(√) Fail(x)**
Subnet 255.255.255.0				
Default Gateway 192.168.250.3				
PLC CPU	20.019	1756-L72/B		
PLC Ethernet	10.007	1756-EN2T/D	192.168.250.1	
PLC Modbus	Prosoft	MVI56-MNET	192.168.250.2	
HMI	IEI	PPC5190	192.168.250.3	
Gen 1 DMS	Schneider	ION-7650	192.168.250.11	
Gen 2 DMS	Schneider	ION-7650	192.168.250.12	
Gen 3 DMS	Schneider	ION-7650	192.168.250.13	
Gen 4 DMS	Schneider	ION-7650	192.168.250.14	
Load Bank DMS	Schneider	PM8240	192.168.250.15	*n/a*
Gen 1 700G	SEL	700G	192.168.250.21	
Gen 2 700G	SEL	700G	192.168.250.22	
Gen 3 700G	SEL	700G	192.168.250.23	
Gen 4 700G	SEL	700G	192.168.250.24	
Ethernet Woodward			**IP Address**	
Subnet 255.255.255.0				
Gen 1 DSLC-2	Woodward	DSLC-2	192.168.0.1	
Gen 2 DSLC-2	Woodward	DSLC-2	192.168.0.2	
Gen 3 DSLC-2	Woodward	DSLC-2	192.168.0.3	
Gen 4 DSLC-2	Woodward	DSLC-2	192.168.0.4	
DND Utility MSLC-2	Woodward	MSLC-2	192.168.0.33	
BCH-1 Utility MSLC-2	Woodward	MSLC-2	192.168.0.34	
BCH-2 Utility MSLC-2	Woodward	MSLC-2	192.168.0.35	
Gen Main MSLC-2	Woodward	MSLC-2	192.168.0.36	

3.2. PSS Write

As per the table in the Sequence of Operations section 8.1, use Modscan to connect a remote PC to write each value into the PLC. If confirmed, enter a check (√) in the test form column.

PSS Write .... ☐

3.3. PSS Read

As per the table in the Sequence of Operations section 8.2, use Modscan to connect a remote PC to read values from the PLC. If confirmed, enter a check (√) in the test form column.

PSS Read .... ☐

4. Additional Tests

- DND breaker in TEST open/close/status ☑
- BCH-1 breaker in TEST open/close/status ☑
- BCH-2 breaker in TEST open/close/status ☑
- Gen Tie in TEST open/close/status ☑
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

5. SAT Test Notes, Comments or Observations

No deficiencies (unless listed below)		

DEFICIENCIES: (☐ Refer to attached Deficiency List)

☐ **None**

Item No.	Description	Action By	Due Date	Rectified (Tester Initials)	(Date)

Site Test Verification Record – Esquimalt Graving Dock

GCS 2200 Generator Control System

C-054107, W-095112… REV.0 17/06/05

COMMENTS / RECOMMENDATIONS: (☐ Refer to attached detailed Service Report)

further site integration testing to be completed

WITNESS TEST / VALIDATION

	VERIFIED (Tester Signature)	(Date)
Site Tested By: (Technician Name/Title)		

---------------------- *If Applicable* ---------------

	(Witness Signature)	*(Date)*
Witness Tested By: *(Customer Name/Title)*		

Schneider Canada Services & Projects

Document Ref: 1.0

Esquimalt Graving Dock: Standby Generation SCADA testing

Q2C: 39022265-001/002

Date: 29/05/2017

Revision: 1.0

Branch office:
Schneider Electric Canada, Inc.
Energy Management and Sustainability Services
2195 Keating Cross Road
Canada V8M 2A5
Tel: 250-652-7100

Main office:
Schneider Electric Canada, Inc.
5985 McLaughlin Road
Mississauga, ON L5R 1B8
Tel: 1-800-565-6699
www.schneider-electric.com

Revision no.	**Date**	**Comments**
1.0	May 29, 2017	Initial document

Table of Contents

1 Introduction

On March 20th, 2017 a scheduled shutdown was performed at the Esquimalt Graving Dock in order to run simulations on the TCS system and load restoration of breaker. None of SES breakers other than the DND and main generator breakers were operated in this test. Testing on PSS side was limited to simulating the sequence of events and sending reclosure commands to the breakers.

A test function was written that when enabled will disable the live load restoration functions so that tests and simulations can be performed.

The information below is limited to tests and simulations performance on the PSS.

This is document is not a configuration report and it will only contain

2 TSC register reads/write

The table below summarized the testing of the register tags read from the TCS and registers that are written to the TCS by the EGD SCADA system. Only select registers a written to the TCS system for use of managing the generation capacity. No other control functions

An “ok” entry indicates data point is read correctly comparing to the TCS HMI. While an “N/A” value indicates that testing for this tag was not available or no test was able to be done at the time.

Tag	Label	Register Test
DND\Breaker_Closed	@(Utility DND Breaker Closed)	Ok
DND\Fail_Time	@(Utility DND Fail Time)	Ok: read but value does not change
DND\Fail_to_Close	@(Utility DND Fail to Close)	Ok
DND\Fail_to_Open	@(Utility DND Fail to Open)	n/a
DND\Fail_to_Unload	@(Utility DND Fail to Unload)	n/a
DND\kW	@(Utility DND kW)	Ok: read but value does not change
DND\MSLC_Alarm	@(Utility DND MSLC Alarm)	Ok
DND\Out_of_Limits	@(Utility DND Out of Limits)	Ok
DND\Preferred	@(Utility DND Preferred)	Ok
DND\Protection_Tripped	@(Utility DND Protection Tripped)	Ok
DND\Retransfer_Time	@(Utility DND Retransfer Time)	Ok
DND\Sync_Attempts	@(Utility DND Sync Attempts)	Ok
DND\Sync_Output	@(Utility DND Synchronize Output)	Ok: read but value does not change
DND\Sync_Time	@(Utility DND Sync Time)	Ok: read but value does not change
DND\utility_failed	@(Utility DND Utility Failed)	Ok: read but value does not change
DND\Utility_NA	@(Utility DND N/A)	Ok
GENBUS\capacity_online_gens	@(600V Gen Bus Capacity of Online Gens)	Ok
GENBUS\gen_bus_load	@(600V Gen Bus Load)	Ok
GENBUS\gen_bus_load_perc	@(600V Gen Bus Load %)	Ok
GENBUS\gen_bus_reserve	@(600V Gen Bus Reserve kW)	Ok
GENBUS\HMI_load_dmd_dly_strt	@(600V Gen Bus Load Dmd HMI Load Dmd Dly Strt)	Ok
GENBUS\HMI_load_dmd_im_start	@(600V Gen Bus Load Dmd HMI Load Dmd Im Start)	Ok
GENBUS\HMI_load_dmd_stop	@(600V Gen Bus Load Dmd HMI Load Dmd Stop)	Ok
GENBUS\HMI_load_dmd_stop_time	@(600V Gen Bus Load Dmd HMI Load Dmd Stop Time)	Ok
GENBUS\HMI_load_dmd_strt_dly_t	@(600V Gen Bus Load Dmd HMI Load Dmd Dly Strt T)	Ok
GENBUS\load_shed_loads_shed	@(600V Gen Bus Load Shed Loads have been Shed)	Ok
GENBUS\load_shed_on_dead_bus	@(600V Gen Bus Load Shed Load Shed on Dead Bus)	Ok

GENBUS\load_shed_on_overload	@(600V Gen Bus Load Shed Load Shed on Overload)	Ok
GENBUS\load_shed_on_under_freq	@(600V Gen Bus Load Shed Load Shed on Under F)	Ok
GENBUS\num_gens_online	@(600V Gen Bus No of Generators Online)	Ok
LOADBANK\ALARM	@(Load Bank Alarm)	Ok
LOADBANK\DUMPOP	@(Load Bank Dump Output)	Ok
LOADBANK\ENLST1	@(Load Bank Energize Load Step 1)	Ok
LOADBANK\ENLST10	@(Load Bank Energize Load Step 10)	Ok
LOADBANK\ENLST11	@(Load Bank Energize Load Step 11)	Ok
LOADBANK\ENLST12	@(Load Bank Energize Load Step 12)	Ok
LOADBANK\ENLST13	@(Load Bank Energize Load Step 13)	Ok
LOADBANK\ENLST14	@(Load Bank Energize Load Step 14)	Ok
LOADBANK\ENLST15	@(Load Bank Energize Load Step 15)	Ok
LOADBANK\ENLST16	@(Load Bank Energize Load Step 16)	Ok
LOADBANK\ENLST17	@(Load Bank Energize Load Step 17)	Ok
LOADBANK\ENLST18	@(Load Bank Energize Load Step 18)	Ok
LOADBANK\ENLST19	@(Load Bank Energize Load Step 19)	Ok
LOADBANK\ENLST2	@(Load Bank Energize Load Step 2)	Ok
LOADBANK\ENLST20	@(Load Bank Energize Load Step 20)	Ok
LOADBANK\ENLST3	@(Load Bank Energize Load Step 3)	Ok
LOADBANK\ENLST4	@(Load Bank Energize Load Step 4)	Ok
LOADBANK\ENLST5	@(Load Bank Energize Load Step 5)	Ok
LOADBANK\ENLST6	@(Load Bank Energize Load Step 6)	Ok
LOADBANK\ENLST7	@(Load Bank Energize Load Step 7)	Ok
LOADBANK\ENLST8	@(Load Bank Energize Load Step 8)	Ok
LOADBANK\ENLST9	@(Load Bank Energize Load Step 9)	Ok
LOADBANK\LBKWCALC	@(Load Bank Load Bank kW Calculated)	Ok
LOADBANK\LSO	@(Load Bank Load Steps Online)	Ok
LOADBANK\LSR	@(Load Bank Load Steps Required)	Ok
LOADBANK\MCRE	@(Load Bank Master Control Relay is Energized)	Ok
LOADBANK\MCS1	@(Load Bank Manual Close Step 1)	Ok
LOADBANK\MCS10	@(Load Bank Manual Close Step 10)	Ok
LOADBANK\MCS11	@(Load Bank Manual Close Step 11)	Ok
LOADBANK\MCS12	@(Load Bank Manual Close Step 12)	Ok
LOADBANK\MCS13	@(Load Bank Manual Close Step 13)	Ok
LOADBANK\MCS14	@(Load Bank Manual Close Step 14)	Ok
LOADBANK\MCS15	@(Load Bank Manual Close Step 15)	Ok
LOADBANK\MCS16	@(Load Bank Manual Close Step 16)	Ok
LOADBANK\MCS17	@(Load Bank Manual Close Step 17)	Ok
LOADBANK\MCS18	@(Load Bank Manual Close Step 18)	Ok

LOADBANK\MCS19	@(Load Bank Manual Close Step 19)	Ok
LOADBANK\MCS2	@(Load Bank Manual Close Step 2)	Ok
LOADBANK\MCS20	@(Load Bank Manual Close Step 20)	Ok
LOADBANK\MCS3	@(Load Bank Manual Close Step 3)	Ok
LOADBANK\MCS4	@(Load Bank Manual Close Step 4)	Ok
LOADBANK\MCS5	@(Load Bank Manual Close Step 5)	Ok
LOADBANK\MCS6	@(Load Bank Manual Close Step 6)	Ok
LOADBANK\MCS7	@(Load Bank Manual Close Step 7)	Ok
LOADBANK\MCS8	@(Load Bank Manual Close Step 8)	Ok
LOADBANK\MCS9	@(Load Bank Manual Close Step 9)	Ok
LOADBANK\NIAUTOALRM	@(Load Bank Not In Auto Alarm)	Ok
LOADBANK\OK2ASIMAN	@(Load Bank Okay to Add Steps in MANUAL)	Ok
LOADBANK\OK2ASSIA	@(Load Bank Okay to Add/Subtract Steps in AUTO)	Ok
LOADBANK\OLSPKWI	@(Load Bank Optimum Load Setpoint Internal)	Ok
LOADBANK\PLCCONAUTO	@(Load Bank PLC Control AUTO)	Ok
LOADBANK\PLCCONMAN	@(Load Bank PLC Control MANUAL)	Ok
LOADBANK\SWAUTO	@(Load Bank Switch in AUTO)	Ok
MAINBRK\gen_main_brk_closed	@(25kV Gen Main Breaker Closed)	Ok
MISCBRK\gen_main_brk_close_fail	@(25kV Gen Main Breaker Fail to Close)	Ok
MISCBRK\gen_main_brk_kw	@(25kV Gen Main Breaker kW)	Ok
MISCBRK\gen_main_brk_MSLC	@(25kV Gen Main Breaker MSLC Alarm)	ok
MISCBRK\gen_main_brk_open_fail	@(25kV Gen Main Breaker Fail to Open)	Ok
MISCBRK\gen_main_brk_sync_att	@(25kV Gen Main Breaker Sync Attempts)	Ok: read but value does not change
MISCBRK\gen_main_brk_sync_time	@(25kV Gen Main Breaker Sync Time)	Ok: read but value does not change
MISCBRK\gen_main_brk_tripped	@(25kV Gen Main Breaker Protection Tripped)	Ok
MISCBRK\gen_main_brk_unload_fail	@(25kV Gen Main Breaker Fail to Unload)	Ok
MISCBRK\loadbank_brk_closed	@(Load Bank Breaker Breaker Closed)	ok
MISCBRK\loadbank_brk_kw	@(Load Bank Breaker Power)	ok
MISCBRK\main_gen_brk_sync	@(25kV Gen Main Breaker Synchronize Output)	ok
MISCBRK\SES6_SP2_closed	@(Feeder Breaker 6SES-SP-2 Closed)	ok
MISCBRK\tie_brk_close_fail	@(25kV Bus Tie Breaker Fail to Close)	Ok
MISCBRK\tie_brk_closed	@(25kV Bus Tie Breaker Closed)	ok
MISCBRK\tie_brk_fail_open	@(25kV Bus Tie Breaker Fail to Open)	Ok
MISCBRK\tie_brk_tripped	@(25kV Bus Tie Breaker Protection Tripped)	Ok
PSSWRITE\ABNOAC_R	@(Anticipated But Not Online R- Air Compressors)	ok
PSSWRITE\ABNOAC_W	@(Anticipated But Not Online W- Air Compressors)	ok
PSSWRITE\ABNOAD_R	@(Anticipated But Not Online R- Aux Dewatering)	ok
PSSWRITE\ABNOAD_W	@(Anticipated But Not Online W- Aux Dewatering)	ok
PSSWRITE\ABNOBL_R	@(Anticipated But Not Online R- Building Loads)	ok
PSSWRITE\ABNOBL_W	@(Anticipated But Not Online W- Building Loads)	ok
PSSWRITE\ABNOMD_R	@(Anticipated But Not Online R- Main Dewatering)	ok
PSSWRITE\ABNOMD_W	@(Anticipated But Not Online W- Main Dewatering)	ok
PSSWRITE\ABNOTC_R	@(Anticipated But Not Online R- Travelling Crane)	ok
PSSWRITE\ABNOTC_W	@(Anticipated But Not Online W- Travelling Crane)	ok
PSSWRITE\ALAC	@(Anticipated Load - Air Compressors)	ok

PSSWRITE\ALADP	@(Anticipated Load - Aux Dewatering Pumps)	ok
PSSWRITE\ALBL	@(Anticipated Load - Building Loads)	ok
PSSWRITE\ALMDP	@(Anticipated Load - Main Dewatering Pumps)	ok
PSSWRITE\ALTC	@(Anticipated Load - Travelling Cranes)	ok
PSSWRITE\Gen_1_Fuel_Vol_L	@(Generator 1 Fuel Volume)	ok
PSSWRITE\Gen_2_Fuel_Vol_L	@(Generator 2 Fuel Volume)	ok
PSSWRITE\Gen_3_Fuel_Vol_L	@(Generator 3 Fuel Volume)	ok
PSSWRITE\WV	@(Watchdog value)	ok
SETPOINTS\CLOSEDTRANS	@(Closed Transition Selected)	ok
SETPOINTS\COMALRMACT	@(Common Alarm Action)	ok
SETPOINTS\F2CDLY	@(Fail to Close Delay Preset)	ok
SETPOINTS\F2ODLY	@(Fail to Open Delay Preset)	ok
SETPOINTS\F2STRTDLY	@(Fail to Start Delay Preset)	ok
SETPOINTS\F2SYNCDLY	@(Fail to Sync Delay Preset)	ok
SETPOINTS\F2ULDLY	@(Fail to Unload Delay Preset)	ok
SETPOINTS\FAILSTART	@(Fail to Start Action)	ok
SETPOINTS\FAILSYNC	@(Fail to Sync Action)	ok
SETPOINTS\FDRULSP	@(Feeder Unloaded Setpoint)	ok
SETPOINTS\GENEXTRT	@(Gen Extended Runtime Preset)	ok
SETPOINTS\GENWARMUPTIME	@(Gen Warm Up Time Preset)	ok
SETPOINTS\LBDLY	@(Live Bus Delay Preset)	ok
SETPOINTS\LBINITDLY	@(Load Bank Initial Delay Timer Preset)	ok
SETPOINTS\LBSTEPADDDLY	@(Load Bank Step Add Delay Timer Preset)	ok
SETPOINTS\LBSTEPFSUBDLY	@(Load Bank Step Fast Subtract Delay Timer Pres)	ok
SETPOINTS\LBSTEPSUBDLY	@(Load Bank Step Subtract Delay Timer Preset)	ok
SETPOINTS\LDDLYSTP	@(Load Demand Delayed Stop Timer Preset)	ok
SETPOINTS\LDMDALEN	@(Load Demand - Anticipated Loads Enabled)	ok
SETPOINTS\LDMDDLYSTPSP	@(Load Demand Delayed Stop Setpoint)	ok
SETPOINTS\LDMDDLYSTRT	@(Load Demand Delayed Start Timer Preset)	ok
SETPOINTS\LDMDDLYSTRTSP	@(Load Demand Delayed Start Setpoint)	ok
SETPOINTS\LDMDEN	@(Load Demand Enabled)	ok
SETPOINTS\LDMDIMSTRTSP	@(Load Demand Immediate Start Setpoint)	ok
SETPOINTS\LDMDN1EN	@(Load Demand - N+1 Redundancy Enabled)	ok
SETPOINTS\LFSP	@(Low Fuel Alarm Setpoint)	ok
SETPOINTS\LOADBANKOPTSP	@(Load Bank Optimum Load Setpoint)	ok
SETPOINTS\LOADSHEDDBUS	@(Load Shed on Dead Bus Enabled)	ok
SETPOINTS\LOADSHEDOL	@(Load Shed on Overload Enabled)	ok
SETPOINTS\LOADSHEDOLSP	@(Load Shed Overload Setpoint)	ok
SETPOINTS\LOADSHEDUFREQ	@(Load Shed on Underfrequency Enabled)	ok

SETPOINTS\LOWFUEL	@(Low Fuel Action)	ok
SETPOINTS\MINRT	@(Minimum Run Time Preset)	ok
SETPOINTS\NDLY	@(Neutral Delay Preset)	ok
SETPOINTS\NGENREQ4TRAN	@(Number of generators required for transfer)	ok
SETPOINTS\SRCFDLY	@(Source Failure Delay Preset)	ok
SETPOINTS\UTILRETRANAUTO	@(Utility Retransfer in Auto)	ok
SETPOINTS\UTILRETRANDLY	@(Utility Retransfer Delay Preset)	ok
SETPOINTS\W4REQGEN	@(Wait For Required Gens Timer Preset)	ok
SYSPLC\B1LIVE	@(25kV Bus 1 Live Bus)	ok
SYSPLC\B2LIVE	@(25kV Bus 2 Live Bus)	ok
SYSPLC\BSTM	@(Block the System TEST Mode)	ok
SYSPLC\GENBLIVE	@(600V Generator Bus Live Bus)	ok
SYSPLC\SMSA	@(System Mode Switch - AUTO)	ok
SYSPLC\SMSM	@(System Mode Switch - MANUAL)	ok
SYSPLC\SMSS	@(System Mode Switch - START)	ok
SYSPLC\SMST	@(System Mode Switch - TEST)	ok

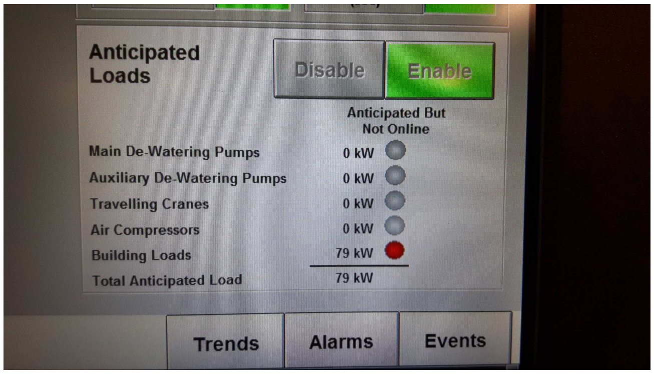
The follow generator tags read and written to and from the TCS have been confirmed.

Tag	Label	Register Test
SSES_Generator1\Gen_Entered_Priority	@(Generator Entered Priority)	ok
SSES_Generator1\MMXU1\TotW	@(Active Power)	ok
SSES_Generator1\Gen_Fuel_Consumption	@(Generator Fuel Consumption)	ok
SSES_Generator1\Gen_Fuel_Time_Rem_Hour	@(Generator Fuel Time Remaining Hours)	ok
SSES_Generator1\Gen_Fuel_Time_Rem_Min	@(Generator Fuel Time Remaining Minutes)	ok
SSES_Generator1\Gen_Fuel_Volume	@(Generator Fuel Volume %)	ok
SSES_Generator1\Gen_Fuel_Volume_L	@(Generator Fuel Volume L)	ok
SSES_Generator1\Gen_Sync_Attempts	@(Generator Sync Attempts)	ok
SSES_Generator1\Gen_Sync_Time	@(Generator Sync Time)	ok
SSES_Generator1\Gen_Warmup_Time	@(Generator WarmupTime)	ok
SSES_Generator1\Gen_Available	@(Generator Available)	ok
SSES_Generator1\Gen_Running	@(Generatror Running)	ok
SSES_Generator1\Gen_Brk_Closed	@(Generator Breaker Closed)	ok
SSES_Generator1\Gen_Engine_Start	@(Generator Engine Start)	ok
SSES_Generator1\Gen_Sync_to_Bus	@(Generator Sync to Bus)	ok
SSES_Generator1\Gen_Common_Alarm	@(Generator Common Alarm)	ok
SSES_Generator1\Gen_Brk_WIthdrwawn	@(Generator Breaker WIthdrawn)	ok
SSES_Generator1\Gen_Common_Shutdown	@(Generator Common Shutdown)	ok
SSES_Generator1\Gen_Protection_Tripped	@(Generator Protection Tripped)	ok
SSES_Generator1\Gen_Local_Brk_Open	@(Generator Local Breaker Open)	ok
SSES_Generator1\Gen_Protectiion_Relay_Alarm	@(Generator Protection Relay Alarm)	ok
SSES_Generator1\Gen_Not_In_Auto	@(Generator Not In Auto)	ok
SSES_Generator1\Gen_DSLC_Alarm	@(Generator DSLC Alarm)	ok
SSES_Generator1\Gen_Fail_to_Close	@(Generator Fail to Close)	ok
SSES_Generator1\Gen_Low_Fuel_Alarm	@(Generator Low Fuel Alarm)	ok
SSES_Generator1\Gen_Fail_to_Open	@(Generator Fail to Open)	ok

SSES_Generator1\Gen_Fail_to_Unload	@(Generator Fail to Unload)	ok
SSES_Generator1\Gen_Fail_to_Start_Alarm	@(Generator Fail to Start Alarm)	ok
SSES_Generator2\Gen_Entered_Priority	@(Generator Entered Priority)	ok
SSES_Generator2\MMXU1\TotW	@(Active Power)	ok
SSES_Generator2\Gen_Fuel_Consumption	@(Generator Fuel Consumption)	ok
SSES_Generator2\Gen_Fuel_Time_Rem_Hour	@(Generator Fuel Time Remaining Hours)	ok
SSES_Generator2\Gen_Fuel_Time_Rem_Min	@(Generator Fuel Time Remaining Minutes)	ok
SSES_Generator2\Gen_Fuel_Volume	@(Generator Fuel Volume %)	ok
SSES_Generator2\Gen_Fuel_Volume_L	@(Generator Fuel Volume L)	ok
SSES_Generator2\Gen_Sync_Attempts	@(Generator Sync Attempts)	ok
SSES_Generator2\Gen_Sync_Time	@(Generator Sync Time)	ok
SSES_Generator2\Gen_Warmup_Time	@(Generator WarmupTime)	ok
SSES_Generator2\Gen_Available	@(Generator Available)	ok
SSES_Generator2\Gen_Running	@(Generatror Running)	ok
SSES_Generator2\Gen_Brk_Closed	@(Generator Breaker Closed)	ok
SSES_Generator2\Gen_Engine_Start	@(Generator Engine Start)	ok
SSES_Generator2\Gen_Sync_to_Bus	@(Generator Sync to Bus)	ok
SSES_Generator2\Gen_Common_Alarm	@(Generator Common Alarm)	ok
SSES_Generator2\Gen_Brk_WIthdrwawn	@(Generator Breaker WIthdrawn)	ok
SSES_Generator2\Gen_Common_Shutdown	@(Generator Common Shutdown)	ok
SSES_Generator2\Gen_Protection_Tripped	@(Generator Protection Tripped)	ok
SSES_Generator2\Gen_Local_Brk_Open	@(Generator Local Breaker Open)	ok
SSES_Generator2\Gen_Protectiion_Relay_Alarm	@(Generator Protection Relay Alarm)	ok
SSES_Generator2\Gen_Not_In_Auto	@(Generator Not In Auto)	ok
SSES_Generator2\Gen_DSLC_Alarm	@(Generator DSLC Alarm)	ok
SSES_Generator2\Gen_Fail_to_Close	@(Generator Fail to Close)	ok
SSES_Generator2\Gen_Low_Fuel_Alarm	@(Generator Low Fuel Alarm)	ok
SSES_Generator2\Gen_Fail_to_Open	@(Generator Fail to Open)	ok
SSES_Generator2\Gen_Fail_to_Unload	@(Generator Fail to Unload)	ok
SSES_Generator2\Gen_Fail_to_Start_Alarm	@(Generator Fail to Start Alarm)	ok
SSES_Generator3\Gen_Entered_Priority	@(Generator Entered Priority)	ok
SSES_Generator3\MMXU1\TotW	@(Active Power)	ok
SSES_Generator3\Gen_Fuel_Consumption	@(Generator Fuel Consumption)	ok
SSES_Generator3\Gen_Fuel_Time_Rem_Hour	@(Generator Fuel Time Remaining Hours)	ok
SSES_Generator3\Gen_Fuel_Time_Rem_Min	@(Generator Fuel Time Remaining Minutes)	ok
SSES_Generator3\Gen_Fuel_Volume	@(Generator Fuel Volume %)	ok
SSES_Generator3\Gen_Fuel_Volume_L	@(Generator Fuel Volume L)	ok
SSES_Generator3\Gen_Sync_Attempts	@(Generator Sync Attempts)	ok
SSES_Generator3\Gen_Sync_Time	@(Generator Sync Time)	ok
SSES_Generator3\Gen_Warmup_Time	@(Generator WarmupTime)	ok
SSES_Generator3\Gen_Available	@(Generator Available)	ok
SSES_Generator3\Gen_Running	@(Generatror Running)	ok
SSES_Generator3\Gen_Brk_Closed	@(Generator Breaker Closed)	ok
SSES_Generator3\Gen_Engine_Start	@(Generator Engine Start)	ok
SSES_Generator3\Gen_Sync_to_Bus	@(Generator Sync to Bus)	ok
SSES_Generator3\Gen_Common_Alarm	@(Generator Common Alarm)	ok
SSES_Generator3\Gen_Brk_WIthdrwawn	@(Generator Breaker WIthdrawn)	ok
SSES_Generator3\Gen_Common_Shutdown	@(Generator Common Shutdown)	ok
SSES_Generator3\Gen_Protection_Tripped	@(Generator Protection Tripped)	ok
SSES_Generator3\Gen_Local_Brk_Open	@(Generator Local Breaker Open)	ok
SSES_Generator3\Gen_Protectiion_Relay_Alarm	@(Generator Protection Relay Alarm)	ok
SSES_Generator3\Gen_Not_In_Auto	@(Generator Not In Auto)	ok
SSES_Generator3\Gen_DSLC_Alarm	@(Generator DSLC Alarm)	ok
SSES_Generator3\Gen_Fail_to_Close	@(Generator Fail to Close)	ok

SSES_Generator3\Gen_Low_Fuel_Alarm	@(Generator Low Fuel Alarm)	ok
SSES_Generator3\Gen_Fail_to_Open	@(Generator Fail to Open)	ok
SSES_Generator3\Gen_Fail_to_Unload	@(Generator Fail to Unload)	ok
SSES_Generator3\Gen_Fail_to_Start_Alarm	@(Generator Fail to Start Alarm)	ok

Image of HMI display with values written from PSS to TCS PLC.



Anticipated Loads

	Anticipated But Not Online	
Main De-Watering Pumps	0 kW	○
Auxiliary De-Watering Pumps	0 kW	○
Travelling Cranes	0 kW	○
Air Compressors	0 kW	○
Building Loads	79 kW	●
Total Anticipated Load	79 kW	

The “enable” of the anticipated loads function via the HMI appears to only enable the inclusion and calculation of the anticipated total loads. These values are constantly written to the TCS PLC unless the write enable function is disabled from the SCADA screen.

3 Load Restoration Simulation

When the PSS is running under normal operation it will continuously evaluate the signals read by the TCS to determine if the system is running normally, under generator power, and when the system is read to begin the load restoration sequence.

1. Is the load restoration function enabled: this is a user interface toggle function that can only be enabled/disabled when a level 6 user logs in
2. The preferred utility failed: function checks the flag for the preferred utility read from the TCS has failed. A “utility failed” indication is supplied primarily from the protection relay SES 25/12 CB-01.
3. Are the generators online and is the 600V bus energized: when X generators have been brought online and the generator breaker(s) have been closed, the TCS will determine if the 600V generator bus has been energized. The PSS will read this flag.
4. The main generator feed breaker has been closed and the bus is live: the TCS will have full control over the main generator breaker SES 25/12 CB-02. When the breaker is closed and bus is energized the load restoration sequence will commence after the prescribed delay.

When the above conditions are met, a program will be executed to commence the load restoration sequence for breaker that are configured into the load restoration program.

A “Test mode” enable is available in the load restoration screen. When this is enabled, the live load restoration function is disabled and the load restoration function goes into a test/simulation mode.

While in test mode, the actual signals from the TCS are used or the signals from test button. The buttons and indications will only appear when test mode is enabled. The simulation buttons allow the user to simulate conditions that would normally trigger the load restoration sequence.

Status LEDs indicate the conditions and status of the load restoration sequence.

The Load Restoration screen has an edit mode which enables users to configure the load control priority. Breakers configured with a load control priority of 0 are ignored. All of the events are time-stamped and are observable in the PSS event log.

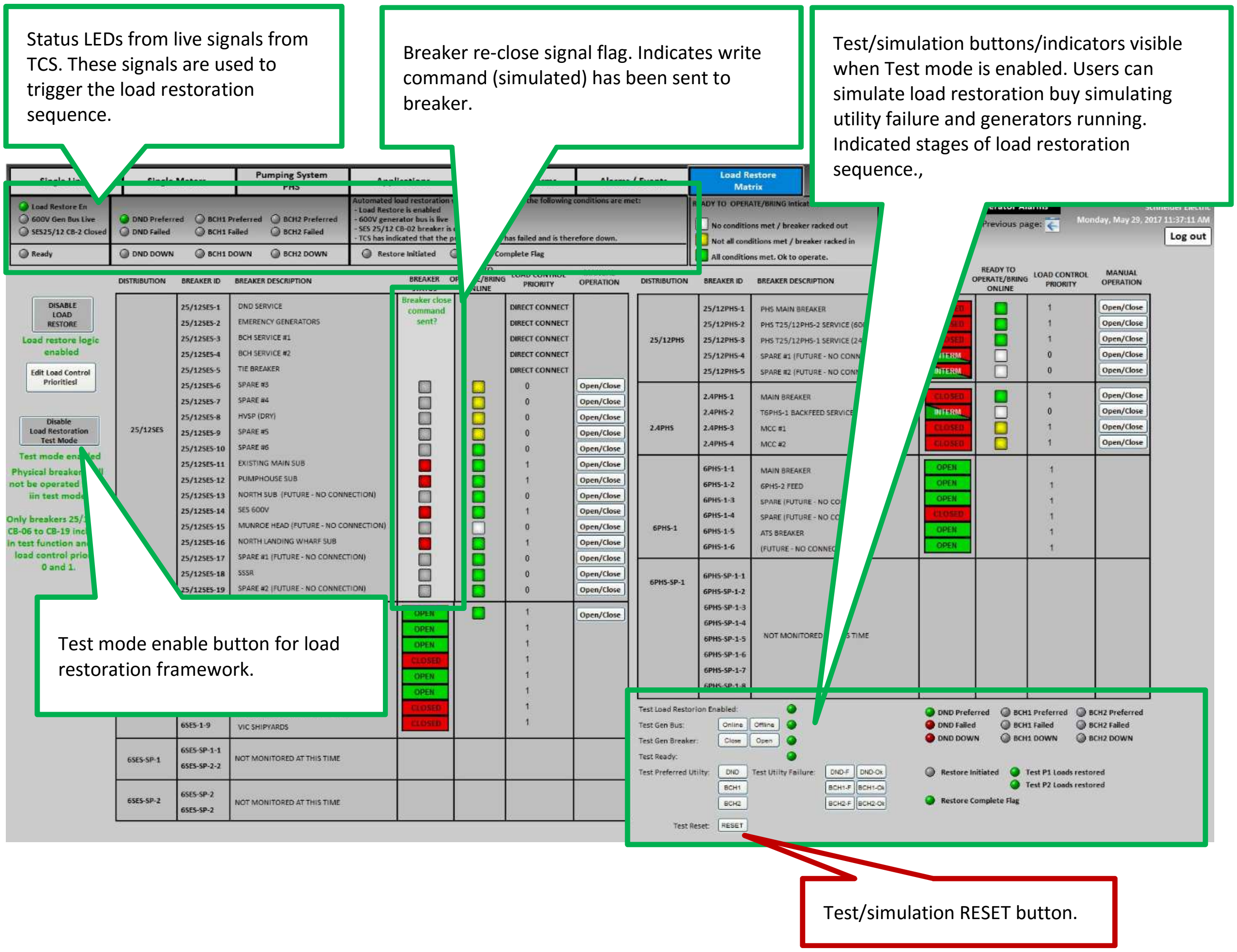
To test the load restoration framework the following sequence of events was triggered:

1. Load restoration enabled
2. DND breaker opened
3. TCS determined that DND utility failed
4. TCS started up generators and closed individual generator feed breakers
5. TCS closed the main generator feed breaker to the SES 25/12Kv distribution

At this point the load restoration sequence will be triggered.

When viewing the Load Restoration page, users will see all of the above stages as well as the events triggered in the event log.

Refer to the screen shots below for details on the information displayed:



Status LEDs from live signals from TCS. These signals are used to trigger the load restoration sequence.

Breaker re-close signal flag. Indicates write command (simulated) has been sent to breaker.

Test/simulation buttons/indicators visible when Test mode is enabled. Users can simulate load restoration buy simulating utility failure and generators running. Indicated stages of load restoration sequence.,

Test mode enable button for load restoration framework.

Test/simulation RESET button.

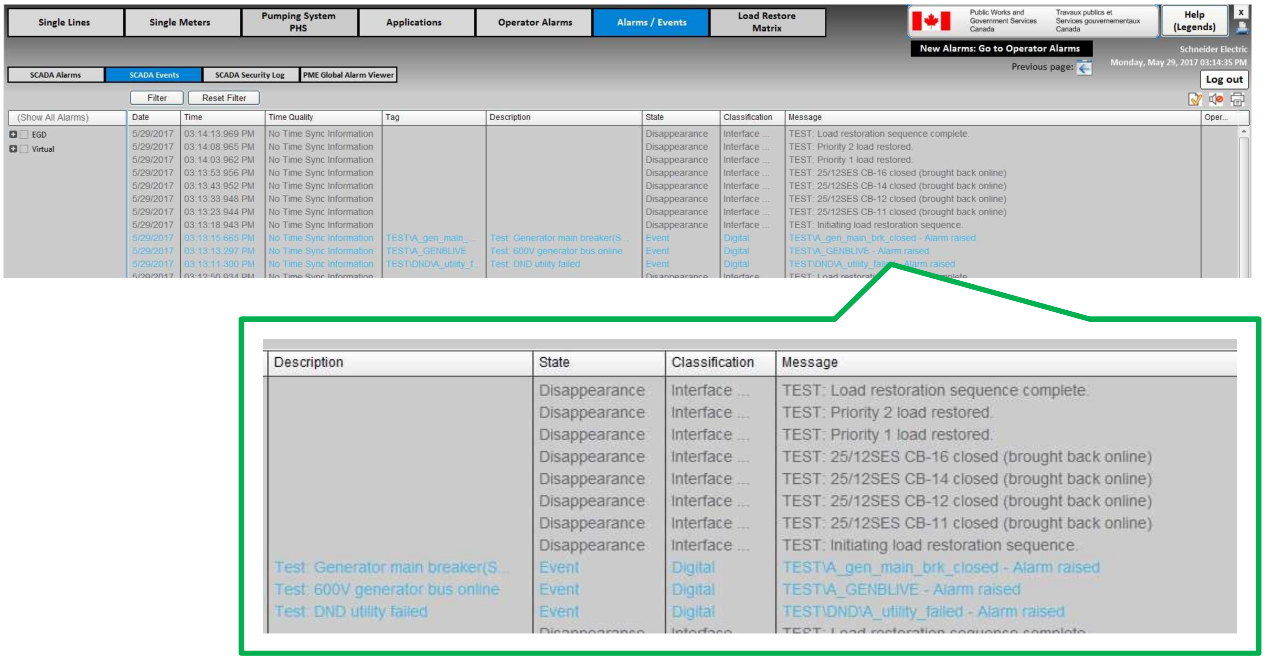
DISTRIBUTION	BREAKER ID	BREAKER DESCRIPTION	Breaker close command sent?		LOAD CONTROL PRIORITY	MANUAL OPERATION
25/12SES	25/12SES-1	DND SERVICE			DIRECT CONNECT	
	25/12SES-2	EMERENCY GENERATORS			DIRECT CONNECT	
	25/12SES-3	BCH SERVICE #1			DIRECT CONNECT	
	25/12SES-4	BCH SERVICE #2			DIRECT CONNECT	
	25/12SES-5	TIE BREAKER			DIRECT CONNECT	
	25/12SES-6	SPARE #3	⬜	🟨	0	Open/Close
	25/12SES-7	SPARE #4	⬜	🟨	0	Open/Close
	25/12SES-8	HVSP (DRY)	⬜	🟨	0	Open/Close
	25/12SES-9	SPARE #5	⬜	🟨	0	Open/Close
	25/12SES-10	SPARE #6	⬜	🟩	0	Open/Close
	25/12SES-11	EXISTING MAIN SUB	🟥	🟩	1	Open/Close
	25/12SES-12	PUMPHOUSE SUB	🟥	🟩	1	Open/Close
	25/12SES-13	NORTH SUB (FUTURE - NO CONNECTION)	⬜	🟩	0	Open/Close
	25/12SES-14	SES 600V	🟥	🟩	1	Open/Close
	25/12SES-15	MUNROE HEAD (FUTURE - NO CONNECTION)	⬜	⬜	0	Open/Close
	25/12SES-16	NORTH LANDING WHARF SUB	🟥	🟩	1	Open/Close
	25/12SES-17	SPARE #1 (FUTURE - NO CONNECTION)	⬜	🟩	0	Open/Close
	25/12SES-18	SSSR	⬜	🟩	0	Open/Close
	25/12SES-19	SPARE #2 (FUTURE - NO CONNECTION)	⬜	🟩	0	Open/Close
	6SES-1-9	VIC SHIPYARDS	CLOSED		1	
6SES-SP-1	6SES-SP-1-1 6SES-SP-2-2	NOT MONITORED AT THIS TIME				
6SES-SP-2	6SES-SP-2 6SES-SP-2	NOT MONITORED AT THIS TIME				

DISTRIBUTION	BREAKER ID	BREAKER DESCRIPTION		READY TO OPERATE/BRING ONLINE	LOAD CONTROL PRIORITY	MANUAL OPERATION
25/12PHS	25/12PHS-1	PHS MAIN BREAKER		🟩	1	Open/Close
	25/12PHS-2	PHS T25/12PHS-2 SERVICE (60		🟩	1	Open/Close
	25/12PHS-3	PHS T25/12PHS-1 SERVICE (24		🟩	1	Open/Close
	25/12PHS-4	SPARE #1 (FUTURE - NO CONN		⬜	0	Open/Close
	25/12PHS-5	SPARE #2 (FUTURE - NO CONN		⬜	0	Open/Close
2.4PHS	2.4PHS-1	MAIN BREAKER	CLOSED	🟩	1	Open/Close
	2.4PHS-2	T6PHS-1 BACKFEED SERVICE	INTERM	⬜	0	Open/Close
	2.4PHS-3	MCC #1	CLOSED	🟨	1	Open/Close
	2.4PHS-4	MCC #2	CLOSED	🟨	1	Open/Close
6PHS-1	6PHS-1-1	MAIN BREAKER	OPEN		1	
	6PHS-1-2	6PHS-2 FEED	OPEN		1	
	6PHS-1-3	SPARE (FUTURE - NO CO	OPEN		1	
	6PHS-1-4	SPARE (FUTURE - NO CO	CLOSED		1	
	6PHS-1-5	ATS BREAKER	OPEN		1	
	6PHS-1-6	(FUTURE - NO CONNEC	OPEN		1	
6PHS-SP-1	6PHS-SP-1-1 6PHS-SP-1-2 6PHS-SP-1-3 6PHS-SP-1-4 6PHS-SP-1-5 6PHS-SP-1-6 6PHS-SP-1-7 6PHS-SP-1-8	NOT MONITORED S TIME				

When the Test Mode is enabled, the Test/simulation buttons/indicators will appear as well as a window that displays “Breaker re-close signal flag”.

The Reset button is available to reset the simulation and start over.

The screen shot below shows the events triggers during a test/simulation of the load restoration scheme.



Date	Time	Time Quality	Tag	Description	State	Classification	Message	Oper...
5/29/2017	03:14:13.969 PM	No Time Sync Information			Disappearance	Interface ...	TEST: Load restoration sequence complete.	
5/29/2017	03:14:08.965 PM	No Time Sync Information			Disappearance	Interface ...	TEST: Priority 2 load restored.	
5/29/2017	03:14:03.962 PM	No Time Sync Information			Disappearance	Interface ...	TEST: Priority 1 load restored.	
5/29/2017	03:13:53.956 PM	No Time Sync Information			Disappearance	Interface ...	TEST: 25/12SES CB-16 closed (brought back online)	
5/29/2017	03:13:43.952 PM	No Time Sync Information			Disappearance	Interface ...	TEST: 25/12SES CB-14 closed (brought back online)	
5/29/2017	03:13:33.948 PM	No Time Sync Information			Disappearance	Interface ...	TEST: 25/12SES CB-12 closed (brought back online)	
5/29/2017	03:13:23.944 PM	No Time Sync Information			Disappearance	Interface ...	TEST: 25/12SES CB-11 closed (brought back online)	
5/29/2017	03:13:18.943 PM	No Time Sync Information			Disappearance	Interface ...	TEST: Initiating load restoration sequence.	
5/29/2017	03:13:15.665 PM	No Time Sync Information	TEST\A_gen_main_...	Test: Generator main breaker(S...	Event	Digital	TEST\A_gen_main_brk_closed - Alarm raised	
5/29/2017	03:13:13.297 PM	No Time Sync Information	TEST\A_GENBLIVE	Test: 600V generator bus online	Event	Digital	TEST\A_GENBLIVE - Alarm raised	
5/29/2017	03:13:11.300 PM	No Time Sync Information	TEST\DND\A_utility_f...	Test: DND utility failed	Event	Digital	TEST\DND\A_utility_failed - Alarm raised	
5/29/2017	03:12:50.934 PM	No Time Sync Information			Disappearance	Interface	TEST: Load restoration sequence complete	

Messages in grey are open messages written to the event log from the program executed. Messages in blue are event alarm tags configured that evaluate the status of the test tags.

4 Conclusion

The load restoration function simulation trigged successfully with under both scenarios when:

- Simulated utility and generator status’s were toggled using the test buttons
- Using signals from the TCS while in test mode that indicated utility failure occurred and generators were online with the breakers in the closed posisiton

Breakers have the ability to be manually controlled when the automated load restoration has been triggered.

Using the same triggers, the load restoraion program will be executed as long as the load restoration function is enabled from the PSS screen and the Test mode is disabled (also from the PSS screen).

Frontier POWER PRODUCTS
Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com
KOHLER Power Systems

Startup Notification

Startup Date
Apr 10, 2017

Work Order #
68513

This form is required for coverage under the Kohler limited warranty and must be completely filled out at the time of initial startup. Representatives of the distributor/dealer and owner must sign the notification form. Signing this form represents acceptance of the unit and that all information on the startup form is correct. Return a copy of the completed form to the Kohler Co. within 60 days of the startup date.

Authorized Kohler Representative Performing Startup

Telephone: 604-946-5531
Company Name: Frontier Power Products Ltd.
Address: 7983 Progress Way
City: Delta
Province: British Columbia
Postal Code: V4G 1A3
Country: Canada

Owner Name / Unit Location

Telephone:
Company Name: Government Services Canada
Unit Address: 825 Admirals Road
City: Victoria
Province: British Columbia
Postal Code:
Country: Canada

Generator Set and Nameplate Information

	Generator Set No. 1	Engine No. 1	Generator Set No. 2	Engine No. 2
Serial Number	SGM32HWDD	28782		
Model Number	750 REOZMAD-CP1	S12A2-Y2PTAW-2		
Specification #	GM81540-GA9			

Application Information (One item in each column must be checked.)

Industrial	Stationary	Standby Power

Transfer Switch, Switchgear, and UPS Nameplate Information

	ATS No. 1	ATS No. 2	ATS No. 3	ATS No. 4	Switchgear	UPS*
Serial No.						
Spec No.						
Contactor S/N#						
Model No.						

* Fill out the UPS G31-25 Installation, G31-21 Prestart, and G31-22 Startup Checklists

Kohler Representative's Name
Brian Blagdon

Signature	**Date**
BB	Apr 10, 2017

Owner Representative's Name
Gordon Webster

Signature	**Date**
	Apr 10, 2017

Generator Set/Transfer Switch Installation Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Make the following installation checks before performing the Startup Checklist. Note: Use this form as a general guide, along with any applicable codes or standards. Comply with all applicable codes and standards. Improper installation voids the warranty.

Equipment Room or Weather Housing

Yes	Does not Apply	
☑	☐	**1.** Is the equipment installed in a fire-resistant room (made of non-combustible material) or in an outdoor weather housing?
☑	☐	**2.** Is there adequate clearance between the engine and floor for service maintenance?
☑	☐	**3.** Is there emergency lighting available at the equipment room or weather housing?
☑	☐	**4.** Is there adequate heating for the equipment room or outdoor weather housing?
☐	◆	**5.** Is the equipment room clean with all materials not related to the emergency power supply system removed?
☐	◆	**6.** Is the equipment room protected with a fire protection system?

Engine and Mounting

☑	☐	**7.** Is the mounting surface(s) properly constructed and leveled?
☑	☐	8. Is the mounting surface made from non-combustible material?
☐	◆	9. Was the generator-to-engine alignment performed after attaching the skid to the mounting base? Generator sets with two-bearing generators require alignment.

Lubrication, Cooling and Ventilation

☑	☐	10. Is the engine crankcase filled with the specified oil?
☑	☐	11. Is the cooling system filled with the manufacturer's specified coolant/antifreeze and purged of air?
☐	◆	12. Is there adequate inlet and outlet air flow (electric louvers adjusted and ventilation fan motor(s) connected to the corresponding voltage)?
☑	☐	13. Is the radiator duct properly sized and connected to the air vent or louver?
☑	☐	14. Are flexible sections installed in the cooling water lines?

Fuel

☑	☐	15. Is there an adequate/dedicated fuel supply?
☑	☐	16. Are the fuel filters installed?
☑	☐	17. Are the fuel tanks and piping installed in accordance with applicable codes and standards?
☐	◆	18. Is there adequate fuel transfer tank pump lift capacity and is the pump motor connected to the corresponding voltage?
☐	◆	19. Is the fuel transfer tank pump connected to the emergency power source?
☑	◆	20. Are flexible fuel lines installed between the engine fuel inlet and fuel piping?
☐	◆	21. Is the specified gas pressure available at the fuel regulator inlet?
☐	◆	22. Does the gas solenoid valve function?
☐	◆	23. Are the manually operated fuel and cooling water valves installed allowing manual operation or bypass of the solenoid valves?

Exhaust

Yes	Does not Apply	
☑	☐	**24.** Is the exhaust line sized per guidelines and does it have flexible connector(s)? Is the flexible connector(s) straight?
☑	☐	25. Is there exhaust line condensate trap with drain installed?
☑	☐	26. Is the specified silencer installed and are the hanger and mounting hardware tightened?
☑	☐	27. Is a heat-isolating thimble(s) installed at points where exhaust lines pass through combustible wall(s) or partition(s)?
☑	☐	28. Is the exhaust line free of excessive bends and restrictions? Is the backpressure within specifications?
☐	◆	29. Is the exhaust line installed with a downward pitch toward the outside of the building?
☑	☐	30. Is the exhaust line protected from entry by rain, snow, and animals?
☑	☐	31. Does the exhaust system outlet location prevent entry of exhaust gases into buildings or structures?
☑	☐	32. Are individuals protected from exposure to high temperature exhaust parts and are hot parts safety decals present?

AC Electrical System

☑	☐	33. Does the nameplate voltage/frequency of the generator set and transfer switch match normal/utility source ratings?
☑	☐	34. Do the generator set load conductors have adequate ampacity and are they correctly connected to the circuit breakers and/or the emergency side of the transfer switch?
☑	☐	35. Are the load conductors, engine starting cables, battery charger cables, and remote annunciator leads installed in separate conduits?
☑	☐	36. Is the battery charger AC circuit connected to the corresponding voltage?

Transfer Switch, Remote Control System, Accessories

☑	☐	37. Is the transfer switch mechanism free of binding? NOTE: Disconnect all AC sources and operate the transfer switch manually.
☑	☐	38. Are the transfer switch AC conductors correctly connected? Verify lead designations using the appropriate wiring diagrams.
☐	◆	39. Is there a UPS system? If yes, is the UPS installation checklist filled out?
☑	☐	40. Is all other wiring connected, as required?

Batteries and DC Electrical System

☑	☐	41. Does the battery(ies) have the specified CCA rating and voltage?
☑	☐	42. Is the battery(s) filled with electrolyte and connected to the battery charger?
☑	☐	43. Are the engine starting cables connected to the battery(s)?
☑	☐	44. Do the engine starting cables have adequate length and gauge?
☑	☐	45. Is the battery(s) installed with adequate air ventilation?

Special Requirements

☐	◆	46. Is the earthquake protection adequate for the equipment and support systems?
☐	◆	47. Is the equipment protected from lightning damage?

Generator Set/Transfer Switch Startup Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Complete the Installation Checklist before performing the initial startup checks. Refer to Service Bulletin 616 for Warranty Startup Procedure Requirements regarding generator set models with ECM-controlled engines.

Yes	Does not Apply	
☑	☐	1. Verify that the engine is filled with oil and the cooling system is filled with coolant/antifreeze.
☑	☐	2. Prime the fuel system.
☑	☐	3. Open all water and fuel valves. Temporarily remove the radiator cap to eliminate air in the cooling system. Replace radiator cap in step 21.
☑	☐	4. Place the generator set master switch in the OFF/RESET position. Observe Not-in-Auto lamp and alarm, if equipped, on the controller.
☑	☐	5. Press the lamp test, if equipped on controller. Do all the alarm lamps on the panel illuminate?
☑	☐	6. Open the main line circuit breakers, open the safeguard breaker, and/or remove fuses connected to the generator set output leads.
☑	☐	7. Turn down the speed control (electronic governor) or speed screw (mechanical governor).*
☑	☐	8. Verify the presence of lube oil in the turbocharger, if equipped. See the engine and/or generator set operation manual.
☑	☐	9. Place the generator set master switch in the RUN position. Allow the engine to start and run for several seconds.
☑	☐	10. Verify that the day tank, if equipped, is energized.
☑	☐	11. Place the generator set master switch in the OFF/RESET position. Check for oil, coolant, and exhaust leaks.
☑	☐	12. Turn on the water/oil heaters and fuel lift pumps.
☑	☐	13. Check the battery charger ammeter for battery charging indication.
☑	☐	14. Place the generator set master switch in the RUN position. Verify whether there is sufficient oil pressure. Check for oil, coolant, and exhaust leaks.
☑	☐	15. Close the safeguard circuit breaker. Adjust the engine speed to 50/60 Hz if equipped with an electronic governor or to 52.8/63 Hz if equipped with a mechanical governor.*
☑	☐	16. If the speed is unstable, adjust according to the appropriate engine and/or governor manual.*
☑	☐	17. Adjust the AC output voltage to match the load voltage using the voltage adjusting control. See the generator set/controller operation manual.
☑	☐	18. Allow the engine to reach normal operating coolant temperature.
☐	◆	19. Check the operating temperature on city water-cooled models and adjust the thermostatic valve as necessary.
☐	◆	20. Manually overspeed the engine to cause an engine shutdown (68-70 Hz on 60 Hz models and 58-60 Hz on 50 Hz models). Place the generator set master switch in the OFF/RESET position.*
☑	☐	21. Check the coolant level, add coolant as necessary, and replace the radiator cap. Verify that all hose clamps are tight and secure.
☑	☐	22. Place the generator set master switch in the RUN position.
☑	☐	23. Verify the engine low oil pressure and high coolant temperature shutdowns.*
☑	☐	24. Check the overcrank shutdown.*
☑	☐	25. Place the generator set master switch in the OFF/RESET position.
☐	☐	26. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	27. Disconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	28. Manually transfer the load to the emergency source.
☐	☐	29. Close the normal source circuit breaker or replace fuses to the transfer switch.
☐	☐	30. Check the normal source voltage, frequency, and phase sequence on three-phase models. The normal source must match the load.
☐	☐	31. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	32. Manually transfer the load to the normal source.
☐	☐	33. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	34. Place the generator set master switch in the RUN position.
☐	☐	35. Check the generator set voltage, frequency, and phase sequence on three-phase models. The generator set must match normal source and load.
☐	☐	36. Place the generator set master switch in the OFF/RESET position.
☐	☐	37. Open the generator set main line circuit breakers, open the safeguard breaker, and/or remove the fuses connected to the transfer switch.
☐	☐	38. Reconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	39. Close the normal source circuit breaker or replace fuses to the transfer switch. Place the generator set master switch to the AUTO position.
☐	☐	40. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	41. Place the transfer switch in the TEST position (load test or open normal source circuit breaker). NOTE: Obtain permission from the building authority before proceeding. This procedure tests transfer switch operation and connects building load to generator set power.
☐	☐	42. Readjust frequency to 50 or 60 Hz with total building loads.*
☐	☐	43. Verify that the current phase is balanced for three phase systems.
☐	☐	44. Release the transfer switch test switch or close the normal circuit breaker. The transfer switch should retransfer to the normal source after appropriate time delay(s).
☐	☐	45. Allow the generator set to run and shut down automatically after the appropriate cool down time delay(s).
☐	☐	46. Set the plant exerciser to the customer's required exercise period, if equipped.
☐	☐	47. Verify that all options on the transfer switch are adjusted and functional for the customer's requirements.
☐	☐	48. If possible, run the building loads on the generator set for several hours or perform the load bank test if required.
☐	☐	49. Verify that all the wire connections from the generator set to the transfer switch and optional accessories are tight and secure.
☐	◆	50. If there is a UPS system, fill out the UPS prestart checklist and UPS startup checklist.
☐	☐	51. Verify that the customer has the appropriate engine/generator set and transfer switch literature. Instruct the customer in the operation and maintenance of the power system.
☑	☐	52. Fill out the startup notification at this time and send the white copy to the Generator Warranty Dept. Include the warranty form if applicable.

* Some models with electronic engine controls may limit or prohibit adjusting the engine speed or testing shutdowns.

Generator Start-Up Report

Frontier POWER PRODUCTS

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

Work Order #	Client	Unit Address	Date
68513	Government Services Canada	825 Admirals Road	Apr 10, 2017

Gen#1 Make	Gen#1 Serial #	Engine #1 S/N#	Kw	Amps	Volts	Phase	Load Bank Cable	
Kohler	SGM32HWDD	28782	760	914	600	3	Built in l	
Gen#2 Make	**Gen#2 Serial #**	**Engine #2 S/N#**	**Kw**	**Amps**	**Volts**	**Phase**	**Load Bank Cable**	

Engine Battery and Charging Systems

System Voltage	24V	**Type**	8D	**Battery Rating**	1400	**cca**	**Install Date**	April	2017

	Battery #1						Battery #2						Battery #3						Battery #4				
Battery Condition	Good						Good																
Battery Test	12.6	V	@		cca		12.7	V	@		cca			V	@		cca			V	@		cca
Electrolyte Level	Good						Good																
Terminals / Cables	Clean and Secure						Clean and Secure																
Charger Operation	12.6	V	@		A			V	@		A			V	@		A			V	@		A
Alternator Charging		V	@		A			V	@		A		**Starter Connections / Operation**										

Cooling System

Check Coolant Level	OK	**Check Block Heater Operation**		**Inspect Coolant Hoses**	
Check Coolant Strength	OK	**Inspect Block Heater Hoses**		**Inspect Radiator**	

Lubrication and Air Intake Systems

Check Engine Oil Level	OK	**Inspect Crank Case Breather**	OK	**Inspect Turbo**	OK
Inspect Oil Cooler	N/A	**Inspect Air Filter**	OK	**Inspect Air Duct / Louvers**	N/A

☐ **Diesel** ☐ **Gas**

Fuel System

Inspect Fuel Filter	OK	**Inspect Fuel Tank**	OK	**Check Transfer Pump**	OK	**Check Fuel Gauge**	OK
Inspect Fuel Hoses	OK	**Inspect Pipe Work**	OK	**Check Lift Pump**	OK	**Check Fuel Level**	OK
Inspect Gas Solenoid		**Inspect Gas Regulator**		**Check For Gas Leaks**		**Check Gas Pressure**	

General Engine Checks

Inspect Drive Belts	OK	**Check for Exhaust Leaks**	OK	**Check for Abnormal Noises**	OK
Inspect Governor Linkage	OK	**Check for Fluid Leaks**	OK	**Check for Warning Indicators**	OK

Generator and Electrical Checks								Main Breaker	
Warning Indicators	OK	**Wire Connections**	OK	**Breakers**	OK	**Grounds**	OK	**Amps**	1000
Meters / Guages	OK	**Wiring Harness**	OK	**Annunciator**	N/A	**Lugs**	OK	**Type**	Thermo-mag

Running Checks / Protection and Alarms

Output Frequency	60	Hz	**Output Voltage**	600	V	**Oil Pressure**	90	psi	**Temperature**	161	ºF

Low Oil Pressure	OK	**Over-Speed**	N/A	**Coolant Level**	OK
High Coolant Temperature	OK	**Over-Crank**	OK	**Emergency Stop**	OK

Generator Start-Up Report

Frontier POWER PRODUCTS
Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

Transfer Switch # 1

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 2

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 3

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 4

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Commissioning Notes / Recommendations

4 Hour Load Test Report

Frontier POWER PRODUCTS

www.frontierpower.com

WO#	68513	**Date:**	Apr 11, 2017	**Project / Site:**	Esquimalt Graving Dock, Generator 2

Unit Make:	**Kohler**	**Model:**	750REOZMD	**Serial#**	SGM32HWDD
Engine Make:	**Mitsubishi**	**Model:**	S12A-Y2PTAW-2	**Serial#**	28782
Alternator Make:	**Kohler**	**Model:**	5M4278BF	**Serial#**	MT-0041649-1216

Run	**Read**	**Load**		**Voltage (V)**			**Current (A)**			**Freqency**	**Oil Pressure**	**Oil Temp**	**Coolant Temp**	**Ambient Outside Temp**	**Frame Temp**	**Ambient Inside Temp**	**Boost Manifold Pressure**	**Ex (F1 - F2)**		**Gen Air Outlet Temp**
Time	**Time**	**(Kw)**	**(%)**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	**(Hz)**	**psi**	**ºF**	**ºF**	**ºC**	**ºC**	**ºC**	(PSI)	**(Volts)**	**(Amps)**	**ºC**
Start	1:30	744	97	600	602	598	714	714	714	60	88	172	158	10	14.9	13.4	35	25.0	1.15	15.4
30 min	2:00	744	97	600	602	598	714	714	714	60	83	178	161	10	27.0	13.8	35	26.0	1.18	13.0
60 min	2:30	744	97	600	602	598	714	714	714	60	83	178	161	11	29.3	14.3	35	26.0	1.18	12.9
90 min	3:00	744	97	600	602	598	714	714	714	60	84	177	161	11	30.4	14.2	35	26.0	1.18	11.6
120 min	3:30	744	97	600	602	598	714	714	714	60	82	179	161	11	31.5	14.2	35	26.2	1.18	13.4
150 min	4:00	744	97	600	602	598	714	714	714	60	82	180	161	11	32.0	13.8	35	26.1	1.18	14.0
180 min	4:30	744	97	600	602	598	714	714	714	60	83	180	163	11	31.9	13.6	35	26.2	1.18	12.5
210 min	5:00	744	97	600	602	598	714	714	714	60	83	180	161	12	32.5	13.8	35	26.2	1.18	13.6
240 min	5:30	744	97	600	602	598	714	714	714	60	83	180	161	12	32.9	13.6	35	26.2	1.18	14.0

Battery Voltage During Cranking: 21.3V (battery voltage was 25.1V prior to cranking)

On completion of load test, take hot winding resistance readings:

L1 - N:	3.25 mΩ	**L2 - N:**	3.21 mΩ	**L3 - N:**	3.21 mΩ

Remarks

This unit was named "Generator 1" when it left Frontier Power Products facility. It was renamed "Generator 2" after installation on site.

Technician: Preston Li

Form# 04-27-17

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

Startup Notification

Startup Date
2017-04-10

Work Order #
68513

This form is required for coverage under the Kohler limited warranty and must be completely filled out at the time of initial startup. Representatives of the distributor/dealer and owner must sign the notification form. Signing this form represents acceptance of the unit and that all information on the startup form is correct. Return a copy of the completed form to the Kohler Co. within 60 days of the startup date.

Authorized Kohler Representative Performing Startup	
Telephone	604-946-5531
Company Name	Frontier Power Products Ltd.
Address	7983 Progress Way
City	Delta
Province	British Columbia
Postal Code	V4G 1A3
Country	Canada

Owner Name / Unit Location	
Telephone	
Company Name	Government Services
Unit Address	825 Admirals way
City	Victoria
Province	British Columbia
Postal Code	
Country	Canada

Generator Set and Nameplate Information

	Generator Set No. 1	**Engine No. 1**	**Generator Set No. 2**	**Engine No. 2**
Serial Number	SGM32HWDC	28781		
Model Number	750REOZMD-CP1	S12A2-Y2PAW-2		
Specification #	GM81540-GA-9			

Application Information (One item in each column must be checked.)

Industrial	Stationary	Standby Power

Transfer Switch, Switchgear, and UPS Nameplate Information

	ATS No. 1	**ATS No. 2**	**ATS No. 3**	**ATS No. 4**	**Switchgear**	**UPS***
Serial No.						
Spec No.						
Contactor S/N#						
Model No.						

* Fill out the UPS G31-25 Installation, G31-21 Prestart, and G31-22 Startup Checklists

Kohler Representative's Name	
Brian Blagdon	
Signature	**Date**
BB	2017-04-10

Owner Representative's Name	
Gordon Webster	
Signature	**Date**
	2017-04-10

Generator Set/Transfer Switch Installation Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Make the following installation checks before performing the Startup Checklist. Note: Use this form as a general guide, along with any applicable codes or standards. Comply with all applicable codes and standards. Improper installation voids the warranty.

Equipment Room or Weather Housing

Yes	Does not Apply	
✔	☐	**1.** Is the equipment installed in a fire-resistant room (made of non-combustible material) or in an outdoor weather housing?
✔	☐	**2.** Is there adequate clearance between the engine and floor for service maintenance?
✔	☐	**3.** Is there emergency lighting available at the equipment room or weather housing?
✔	☐	**4.** Is there adequate heating for the equipment room or outdoor weather housing?
☐	◆	**5.** Is the equipment room clean with all materials not related to the emergency power supply system removed?
☐	◆	**6.** Is the equipment room protected with a fire protection system?

Engine and Mounting

✔	☐	**7.** Is the mounting surface(s) properly constructed and leveled?
✔	☐	8. Is the mounting surface made from non-combustible material?
☐	◆	9. Was the generator-to-engine alignment performed after attaching the skid to the mounting base? Generator sets with two-bearing generators require alignment.

Lubrication, Cooling and Ventilation

✔	☐	10. Is the engine crankcase filled with the specified oil?
✔	☐	11. Is the cooling system filled with the manufacturer's specified coolant/antifreeze and purged of air?
☐	◆	12. Is there adequate inlet and outlet air flow (electric louvers adjusted and ventilation fan motor(s) connected to the corresponding voltage)?
✔	☐	13. Is the radiator duct properly sized and connected to the air vent or louver?
✔	☐	14. Are flexible sections installed in the cooling water lines?

Fuel

✔	☐	15. Is there an adequate/dedicated fuel supply?
✔	☐	16. Are the fuel filters installed?
✔	☐	17. Are the fuel tanks and piping installed in accordance with applicable codes and standards?
☐	◆	18. Is there adequate fuel transfer tank pump lift capacity and is the pump motor connected to the corresponding voltage?
☐	◆	19. Is the fuel transfer tank pump connected to the emergency power source?
✔	☐	20. Are flexible fuel lines installed between the engine fuel inlet and fuel piping?
☐	◆	21. Is the specified gas pressure available at the fuel regulator inlet?
☐	◆	22. Does the gas solenoid valve function?
☐	◆	23. Are the manually operated fuel and cooling water valves installed allowing manual operation or bypass of the solenoid valves?

Exhaust

Yes	Does not Apply	
✔	☐	**24.** Is the exhaust line sized per guidelines and does it have flexible connector(s)? Is the flexible connector(s) straight?
✔	☐	25. Is there exhaust line condensate trap with drain installed?
✔	☐	26. Is the specified silencer installed and are the hanger and mounting hardware tightened?
✔	☐	27. Is a heat-isolating thimble(s) installed at points where exhaust lines pass through combustible wall(s) or partition(s)?
✔	☐	28. Is the exhaust line free of excessive bends and restrictions? Is the backpressure within specifications?
☐	◆	29. Is the exhaust line installed with a downward pitch toward the outside of the building?
✔	☐	30. Is the exhaust line protected from entry by rain, snow, and animals?
✔	☐	31. Does the exhaust system outlet location prevent entry of exhaust gases into buildings or structures?
✔	☐	32. Are individuals protected from exposure to high temperature exhaust parts and are hot parts safety decals present?

AC Electrical System

✔	☐	33. Does the nameplate voltage/frequency of the generator set and transfer switch match normal/utility source ratings?
✔	☐	34. Do the generator set load conductors have adequate ampacity and are they correctly connected to the circuit breakers and/or the emergency side of the transfer switch?
✔	☐	35. Are the load conductors, engine starting cables, battery charger cables, and remote annunciator leads installed in separate conduits?
✔	☐	36. Is the battery charger AC circuit connected to the corresponding voltage?

Transfer Switch, Remote Control System, Accessories

✔	☐	37. Is the transfer switch mechanism free of binding? NOTE: Disconnect all AC sources and operate the transfer switch manually.
✔	☐	38. Are the transfer switch AC conductors correctly connected? Verify lead designations using the appropriate wiring diagrams.
☐	◆	39. Is there a UPS system? If yes, is the UPS installation checklist filled out?
✔	☐	40. Is all other wiring connected, as required?

Batteries and DC Electrical System

✔	☐	41. Does the battery(ies) have the specified CCA rating and voltage?
✔	☐	42. Is the battery(s) filled with electrolyte and connected to the battery charger?
✔	☐	43. Are the engine starting cables connected to the battery(s)?
✔	☐	44. Do the engine starting cables have adequate length and gauge?
✔	☐	45. Is the battery(s) installed with adequate air ventilation?

Special Requirements

☐	◆	46. Is the earthquake protection adequate for the equipment and support systems?
☐	◆	47. Is the equipment protected from lightning damage?

Generator Set/Transfer Switch Startup Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Complete the Installation Checklist before performing the initial startup checks. Refer to Service Bulletin 616 for Warranty Startup Procedure Requirements regarding generator set models with ECM-controlled engines.

Yes	Does not Apply	
☑	☐	1. Verify that the engine is filled with oil and the cooling system is filled with coolant/antifreeze.
☑	☐	2. Prime the fuel system.
☑	☐	3. Open all water and fuel valves. Temporarily remove the radiator cap to eliminate air in the cooling system. Replace radiator cap in step 21.
☑	☐	4. Place the generator set master switch in the OFF/RESET position. Observe Not-in-Auto lamp and alarm, if equipped, on the controller.
☑	☐	5. Press the lamp test, if equipped on controller. Do all the alarm lamps on the panel illuminate?
☑	☐	6. Open the main line circuit breakers, open the safeguard breaker, and/or remove fuses connected to the generator set output leads.
☐	◆	7. Turn down the speed control (electronic governor) or speed screw (mechanical governor).*
☑	☐	8. Verify the presence of lube oil in the turbocharger, if equipped. See the engine and/or generator set operation manual.
☑	☐	9. Place the generator set master switch in the RUN position. Allow the engine to start and run for several seconds.
☑	☐	10. Verify that the day tank, if equipped, is energized.
☑	☐	11. Place the generator set master switch in the OFF/RESET position. Check for oil, coolant, and exhaust leaks.
☑	☐	12. Turn on the water/oil heaters and fuel lift pumps.
☑	☐	13. Check the battery charger ammeter for battery charging indication.
☑	☐	14. Place the generator set master switch in the RUN position. Verify whether there is sufficient oil pressure. Check for oil, coolant, and exhaust leaks.
☑	☐	15. Close the safeguard circuit breaker. Adjust the engine speed to 50/60 Hz if equipped with an electronic governor or to 52.8/63 Hz if equipped with a mechanical governor.*
☐	◆	16. If the speed is unstable, adjust according to the appropriate engine and/or governor manual.*
☑	☐	17. Adjust the AC output voltage to match the load voltage using the voltage adjusting control. See the generator set/controller operation manual.
☑	☐	18. Allow the engine to reach normal operating coolant temperature.
☐	◆	19. Check the operating temperature on city water-cooled models and adjust the thermostatic valve as necessary.
☐	◆	20. Manually overspeed the engine to cause an engine shutdown (68-70 Hz on 60 Hz models and 58-60 Hz on 50 Hz models). Place the generator set master switch in the OFF/RESET position.*
☑	☐	21. Check the coolant level, add coolant as necessary, and replace the radiator cap. Verify that all hose clamps are tight and secure.
☑	☐	22. Place the generator set master switch in the RUN position.
☑	☐	23. Verify the engine low oil pressure and high coolant temperature shutdowns.*
☑	☐	24. Check the overcrank shutdown.*
☑	☐	25. Place the generator set master switch in the OFF/RESET position.
☐	☐	26. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	27. Disconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	28. Manually transfer the load to the emergency source.

Yes	Does not Apply	
☐	☐	29. Close the normal source circuit breaker or replace fuses to the transfer switch.
☐	☐	30. Check the normal source voltage, frequency, and phase sequence on three-phase models. The normal source must match the load.
☐	☐	31. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	32. Manually transfer the load to the normal source.
☐	☐	33. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	34. Place the generator set master switch in the RUN position.
☐	☐	35. Check the generator set voltage, frequency, and phase sequence on three-phase models. The generator set must match normal source and load.
☐	☐	36. Place the generator set master switch in the OFF/RESET position.
☐	☐	37. Open the generator set main line circuit breakers, open the safeguard breaker, and/or remove the fuses connected to the transfer switch.
☐	☐	38. Reconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	39. Close the normal source circuit breaker or replace fuses to the transfer switch. Place the generator set master switch to the AUTO position.
☐	☐	40. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	41. Place the transfer switch in the TEST position (load test or open normal source circuit breaker). NOTE: Obtain permission from the building authority before proceeding. This procedure tests transfer switch operation and connects building load to generator set power.
☐	☐	42. Readjust frequency to 50 or 60 Hz with total building loads.*
☐	☐	43. Verify that the current phase is balanced for three phase systems.
☐	☐	44. Release the transfer switch test switch or close the normal circuit breaker. The transfer switch should retransfer to the normal source after appropriate time delay(s).
☐	☐	45. Allow the generator set to run and shut down automatically after the appropriate cool down time delay(s).
☐	☐	46. Set the plant exerciser to the customer's required exercise period, if equipped.
☐	☐	47. Verify that all options on the transfer switch are adjusted and functional for the customer's requirements.
☐	☐	48. If possible, run the building loads on the generator set for several hours or perform the load bank test if required.
☐	☐	49. Verify that all the wire connections from the generator set to the transfer switch and optional accessories are tight and secure.
☐	◆	50. If there is a UPS system, fill out the UPS prestart checklist and UPS startup checklist.
☐	☐	51. Verify that the customer has the appropriate engine/generator set and transfer switch literature. Instruct the customer in the operation and maintenance of the power system.
☑	☐	52. Fill out the startup notification at this time and send the white copy to the Generator Warranty Dept. Include the warranty form if applicable.

* Some models with electronic engine controls may limit or prohibit adjusting the engine speed or testing shutdowns.

Generator Start-Up Report

Frontier POWER PRODUCTS

Delta, BC	1-877-946-5531
Edmonton, AB	1-877-455-2260
Calgary, AB	1-877-720-3735
Winnipeg, MB	1-877-949-1526

www.frontierpower.com

Work Order #	Client	Unit Address	Date
68513	Government Services	825 Admirals way	2017-04-10

Gen#1 Make	Gen#1 Serial #	Engine #1 S/N#	Kw	Amps	Volts	Phase	Load Bank Cable	
Kohler	SGM32HWDC	28781	750	825	600	3	50'	
Gen#2 Make	**Gen#2 Serial #**	**Engine #2 S/N#**	**Kw**	**Amps**	**Volts**	**Phase**	**Load Bank Cable**	

Engine Battery and Charging Systems

System Voltage	24V	**Type**	8D	**Battery Rating**	1400	**cca**	**Install Date**	April	2017

	Battery #1	Battery #2	Battery #3	Battery #4
Battery Condition	Good	Good		
Battery Test	12.6 V @ 1620 cca	12.6 V @ 1490 cca	V @ cca	V @ cca
Electrolyte Level	Good	Good		
Terminals / Cables	Clean and Secure	Clean and Secure		
Charger Operation	26.3 V @ 8.9 A	V @ A	V @ A	V @ A
Alternator Charging	27.5 V @ 13 A	V @ A	**Starter Connections / Operation**	OK

Cooling System

Check Coolant Level	OK	**Check Block Heater Operation**	OK	**Inspect Coolant Hoses**	OK
Check Coolant Strength	OK	**Inspect Block Heater Hoses**	OK	**Inspect Radiator**	OK

Lubrication and Air Intake Systems

Check Engine Oil Level	OK	**Inspect Crank Case Breather**	OK	**Inspect Turbo**	OK
Inspect Oil Cooler	N/A	**Inspect Air Filter**	OK	**Inspect Air Duct / Louvers**	N/A

☑ **Diesel** ☐ **Gas**

Fuel System

Inspect Fuel Filter	OK	**Inspect Fuel Tank**	OK	**Check Transfer Pump**	N/A	**Check Fuel Gauge**	OK
Inspect Fuel Hoses	OK	**Inspect Pipe Work**	OK	**Check Lift Pump**	OK	**Check Fuel Level**	OK
Inspect Gas Solenoid	N/A	**Inspect Gas Regulator**	N/A	**Check For Gas Leaks**	N/A	**Check Gas Pressure**	N/A

General Engine Checks

Inspect Drive Belts	OK	**Check for Exhaust Leaks**	OK	**Check for Abnormal Noises**	OK
Inspect Governor Linkage	OK	**Check for Fluid Leaks**	OK	**Check for Warning Indicators**	OK

Generator and Electrical Checks

Main Breaker

Warning Indicators	OK	**Wire Connections**	OK	**Breakers**	OK	**Grounds**	OK	**Amps**	1200
Meters / Guages	OK	**Wiring Harness**	OK	**Annunciator**	N/A	**Lugs**	OK	**Type**	Thermo-mag

Running Checks / Protection and Alarms

Output Frequency	60	Hz	**Output Voltage**	601	V	**Oil Pressure**	89	psi	**Temperature**	159	ºF

Low Oil Pressure	OK	**Over-Speed**	N/A	**Coolant Level**	OK
High Coolant Temperature	OK	**Over-Crank**	OK	**Emergency Stop**	OK

Generator Start-Up Report

Frontier POWER PRODUCTS

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

Transfer Switch # 1

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 2

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 3

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 4

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Commissioning Notes / Recommendations

4 Hour Load Test Report

Frontier
POWER PRODUCTS
www.frontierpower.com

WO#	68513	**Date:**	Apr 11, 2017	**Project / Site:**	Esquimalt Graving Dock, Generator 1

Unit Make:	**Kohler**	**Model:**	750REOZMD	**Serial#**	SGM32HWDC
Engine Make:	**Mitsubishi**	**Model:**	S12A-Y2PTAW-2	**Serial#**	28781
Alternator Make:	**Kohler**	**Model:**	5M4278BF	**Serial#**	MT-0041647-1216

Run	**Read**	**Load**		**Voltage (V)**			**Current (A)**			**Freqency**	**Oil Pressure**	**Oil Temp**	**Coolant Temp**	**Ambient Outside Temp**	**Frame Temp**	**Ambient Inside Temp**	**Boost Manifold Pressure**	**Ex (F1 - F2)**		**Gen Air Outlet Temp**
Time	**Time**	**(Kw)**	**(%)**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	**(Hz)**	**psi**	**°F**	**°F**	**°C**	**°C**	**°C**	(PSI)	**(Volts)**	**(Amps)**	**°C**
Start	8:40	0	0	601	602	601	0	0	0	60	94	160	149	7	15.3	7	14	17.7	0.83	7.1
30 min	9:10	742	97	601	603	599	712	714	716	60	90	182	159	7	31.5	14.5	35	26.3	1.20	11.6
60 min	9:40	742	97	601	603	599	712	714	716	60	88	188	159	8	35.0	15.5	35	27.1	1.22	10.4
90 min	10:10	742	97	601	603	599	712	714	716	60	88	185	159	8	34.3	15.8	35	27.0	1.22	11.1
120 min	10:40	742	97	601	603	599	712	714	716	60	88	188	159	9	34.4	17.3	35	27.2	1.22	11.0
150 min	11:10	742	97	601	603	599	712	714	716	60	88	189	159	9	35.5	21.0	35	27.2	1.22	11.6
180 min	11:40	742	97	601	603	599	712	714	716	60	88	188	159	9	36.0	20.5	35	27.3	1.22	12.5
210 min	12:10	742	97	601	603	599	712	714	716	60	88	188	159	10	38.3	19.9	35	27.5	1.22	13.0
240 min	12:40	742	97	601	603	599	712	714	716	60	87	188	159	10	37.3	19.5	35	27.0	1.21	13.5

Battery Voltage During Cranking: 20.0V (battery voltage was 26.0V prior to cranking)

On completion of load test, take hot winding resistance readings:

L1 - N:	3.24 mΩ	**L2 - N:**	3.23 mΩ	**L3 - N:**	3.24 mΩ

Remarks

This unit was named "Generator 2" when it left Frontier Power Products facility. It was renamed "Generator 1" after installation on site.

Technician: Preston Li

Form# 04-27-17

Frontier POWER PRODUCTS

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

KOHLER Power Systems

Startup Notification

Startup Date

2017-04-21

Work Order #

68513

This form is required for coverage under the Kohler limited warranty and must be completely filled out at the time of initial startup. Representatives of the distributor/dealer and owner must sign the notification form. Signing this form represents acceptance of the unit and that all information on the startup form is correct. Return a copy of the completed form to the Kohler Co. within 60 days of the startup date.

Authorized Kohler Representative Performing Startup		**Owner Name / Unit Location**	
Telephone	604-946-5531	Telephone	
Company Name	Frontier Power Products Ltd.	Company Name	Government Services
Address	7983 Progress Way	Unit Address	825 Admirals Road
City	Delta	City	Victoria
Province	British Columbia	Province	British Columbia
Postal Code	V4G 1A3	Postal Code	
Country	Canada	Country	Canada

Generator Set and Nameplate Information

	Generator Set No. 1	Engine No. 1	Generator Set No. 2	Engine No. 2
Serial Number	SGM32HWDB	28777		
Model Number	750 REOZMD-CP2	S12A2-Y2PTAW-2		
Specification #				

Application Information (One item in each column must be checked.)

Industrial	Stationary	Standby Power

Transfer Switch, Switchgear, and UPS Nameplate Information

	ATS No. 1	ATS No. 2	ATS No. 3	ATS No. 4	Switchgear	UPS*
Serial No.						
Spec No.						
Contactor S/N#						
Model No.						

* Fill out the UPS G31-25 Installation, G31-21 Prestart, and G31-22 Startup Checklists

Kohler Representative's Name		**Owner Representative's Name**	
Brian Blagdon		Gordon Webster	
Signature	**Date**	**Signature**	**Date**
BB	2017-04-21		2017-04-21

Generator Set/Transfer Switch Installation Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Make the following installation checks before performing the Startup Checklist. Note: Use this form as a general guide, along with any applicable codes or standards. Comply with all applicable codes and standards. Improper installation voids the warranty.

Equipment Room or Weather Housing

Yes / Does not Apply

☑ ☐ **1.** Is the equipment installed in a fire-resistant room (made of non-combustible material) or in an outdoor weather housing?
☑ ☐ **2.** Is there adequate clearance between the engine and floor for service maintenance?
☑ ☐ **3.** Is there emergency lighting available at the equipment room or weather housing?
☑ ☐ **4.** Is there adequate heating for the equipment room or outdoor weather housing?
☐ ◆ **5.** Is the equipment room clean with all materials not related to the emergency power supply system removed?
☐ ◆ **6.** Is the equipment room protected with a fire protection system?

Engine and Mounting

☑ ☐ **7.** Is the mounting surface(s) properly constructed and leveled?
☑ ☐ 8. Is the mounting surface made from non-combustible material?
☐ ◆ 9. Was the generator-to-engine alignment performed after attaching the skid to the mounting base? Generator sets with two-bearing generators require alignment.

Lubrication, Cooling and Ventilation

☑ ☐ 10. Is the engine crankcase filled with the specified oil?
☑ ☐ 11. Is the cooling system filled with the manufacturer's specified coolant/antifreeze and purged of air?
☐ ◆ 12. Is there adequate inlet and outlet air flow (electric louvers adjusted and ventilation fan motor(s) connected to the corresponding voltage)?
☑ ☐ 13. Is the radiator duct properly sized and connected to the air vent or louver?
☑ ☐ 14. Are flexible sections installed in the cooling water lines?

Fuel

☑ ☐ 15. Is there an adequate/dedicated fuel supply?
☑ ☐ 16. Are the fuel filters installed?
☑ ☐ 17. Are the fuel tanks and piping installed in accordance with applicable codes and standards?
☐ ◆ 18. Is there adequate fuel transfer tank pump lift capacity and is the pump motor connected to the corresponding voltage?
☐ ◆ 19. Is the fuel transfer tank pump connected to the emergency power source?
☑ ☐ 20. Are flexible fuel lines installed between the engine fuel inlet and fuel piping?
☐ ◆ 21. Is the specified gas pressure available at the fuel regulator inlet?
☐ ◆ 22. Does the gas solenoid valve function?
☐ ◆ 23. Are the manually operated fuel and cooling water valves installed allowing manual operation or bypass of the solenoid valves?

Exhaust

Yes / Does not Apply

☑ ☐ **24.** Is the exhaust line sized per guidelines and does it have flexible connector(s)? Is the flexible connector(s) straight?
☑ ☐ 25. Is there exhaust line condensate trap with drain installed?
☑ ☐ 26. Is the specified silencer installed and are the hanger and mounting hardware tightened?
☑ ☐ 27. Is a heat-isolating thimble(s) installed at points where exhaust lines pass through combustible wall(s) or partition(s)?
☑ ☐ 28. Is the exhaust line free of excessive bends and restrictions? Is the backpressure within specifications?
☐ ◆ 29. Is the exhaust line installed with a downward pitch toward the outside of the building?
☑ ☐ 30. Is the exhaust line protected from entry by rain, snow, and animals?
☑ ☐ 31. Does the exhaust system outlet location prevent entry of exhaust gases into buildings or structures?
☑ ☐ 32. Are individuals protected from exposure to high temperature exhaust parts and are hot parts safety decals present?

AC Electrical System

☑ ☐ 33. Does the nameplate voltage/frequency of the generator set and transfer switch match normal/utility source ratings?
☑ ☐ 34. Do the generator set load conductors have adequate ampacity and are they correctly connected to the circuit breakers and/or the emergency side of the transfer switch?
☑ ☐ 35. Are the load conductors, engine starting cables, battery charger cables, and remote annunciator leads installed in separate conduits?
☑ ☐ 36. Is the battery charger AC circuit connected to the corresponding voltage?

Transfer Switch, Remote Control System, Accessories

☐ ◆ 37. Is the transfer switch mechanism free of binding? NOTE: Disconnect all AC sources and operate the transfer switch manually.
☐ ◆ 38. Are the transfer switch AC conductors correctly connected? Verify lead designations using the appropriate wiring diagrams.
☐ ◆ 39. Is there a UPS system? If yes, is the UPS installation checklist filled out?
☑ ☐ 40. Is all other wiring connected, as required?

Batteries and DC Electrical System

☑ ☐ 41. Does the battery(ies) have the specified CCA rating and voltage?
☑ ☐ 42. Is the battery(s) filled with electrolyte and connected to the battery charger?
☑ ☐ 43. Are the engine starting cables connected to the battery(s)?
☑ ☐ 44. Do the engine starting cables have adequate length and gauge?
☑ ☐ 45. Is the battery(s) installed with adequate air ventilation?

Special Requirements

☐ ◆ 46. Is the earthquake protection adequate for the equipment and support systems?
☐ ◆ 47. Is the equipment protected from lightning damage?

Generator Set/Transfer Switch Startup Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Complete the Installation Checklist before performing the initial startup checks. Refer to Service Bulletin 616 for Warranty Startup Procedure Requirements regarding generator set models with ECM-controlled engines.

Yes	Does not Apply	
☑	☐	1. Verify that the engine is filled with oil and the cooling system is filled with coolant/antifreeze.
☑	☐	2. Prime the fuel system.
☑	☐	3. Open all water and fuel valves. Temporarily remove the radiator cap to eliminate air in the cooling system. Replace radiator cap in step 21.
☑	☐	4. Place the generator set master switch in the OFF/RESET position. Observe Not-in-Auto lamp and alarm, if equipped, on the controller.
☑	☐	5. Press the lamp test, if equipped on controller. Do all the alarm lamps on the panel illuminate?
☑	☐	6. Open the main line circuit breakers, open the safeguard breaker, and/or remove fuses connected to the generator set output leads.
☑	☐	7. Turn down the speed control (electronic governor) or speed screw (mechanical governor).*
☑	☐	8. Verify the presence of lube oil in the turbocharger, if equipped. See the engine and/or generator set operation manual.
☑	☐	9. Place the generator set master switch in the RUN position. Allow the engine to start and run for several seconds.
☑	☐	10. Verify that the day tank, if equipped, is energized.
☑	☐	11. Place the generator set master switch in the OFF/RESET position. Check for oil, coolant, and exhaust leaks.
☑	☐	12. Turn on the water/oil heaters and fuel lift pumps.
☑	☐	13. Check the battery charger ammeter for battery charging indication.
☑	☐	14. Place the generator set master switch in the RUN position. Verify whether there is sufficient oil pressure. Check for oil, coolant, and exhaust leaks.
☑	☐	15. Close the safeguard circuit breaker. Adjust the engine speed to 50/60 Hz if equipped with an electronic governor or to 52.8/63 Hz if equipped with a mechanical governor.*
☑	☐	16. If the speed is unstable, adjust according to the appropriate engine and/or governor manual.*
☑	☐	17. Adjust the AC output voltage to match the load voltage using the voltage adjusting control. See the generator set/controller operation manual.
☑	☐	18. Allow the engine to reach normal operating coolant temperature.
☐	◆	19. Check the operating temperature on city water-cooled models and adjust the thermostatic valve as necessary.
☑	☐	20. Manually overspeed the engine to cause an engine shutdown (68-70 Hz on 60 Hz models and 58-60 Hz on 50 Hz models). Place the generator set master switch in the OFF/RESET position.*
☑	☐	21. Check the coolant level, add coolant as necessary, and replace the radiator cap. Verify that all hose clamps are tight and secure.
☑	☐	22. Place the generator set master switch in the RUN position.
☑	☐	23. Verify the engine low oil pressure and high coolant temperature shutdowns.*
☑	☐	24. Check the overcrank shutdown.*
☑	☐	25. Place the generator set master switch in the OFF/RESET position.
☐	☐	26. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	27. Disconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	28. Manually transfer the load to the emergency source.
☐	☐	29. Close the normal source circuit breaker or replace fuses to the transfer switch.
☐	☐	30. Check the normal source voltage, frequency, and phase sequence on three-phase models. The normal source must match the load.
☐	☐	31. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐	☐	32. Manually transfer the load to the normal source.
☐	☐	33. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	34. Place the generator set master switch in the RUN position.
☐	☐	35. Check the generator set voltage, frequency, and phase sequence on three-phase models. The generator set must match normal source and load.
☐	☐	36. Place the generator set master switch in the OFF/RESET position.
☐	☐	37. Open the generator set main line circuit breakers, open the safeguard breaker, and/or remove the fuses connected to the transfer switch.
☐	☐	38. Reconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐	☐	39. Close the normal source circuit breaker or replace fuses to the transfer switch. Place the generator set master switch to the AUTO position.
☐	☐	40. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐	☐	41. Place the transfer switch in the TEST position (load test or open normal source circuit breaker). NOTE: Obtain permission from the building authority before proceeding. This procedure tests transfer switch operation and connects building load to generator set power.
☐	☐	42. Readjust frequency to 50 or 60 Hz with total building loads.*
☐	☐	43. Verify that the current phase is balanced for three phase systems.
☐	☐	44. Release the transfer switch test switch or close the normal circuit breaker. The transfer switch should retransfer to the normal source after appropriate time delay(s).
☐	☐	45. Allow the generator set to run and shut down automatically after the appropriate cool down time delay(s).
☐	☐	46. Set the plant exerciser to the customer's required exercise period, if equipped.
☐	☐	47. Verify that all options on the transfer switch are adjusted and functional for the customer's requirements.
☐	☐	48. If possible, run the building loads on the generator set for several hours or perform the load bank test if required.
☐	☐	49. Verify that all the wire connections from the generator set to the transfer switch and optional accessories are tight and secure.
☐	◆	50. If there is a UPS system, fill out the UPS prestart checklist and UPS startup checklist.
☐	☐	51. Verify that the customer has the appropriate engine/generator set and transfer switch literature. Instruct the customer in the operation and maintenance of the power system.
☑	☐	52. Fill out the startup notification at this time and send the white copy to the Generator Warranty Dept. Include the warranty form if applicable.

* Some models with electronic engine controls may limit or prohibit adjusting the engine speed or testing shutdowns.

Generator Start-Up Report

Frontier POWER PRODUCTS

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

Work Order #	**Client**	**Unit Address**	**Date**
68513	Government Services	825 Admirals Road	2017-04-21

Gen#1 Make	**Gen#1 Serial #**	**Engine #1 S/N#**	**Kw**	**Amps**	**Volts**	**Phase**	**Load Bank Cable**	
Kohler	SGM32HWDB	28777	760	914	600	3	90ft	
Gen#2 Make	**Gen#2 Serial #**	**Engine #2 S/N#**	**Kw**	**Amps**	**Volts**	**Phase**	**Load Bank Cable**	

Engine Battery and Charging Systems

System Voltage	24V	**Type**	8D	**Battery Rating**	1400	**cca**	**Install Date**	

	Battery #1	**Battery #2**	**Battery #3**	**Battery #4**
Battery Condition	Good	Good		
Battery Test	12.6 **V @** 1600 **cca**	12.7 **V @** 1620 **cca**	**V @** **cca**	**V @** **cca**
Electrolyte Level	Good	Good		
Terminals / Cables	Clean and Secure	Clean and Secure		
Charger Operation	27 **V @** 8.9 **A**	**V @** **A**	**V @** **A**	**V @** **A**
Alternator Charging	27.8 **V @** 41 **A**	**V @** **A**	**Starter Connections / Operation**	OK

Cooling System

Check Coolant Level	OK	**Check Block Heater Operation**	OK	**Inspect Coolant Hoses**	OK
Check Coolant Strength	OK	**Inspect Block Heater Hoses**	OK	**Inspect Radiator**	OK

Lubrication and Air Intake Systems

Check Engine Oil Level	OK	**Inspect Crank Case Breather**	OK	**Inspect Turbo**	OK
Inspect Oil Cooler	N/A	**Inspect Air Filter**	OK	**Inspect Air Duct / Louvers**	N/A

☑ **Diesel** ☐ **Gas**

Fuel System

Inspect Fuel Filter	OK	**Inspect Fuel Tank**	OK	**Check Transfer Pump**	N/A	**Check Fuel Gauge**	OK
Inspect Fuel Hoses	OK	**Inspect Pipe Work**	OK	**Check Lift Pump**	OK	**Check Fuel Level**	OK
Inspect Gas Solenoid	N/A	**Inspect Gas Regulator**	N/A	**Check For Gas Leaks**		**Check Gas Pressure**	

General Engine Checks

Inspect Drive Belts	OK	**Check for Exhaust Leaks**	OK	**Check for Abnormal Noises**	OK
Inspect Governor Linkage	OK	**Check for Fluid Leaks**	OK	**Check for Warning Indicators**	OK

Generator and Electrical Checks

								Main Breaker	
Warning Indicators	OK	**Wire Connections**	OK	**Breakers**	OK	**Grounds**	OK	**Amps**	1200
Meters / Guages	OK	**Wiring Harness**	OK	**Annunciator**	OK	**Lugs**	OK	**Type**	Thermo-mag

Running Checks / Protection and Alarms

Output Frequency	60	Hz	**Output Voltage**	600	V	**Oil Pressure**	88	psi	**Temperature**	162 ºF

Low Oil Pressure	OK	**Over-Speed**		**Coolant Level**	OK
High Coolant Temperature	OK	**Over-Crank**	OK	**Emergency Stop**	OK

Generator Start-Up Report

Frontier POWER PRODUCTS
Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

Transfer Switch # 1

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 2

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 3

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Transfer Switch # 4

Make	Serial Number	Model or Amperage	Exerciser Day / Time		

Panel Lights and Meters		Perform On-Load Transfer		On-Load Voltage			
Manual By-Pass Switch		Cable and Wire Connections		On-Load Amperage			
Time delay on start		Cranking time to engine start & run		Time to come up to operating speed			
Time from power outage to transfer		Time on re-transfer to normal supply		Time delay on cooling and shutdown			

Commissioning Notes / Recommendations

4 Hour Load Test Report

Frontier
POWER PRODUCTS
www.frontierpower.com

WO#	68513	**Date:**	Apr 10, 2017	**Project / Site:**	Esquimalt Graving Dock, Generator 3

Unit Make:	**Kohler**	**Model:**	750REOZMD	**Serial#**	SGM32HWDB
Engine Make:	**Mitsubishi**	**Model:**	S12A-Y2PTAW-2	**Serial#**	28777
Alternator Make:	**Kohler**	**Model:**	5M4278BF	**Serial#**	MT-0041648-1216

Run	**Read**	**Load**		**Voltage (V)**			**Current (A)**			**Freqency**	**Oil Pressure**	**Oil Temp**	**Coolant Temp**	**Ambient Outside Temp**	**Frame Temp**	**Ambient Inside Temp**	**Boost Manifold Pressure**	**Ex (F1 - F2)**		**Gen Air Outlet Temp**
Time	**Time**	**(Kw)**	**(%)**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	**(Hz)**	**psi**	**ºF**	**ºF**	**ºC**	**ºC**	**ºC**	(PSI)	**(Volts)**	**(Amps)**	**ºC**
Start	2:20	0	0	600	600	600	0	0	0	60	90	148	154	10	18.8	10.5	6.5	17.3	0.8	10
30 min	2:50	740	97	600	600	601	712	710	714	60	84	164	161	11	24.6	11.6	34	25.2	1.15	12
60 min	3:20	740	97	600	600	601	712	710	714	60	84	170	161	11	25.3	11.6	34	25.4	1.16	12
90 min	3:50	740	97	600	600	601	712	710	714	60	83	166	161	10	33.0	11.3	34	25.4	1.16	11.5
120 min	4:20	740	97	600	600	601	712	710	714	60	83	171	161	9	28.9	11.8	34	25.5	1.16	11.5
150 min	4:50	740	97	600	600	601	712	710	714	60	82	170	161	9	28.8	11.2	34	25.4	1.16	9.7
180 min	5:20	740	97	600	600	601	712	710	714	60	82	178	161	10	28.5	11.3	34	25.4	1.16	11
210 min	5:50	740	97	600	600	601	712	710	714	60	82	173	161	9	30.0	11.0	34	25.4	1.16	10.5
240 min	6:20	740	97	600	600	601	712	710	714	60	81	174	161	9	31.0	9.8	34	25.3	1.16	11.1

Battery Voltage During Cranking: 21.1V (battery voltage was 26.1V prior to cranking)

On completion of load test, take hot winding resistance readings:

L1 - N:	3.21 mΩ	**L2 - N:**	3.22 mΩ	**L3 - N:**	3.23 mΩ

Remarks

Technician: Preston Li

Form# 04-27-17

100 Cherry Ave, Suite 6B
Eaton, Colorado, 80615
USA

E-Mail: info@aerinox-inc.com
Phone: +1 (970) 454-5639

Commissioning Report

for the

AeriNOx Emissions Control System

SCR Exhaust Gas Treatment

for

Frontier Power / Esquimalt Graving Dock
Victoria, V9A 3S1 ATT

Project number:

PA2016_390

A.Collins
4/27/2017

1. General

Plant	Esquimalt Graving Dock – Victoria, BC, Canada 3 x Kohler 750REOZMD (Mitsubishi S12A3-Y2PTAW-2)
Project Nr.	PA2016_390
Customer	Frontier Power
Location	7983 Progress WayDelta, BC V4G 1A3
Owner	EGD

Dates			**Done By:**
Mechanical Erection		to 4/19/17	Customer
Installation Catalyst		to 4/19/17	Customer
Electrical Installation		to 4/19/17	Customer
Start Up Of The System	from 4/19/17	to 4/21/17	AeriNOx
Cold Commissioning	from 4/19/17	to 4/21/17	AeriNOx
Hot Commissioning	from 4/19/17	to 4/21/17	AeriNOx
Diesel Adjustment	from	to	
Normal operation test run	Unit 1: 4/21/17		AeriNOx
	Unit 2: 4/19/17		
	Unit 3: 4/20/17		
Training Of The Operator	4/21/17 AM		AeriNOx
System Hand Over	4/21/17		AeriNOx
Begin Warranty Period	**see contract**		

2. Commissioning

Project: Frontier Power / Esquimalt Graving Dock
Project Nr.: PA2016_390

- **NOx-values <0.67g/kw-hr have been reached and were verified using a Test 350 Exhaust Gas Analyzer.**
- **Injection point and internal control set up to <0,50g/kw-hr.**
- **Urea specification: 32.5% Urea.**
- **Temperature release (urea injection start) is set to 320°C (hysteresis at 310°C) per DCL suggestion for DPF regen.**
- **Urea setup and further details on the controller setting for each engine (as commissioned) please see attached engine measuring protocols.**
- **Operator training of the DeNOx system done on 04.21.2017 with was done in partnership with the engine/generator training.**
- **The customer gave the commissioning team a deadline of 1 engine commissioned per day to make the training date of 04.21.2017, some raw data points were not able to be collected due to time constraints.**
- **The exhaust piping is not insulated from the elbow as it leaves the container until the SCR reactor, DOC not insulated. Insulating the exhaust piping will reduce the amount of time the system takes to come up to operating temp on startup and widen the load range the SCR system will operate in due to current temp constraints.**
- **All 3 engines will be setup to parallel when they go online.**

Hand over date: 04.21.2017

Andy Collins 4/27/17

AeriNOx Inc
100 Cherry Ave, Suite 6B
Eaton, Colorado, 80615 - USA
Phone: +01 (970)454-5639

Client Signature

Client Name Printed

Company & Title

3. Remaining points

1. For AeriNOx

2. For Customer

4. Pre Commissioning:

4.1 General

Checkpoint	Remark	Action
All components installed according to device list and cable block diagram	√	
All components mounted correctly and stable	√	
All supply systems connected and marked (power, air, urea)	√ No process tags	None
All devices marked if necessary	No device tags	None
General condition, painting, cleanness	Surface rust observed on some exhaust components	To be painted by customer
All components accessible, platforms installed if necessary	Ladder access to catalysts / exhaust components only	None
All openings of the exhaust gas system closed	√	

4.2 Catalysts, Catalytic Reactor, Injection System

Checkpoint	Remark	Action
Reactor mounted correctly and stable	√	
Reactor and injection duct connected and tight welded	√	
All mounting openings and manholes accessible	Scaffolding may need to be erected to conduct maintinance	None
Reducing agent nozzle adjusted and mounted correctly	√	
Catalyst installed according plan	√	
Mounting openings of reactor tightened and closed	√	
Insulation of reactor completed	SCR only, DOC not insulated	TBD
Thermocouples installed according mounting instruction and connected according manual	√	
Differential pressure transmitter installed according mounting instruction and connected according manual	√ Re-scaled DPT to 0 – 100 mBar	Complete

4.3 Electrical System

Checkpoint	Remark	Action
General conditions of wiring	√	
All electrical components connected correctly and according manuals	√	
All cables according cable list	√	
All connections according drawings	√	
All signals available in switch gear cabinet	√	
Connection and signal exchange to engine control system o.k.	Found issue with load signal on Unit 2 terminal pinching the insulation – no problems on Unit 1 or 3	Complete
Power supply for all systems	√	

4.4 Pipes

Checkpoint	Remark	Action
All pipes according to P&ID	√	
Connections to dosing unit, pump station and injection nozzle according to mounting instructions	√	
Pipes cleaned and purged	Unknown	None
Marking of pipework	No tags	None
Urea pipes pressure tested	√ No visible leaks	
Air pipes pressure tested	√ No visible leaks	

4.5 Compressor Station:

Checkpoint	Remark	Action
Compressor **Make - Model**	Hydrovane – V04PURHS	
Compressor, buffer tank and condensate drain placed, connected and fixed according instruction	√	
Oil level confirmed to meet manufacturer spec before startup	√	
Door interlock switch tested	√	
Rotation of compressor in right direction	Direction of rotation incorrect on Unit 3 – switched L1 and L2	Complete
Setting of timer relays and pressure switch	Verified OEM settings	None
Compressor set to operation according manual	√	
Buffer tank: condensate valve of buffer tank function tested	Vavle tested but no buffer tank present	None

4.6 Pump Station

Checkpoint	Remark	Action
Pump gearbox filled with oil	√	
Pump rotation checked	Not correct. Had to change legs L1 and L2 on all 3 pumps to correct the direction of rotation	Complete
Suction pipe return valve checked	√	
Pump set to operate with water	√ Urea used instead of water	
Overflow valve adjusted	√ Set to 7.9 bar when deadheaded	

4.7 Dosing Unit

Checkpoint	Remark	Action
Dosing valve adjustment (zero and maximum stroke) controlled according manual	√ Min stroke adjusted to 260	
Pressure transmitter output signal according to manometer at pump station	Relay signal verified – analog signal not used	Complete
Parameters of flowmeter set	√	
Air pressure reducing valve set	√ 4.5 bar	
Air flow switch set	√	

4.8 Sootblower System

Not in scope of supply

Checkpoint	Remark	Action
Air pressure reducing valve set	-	
Pipework pressure tested	-	
Function of solenoid valves tested	-	
Valve sequence and order tested	-	
Set of blowing times	-	

4.9 NOx-Sensor

Checkpoint	Remark	Action
All Parts mounted according instruction	√	
All parts mounted according flow diagram	√	
Exhaust gas probes mounted to catalytic reactor at correct place and in accordance with manual	√	
Pipes and tubes between single devices of gas analyzing system mounted correctly	√	
All electrical connections ready	√	
All signals available in PLC	√	
NOx-analyzer ready and in correct range	√	

4.10 PLC-System

Checkpoint	Remark	Action
All electrical connections ready	√	
All signals available in PLC	√ Changed urea tank level transmitter to 0 – 10V by adding 500 Ohm resistor to use avaialable IO	Complete
All interfaces checked	√	

4.11 Signal exchange

4.11.1 Interface Signals from SCR to IAS

DQ SCR	AeriNOx Acceptance	Comment
U1 common alarm	√	
U2 common alarm	√	
U3 common alarm	√	

4.11.2 Interface Signals from IAS to SCR

DI/AI SCR	AeriNOx Acceptance	Comment
E1 running	√	
E1 load 0-100%	√	Scaling: 4..20mA = 0..100% load (0-900 kw)
E2 running	√	
E2 load 0-100%	√	Scaling: 4..20mA = 0..100% load (0-900 kw)
E3 running	√	
E3 load 0-100%	√	Scaling: 4..20mA = 0..100% load (0-900 kw)

4.11.3 Interface Signals from SCR to IAS via Modbus TCP/IP

Output SCR	AeriNOx Acceptance	Comment
Signals provided according data list: “PA2016_361_Modbus_SCR_IAS_Rev03”	Not used	External modbus not used on this project – no SCR panel connection provided

5. Hot Commissioning, Commissioning of Complete System

Input conditions exhaust gas	Remark
Exhaust gas before DeNOx according to design data	1. NOx content in exhaust gas flow: **design:** **NO:** **5.36 g/KWh** during operation 5.2 – 5.8 g/KWh 2. Exhaust gas temperature **design:** **883°F** during operation: 662°**F**

Output conditions exhaust gas	Remark:
Exhaust gas after DeNox according to design data	1. NO content in exhaust gas flow: **design:** **NO:** **< 0.67 g/KWh** . during operation: <0.50 g/KWh 2. Exhaust gas temperature for start/stop after SCR: design: 320 / 310°C 608 / 590°F For actual temperature settings please refer to attached engine measurement protocol as start up enable temperature is based on fuel type. 3. Volumeflow: 4793 Nm^3/h @ 900 kW

Performance values	Remark:
Backpressure pre catalyst	**ONLY DIFF PRESS ACROSS SCR MEASURED** approx. 42 - 48 mbar@83%
Consumption of reducing agent per engine	**U1**: 9.5 @ 83% load, **U2**: 8.1 @ 83% load, **U3**: 7.1 @ 83% load

Operation modes DeNOx	Remark
Stand Still	√
Startup	√
Performance	√
Failure	√
Shutdown	√

6. Appendix

DeNOx Measuring Protocol Engine_1

Project: Frontier - EGD

Project no. PA2016_390

V2.0

Measured by: Andy Collins

Meas. Device: Testo 350

Location: Victoria, BC, Canada

Date 4/21/2017

Ambient Cond.: Cloudy

Ambient Temp.: ~17 °C

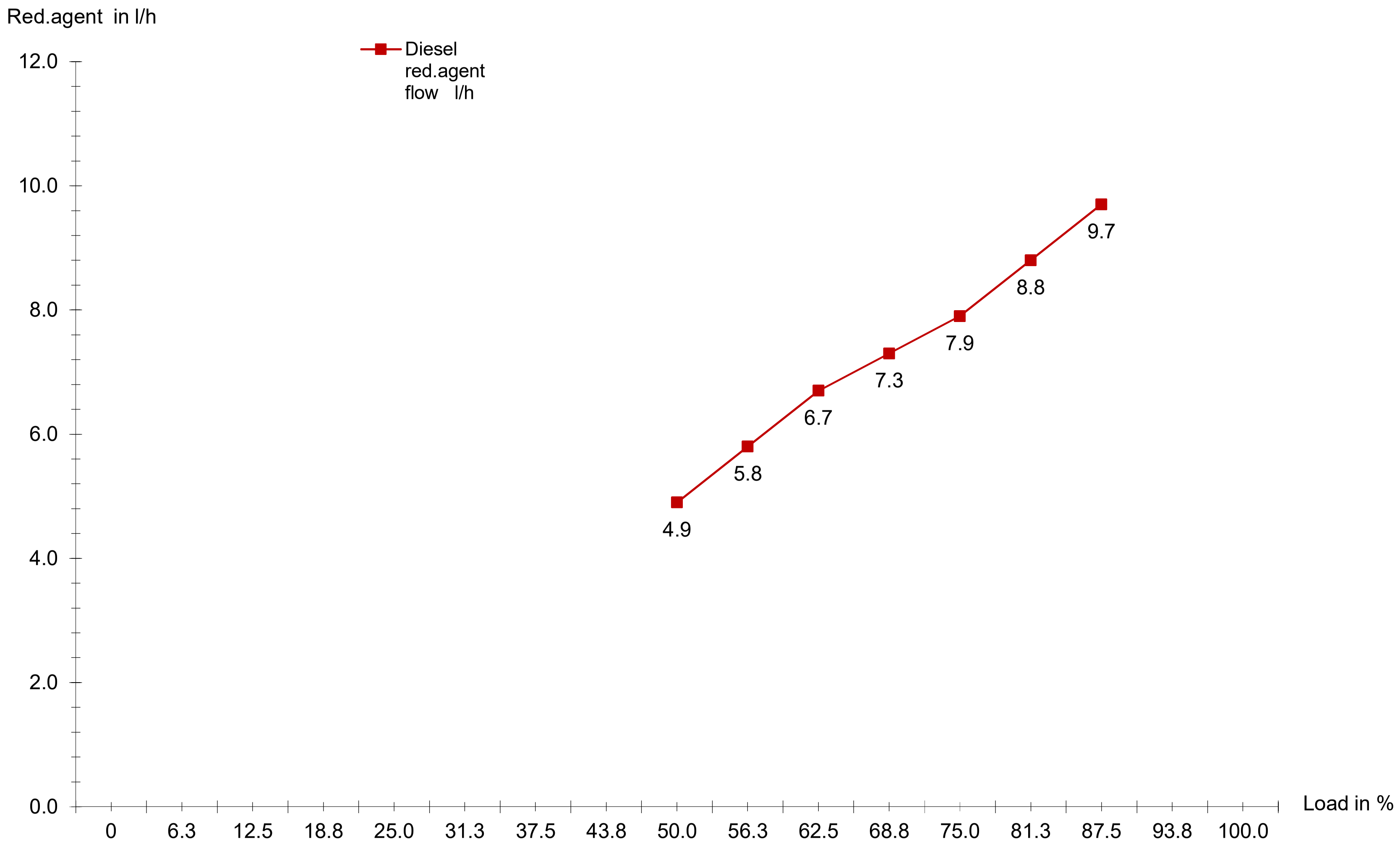
Engine		DeNOx Design Data			Setpoints		Operation		Start-up Conditions			Comment
Engine	1	Red. agent	32.5	% Urea	Pump red. press.	5.7/9	7.9	bar	Engine load min.	~25/23	%	NO raw act. 5.8 g/kWh
Engine	Mitsubishi	Fuel type Diesel	0.0015	% max sulphur	Dos. red. press.	NA	NA	bar	Urea flow min.	---/---	l/h	Engine raw gas value exceed design data.
Typ	S12A2-Y2PTAW-2	Fuel type HFO	---	% max sulphur	Dos. air press.	4/3.5	4.5	bar				Exhaust temperature out of design range.
Power	900 kW				Dos. valve adj.	260/410	10	l/h	Temp. min. GAS	---/---	°C	- Customer set a very tight commissioning schedule so not all RAW data records could be populated.
Gas flow	4,793 Nm^3/h	NOx target	0.67	g/kWh	Dos. valve type	2873	0.8		Temp. min. Diesel	320/310	°C	
Speed	1800 RPM	NOx raw contract	5.36	g/kWh	Flow ctrl p/ti	1.0 / 2.0			Temp. min. HFO	---/---	°C	
Fuel type	Diesel	O2 reference		%	NOx ctrl p/ti	0.08 / 2.0						
Diesel spec.	<0,1% sulphur	Exh. temp. design	473	°C	NOx ctrl target	40		ppm	Cool/Clean time	180/600	s	
HFO spec.	--- sulphur	Exh. temp. max.	500	°C	Exh. temp. max	500		°C				

													Raw (Pre Catalyst) Data Records						Post Catalyst Data Records							
Time		Engine load %	Engine load ^{2}) %	Engine speed rpm	Engine load ^{3} kW	Volume flow $^{3)}$ Nm^3/h	Temp. bef. cat °C	Temp. aft. cat °C	Delta p cat mbar	p Urea pump bar	p Urea dos.unit bar	Dosing valve %	NOx ppm	O2 %	CO ppm		NO mg/Nm^3 @ref.O2	NO g/kWh	NOx ppm	O2 %	CO ppm		NOx**) mg/Nm^3 @ref.O2	NOx **) g/kWh	Diesel red.agent flow l/h	
	0		0																							0
	1		6.3		57	302																				1
	2		12.5		113	599																				2
	3		18.8		169	901																				3
	4		25.0		225	1,198																				4
	5		31.3		282	1,500																				5
	6		37.5		338	1,797																				6
	7		43.8		394	2,099																				7
3:22 PM	8	51	50.0	1800	450	2,397	---	304	28.4	7.8	---	70							35	13.3	---			0.38	4.9	8
3:17 PM	9	56.0	56.3	1800	507	2,698	---	309	30.4	7.8	---	68							31	13.1	---			0.34	5.8	9
3:03 PM	10	62	62.5	1800	563	2,996	---	328	33.0	7.8	---	75							41	12.9	---			0.45	6.7	10
2:57 PM	10	67	68.8	1800	619	3,298	---	333	35.0	7.6 - 8.5	---	75							36	12.6	---			0.39	7.3	11
2:50 PM	11	73	75.0	1800	675	3,595	---	340	37.4	7.6 - 8.5	---	74							42	12.4	---			0.46	7.9	12
2:40 PM	12	78	81.3	1800	732	3,897	---	359	40.1	7.6 - 8.5	---	81	481	12.1	---			5.25	39	12.1	---			0.43	8.8	13
1:59 PM	13	83	87.5	1800	788	4,194	---	370	42.5	7.6 - 8.5	---	77	528	11.8	---			5.76	40	12.1	---			0.44	9.7	14
	15		93.8		844	4,496																				15
	16		100.0		900	4,793																				16
Measur-ement		ECR	TP	ECR	ECR	ECR	1CT010	1CT020	1CP010	0CP010	1CP020		Analyzer Testo 350	Analyzer Testo 350	Analyzer Testo 350		calc.	calc.	Analyzer Testo 350	Analyzer Testo 350	Analyzer Testo 350		calc.	calc.	1CF010	

[2] engine load in % from SCR TP (calculated for injection)

[3] calculated from max value

DeNOx Polygon Engine_1



DeNOx Measuring Protocol Engine_2

Project: Frontier - EGD

Project no. PA2016_390

V2.0

Measured by: Andy Collins

Meas. Device: Testo 350

Location: Victoria, BC, Canada

Date 4/19/2017

Ambient Cond.: Cloudy

Ambient Temp.: ~10 °C

Engine		**DeNOx Design Data**			**Setpoints**		**Operation**		**Start-up Conditions**			**Comment**
Engine	2	Red. agent	32.5	% Urea	Pump red. press.	5.7/9	7.9	bar	Engine load min.	~25/23	%	NO raw act. 5.2 g/kWh
Engine	Mitsubishi	Fuel type Diesel	0.0015	% max sulphur	Dos. red. press.	NA	NA	bar	Urea flow min.	---/---	l/h	
Typ	S12A2-Y2PTAW-2	Fuel type HFO	---	% max sulphur	Dos. air press.	4/3.5	4.5	bar				Exhaust temperature out of design range.
Power	900 kW				Dos. valve adj.	260/410	10	l/h	Temp. min. GAS	---/---	°C	- Customer set a very tight commissioning schedule so not all RAW data records could be populated.
Gas flow	4,793 Nm³/h	NOx target	0.67	g/kWh	Dos. valve type	2873	0.8		Temp. min. Diesel	320/310	°C	
Speed	1800 RPM	NOx raw contract	5.36	g/kWh	Flow ctrl p/ti	1.0 / 2.0			Temp. min. HFO	---/---	°C	
Fuel type	Diesel	O2 reference		%	NOx ctrl p/ti	0.08 / 2.0						
Diesel spec.	<0.1% sulphur	Exh. temp. design	473	°C	NOx ctrl target	40		ppm	Cool/Clean time	180/600	s	
HFO spec.	--- sulphur	Exh. temp. max.	500	°C	Exh. temp. max	500		°C				

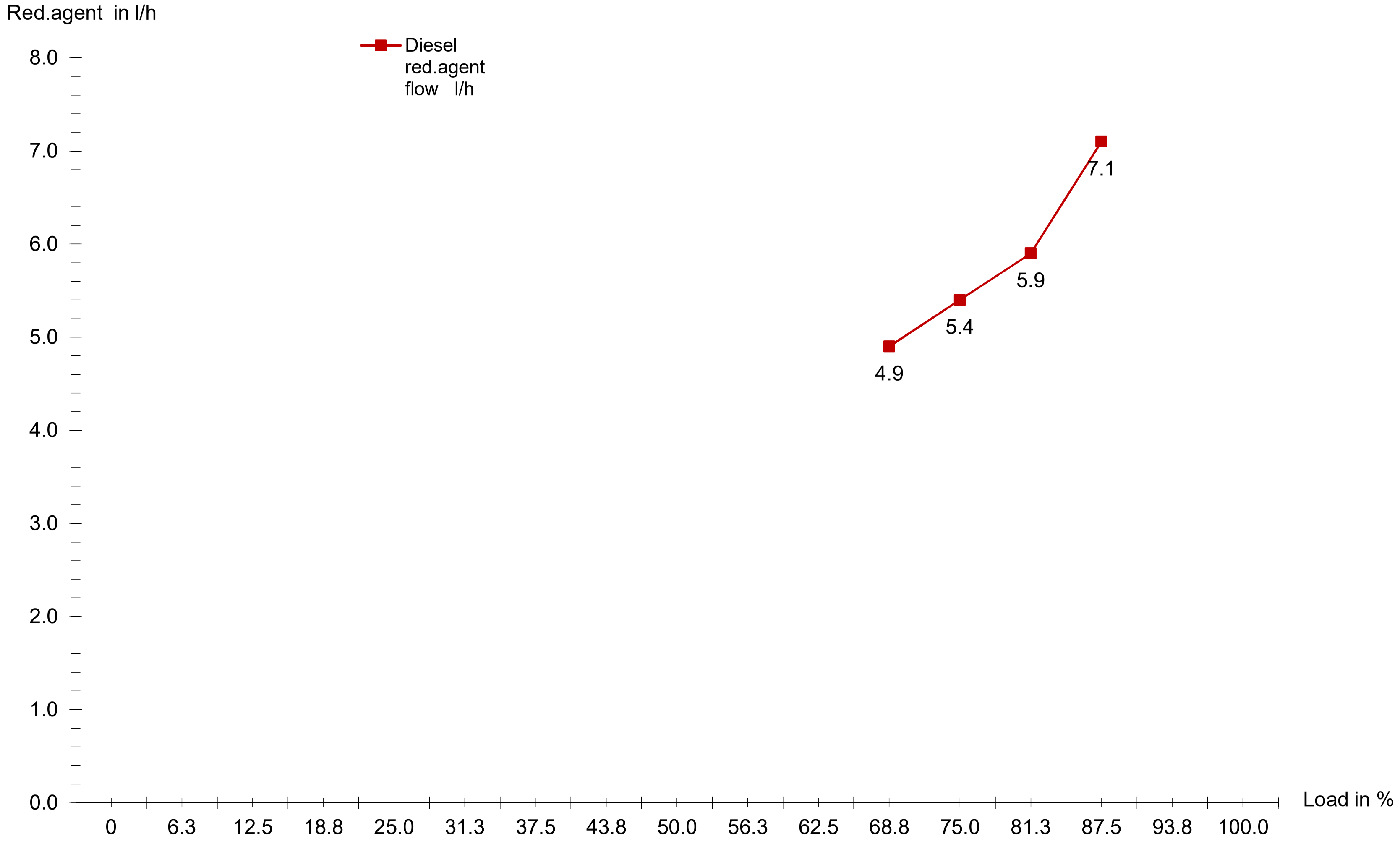
													Raw (Pre Catalyst) Data Records						**Post Catalyst Data Records**							
Time		Engine load %	Engine load [2]) %	Engine speed rpm	Engine load [3] kW	Volume flow [3]) Nm³/h	Temp. bef. cat °C	Temp. aft. cat °C	Delta p cat mbar	p Urea pump bar	p Urea dos.unit bar	Dosing valve %	NOx ppm	O2 %	CO ppm		NO mg/Nm³ @ref.O2	NO g/kWh	NOx ppm	O2 %	CO ppm		NOx**) mg/Nm³ @ref.O2	NOx **) g/kWh	Diesel red.agent flow l/h	
	0		0																							0
	1		6.3		57	302																				1
	2		12.5		113	599																				2
	3		18.8		169	901																				3
	4		25.0		225	1,198																				4
	5		31.3		282	1,500																				5
	6		37.5		338	1,797																				6
	7		43.8		394	2,099																				7
	8		50.0		450	2,397																				8
	9		56.3		507	2,698																				9
	10		62.5		563	2,996																				10
8:37 PM	10	67	68.8	1800	619	3,298	---	314	35.8	8.0	---	74			---				36	13.1	---			0.39	4.9	11
8:13 PM	11	73	75.0	1800	675	3,595	---	331	38.1	8.0	---	74			---				37	12.8	---			0.40	5.4	12
8:06 PM	12	78	81.3	1800	732	3,897	---	334	40.3	7.9	---	77	478	12.5	---			5.22	46	12.5	---			0.50	5.9	13
5:11 PM	13	83	87.5	1800	788	4,194	---	351	44.5	7.9	---	81							37	12.2				0.40	7.1	14
	15		93.8		844	4,496																				15
	16		100.0		900	4,793																				16
Measur-ement		ECR	TP	ECR	ECR	ECR	2CT010	2CT020	2CP010	0CP010	2CP020		Analyzer Testo 350	Analyzer Testo 350	Analyzer Testo 350		calc.	calc.	Analyzer Testo 350	Analyzer Testo 350	Analyzer Testo 350		calc.	calc.	2CF010	

---

[2] engine load in % from SCR TP (calculated for injection)

[3] calculated from max value

DeNOx Polygon Engine_2



DeNOx Measuring Protocol Engine_3

Project: Frontier - EGD

Project no. PA2016_390

V2.0

Measured by: Andy Collins

Meas. Device: Testo 350

Location: Victoria, BC, Canada

Date 4/20/2017

Ambient Cond.: Cloudy

Ambient Temp.: ~13.5 °C

Engine		DeNOx Design Data			Setpoints		Operation		Start-up Conditions			Comment
Engine	3	Red. agent	32.5	% Urea	Pump red. press.	5.7/9	7.9	bar	Engine load min.	~25/23	%	NO raw act. 5.7 g/kWh
Engine	Mitsubishi	Fuel type Diesel	0.0015	% max sulphur	Dos. red. press.	NA	NA	bar	Urea flow min.	---/---	l/h	Engine raw gas value exceed design data.
Typ	S12A2-Y2PTAW-2	Fuel type HFO	---	% max sulphur	Dos. air press.	4/3.5	4.5	bar				Exhaust temperature out of design range.
Power	900 kW				Dos. valve adj.	260/410	10	l/h	Temp. min. GAS	---/---	°C	- Customer set a very tight commissioning schedule so not all RAW data records could be populated.
Gas flow	4,793 Nm³/h	NOx target	0.67	g/kWh	Dos. valve type	2873 0.8			Temp. min. Diesel	320/310	°C	
Speed	1800 RPM	NOx raw contract	5.36	g/kWh	Flow ctrl p/ti	1.0 / 2.0			Temp. min. HFO	---/---	°C	
Fuel type	Diesel	O2 reference		%	NOx ctrl p/ti	0.08 / 2.0						
Diesel spec.	<0,1% sulphur	Exh. temp. design	473	°C	NOx ctrl target	40		ppm	Cool/Clean time	180/600	s	
HFO spec.	--- sulphur	Exh. temp. max.	500	°C	Exh. temp. max	500		°C				

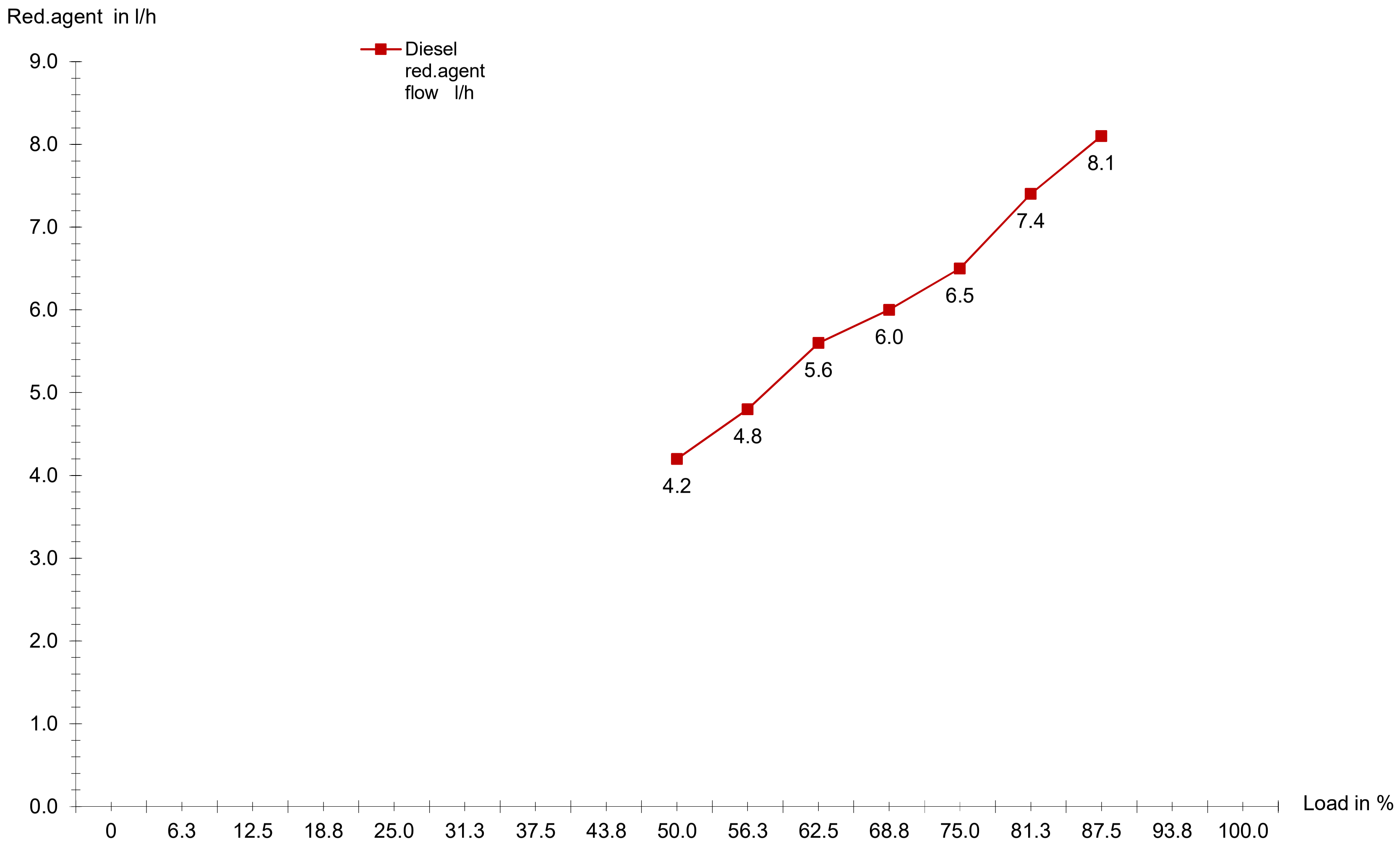
													Raw (Pre Catalyst) Data Records						Post Catalyst Data Records							
Time		Engine load %	Engine load $^{2)}$ %	Engine speed rpm	Engine load ^{3} kW	Volume flow $^{3)}$ Nm³/h	Temp. bef. cat °C	Temp. aft. cat °C	Delta p cat mbar	p Urea pump bar	p Urea dos.unit bar	Dosing valve %	NOx ppm	O2 %	CO ppm		NO mg/Nm³ @ref.O2	NO g/kWh	NOx ppm	O2 %	CO ppm		NOx**) mg/Nm³ @ref.O2	NOx **) g/kWh	Diesel red.agent flow l/h	
	0		0																							0
	1		6.3		57	302																				1
	2		12.5		113	599																				2
	3		18.8		169	901																				3
	4		25.0		225	1,198																				4
	5		31.3		282	1,500																				5
	6		37.5		338	1,797																				6
	7		43.8		394	2,099																				7
11:40 AM	8	51	50.0	1800	450	2,397	---	306	31.9	8.2	---	80							39	13.5	---			0.43	4.2	8
11:34 AM	9	56.0	56.3	1800	507	2,698	---	313	34.5	8.2	---	81							37	13.3	---			0.40	4.8	9
11:27 AM	10	62	62.5	1800	563	2,996	---	316	37.0	8.1	---	82							27	13.1	---			0.29	5.6	10
11:20 AM	10	67	68.8	1800	619	3,298	---	325	39.5	8.1	---	82							36	12.9	---			0.39	6.0	11
11:12 AM	11	73	75.0	1800	675	3,595	---	330	42.1	8.0	---	82							38	12.7	---			0.41	6.5	12
10:35 AM	12	78	81.3	1800	732	3,897	---	346	45.4	7.6	---	85	506	12.5	---			5.52	36	12.5	---			0.39	7.4	13
9:20 AM	13	83	87.5	1800	788	4,194	---	350	48.2	7.6	---	86	524	12.2	---			5.72	36	12.1	---			0.39	8.1	14
	15		93.8		844	4,496																				15
	16		100.0		900	4,793																				16
Measur-ement)		ECR	TP	ECR	ECR	ECR	3CT010	3CT020	3CP010	0CP010	3CP020		Analyzer Testo 350	Analyzer Testo 350	Analyzer Testo 350		calc.	calc.	Analyzer Testo 350	Analyzer Testo 350	Analyzer Testo 350		calc.	calc.	3CF010	

)

[2] engine load in % from SCR TP (calculated for injection)

[3] calculated from max value

DeNOx Polygon Engine_3



7. Notes

Pre-Commissioning / Start Up Checklist

Frontier POWER PRODUCTS

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

The following section is to be completed by the sales person.

WO# 68513 **Company Name** Western Pacific enterprises Lt **Project Name** EGD - Towable Standby

Main Contact Gord Webster **PH#** 778-229-1479 **Email:** Gord@wpe.ca

Unit Application

Standby Power ☑ Prime Power ☐ Farm ☐ Other (specify) ☐ ______

Generator Ratings

Serial Number: HOP-103121 **Serial Number:** ______

Diesel ☑ Natural Gas ☐ LPG Vapor ☐ LPG Liquid ☐ Kw Size 75 Voltage 600 Phase 3

Transfer Switch

(Please include all transfer switches at site. Use "Notes" section if more than two.)

Serial # not applicable **Model #** ______ **Serial #** ______ **Model #** ______

Automatic ☐ Bypass ☐ Fire Pump ☐ CTS ☐ Manual ☐ Amperage#1 ______ Amperage#2 ______

Testing Options

Start-up only ☐ Load Test ☑ Load test length 1 CSA 282 Type ☐ Strip Charting ☐

Specials (Attach Specs) ☐ Pump Station ☐

Note: Pump station start-ups **require** the attendance of the pump supplier technical staff. Failure to do so may cause VFD or soft starts to function incorrectly requiring additional **chargeable** visits.

The following sections are to be completed by the contractor.

Requested Start-up Date	May 18, 2017

Note: We require **2 - 3 weeks** advance notice booking time for start-ups. Test dates **will not** be provided without this form completed, signed and approved. A fixed amount of time has been allotted to the start up of this unit. If a return trip is required due to incomplete installation, the return trip will be **chargeable** at our regular field rate, and booked when time permits.

Site Contact Gord Webster **PH#** 778-229-1479 **Email** gord@wpe.ca

Site Address 825 Admirals Rd **City** victoria **Prov.** BC **P/C** V9A 2P1

End User Name PWGSC

Note: This is required for warranty registration purposes. Please provide mailing address if different from above.

Mailing Address ______ **City** ______ **Prov.** ______ **P/C** ______

The installation of this unit must adhere to supplied installation manual and applicable legislated codes.

Notes

Checklist Items

☐ Generator must be bolted to the concrete pad.

☑ Radiator must be full of coolant.

☑ Pre-wire service plug for block heater.

☑ Ensure batteries are connected properly.

☐ Radiator duct louvers must be installed and wired.

☑ Area under and around unit must be free of debris.

☐ Remote annunciator/fire panel installed and wiring in place.

☐ Pre-wire service plug for battery charger.

☑ Exhaust system must be installed and insulated. (If applicable.)

☐ Control wiring should be in a conduit separate from the load conductors. Start wires need to be a minimum of #18 and labeled #3 and #4. They need to be pulled up into the generator controller and to the connection point in the transfer switch. If start wires are in the same conduit as the load conductors, they should be shielded.

☐ ATS line, load and genset connections must be made and terminated. The installing electrician **must** be on site in case wiring verification is required.

☑ Diesel fuel system must be complete and the tank filled to 80% maximum to allow for expansion.

☐ Spark ignited engine fuel system must be installed per Kohler installation manual. Gas pressure ***MUST*** be 7 - 11 inches of water column at the generator fuel inlet at all times. Supply volume must be sized for 100% rated load. Volume requirement is supplied on the generator data sheet.

☐ Confirm special site concerns. (Use "Notes" section on previous page.)

☑ Clear access for service vehicle and load bank will be confirmed. If a load test is to be performed, please indicate the distance in feet from where the load bank can be situated to the connection points.

_________ Feet

Notes

- The above checklist is to help ensure that the start-up of the emergency power system goes smoothly.
- Fire alarm connections will be made at this time. Fire alarm personnel must be available or subsequent visits will be chargeable.
- Power interruptions are inevitable. They will be kept to a minimum, and announced where possible.

* If any of the above items are not complete at the time of start-up **costs will be chargeable** to the contractor.

Our technicians are on site to commission the components supplied by Frontier Power Products only. All code, safety compliance and testing of the complete power system are the responsibility of the owner (s) and their representatives.

Note: The sales person has verified that the contractor's account is in good standing. Before a commissioning date will be set the account must be up to date. ☐

Representative: Gord Webster

Signature:

Sales Person: craig einarson

Signature: ____________________

POWER SYSTEMS

Startup Notification

Follow the startup checklist on the back of this form. Then complete the form. This form is required for coverage under the limited warranty and must be completely filled out at the time of initial startup. Representatives of the distributor/dealer and owner must sign the notification form. **Signing this form represents acceptance of the unit and that all information on the startup form is correct.** Please submit registration to Frontier Power. using the online warranty processing system. Users that do not have access to the online warranty site should mail a copy to

Startup Date
mo. 06 day 14 yr. 17

Authorized Representative Performing Startup

Telephone: 604 946 5531
Company Name: Frontier Power Products.
Address: 7983 Progress Way
City: Delta
State: B.C.
ZIP/Postal Code: V4G 1A3
Country: CANADA

Owner Name/Unit Location

Telephone:
Company Name/Owner:
Address of Unit Location: 825 ADMIRALS RD
City: VICTORIA
State: B.C.
ZIP/Postal Code:
Country: CANADA
Round-trip miles from nearest authorized Kohler servicing distributor/dealer to the power system equipment:

Generator Set and Engine Nameplate Information

	Generator Set. No 1	Engine No. 1	Generator Set No. 2	Engine No. 2
Serial No.	HOP103121	PE4045R097273		
Model No.	QAS90MVT	PE4045		
Spec. No				

Application Information (one item in each column must be checked)

☑ Industrial
☐ Residential/Commercial

☑ Mobile/Towable/Trailer-Mounted
☐ Stationary

☐ Prime
☐ Rental
☑ Standby

Transfer Switch and Switchgear Nameplate Information

	ATS No. 1	ATS No. 2	ATS No. 3	ATS No. 4	Switchgear
Serial No.					
Spec. No	NOT ~~Applic~~ Availible				
Contractor Serial No.					
Model No.					

Representative's Name (print): BRIAN Blagdon

Representative's Signature and Date mo. 06 day 14 yr. 17

Owner Representative's Name (print): GORD WEBSTER

Owner Representative's Signature and Date mo. 06 day 14 yr. 17.

Form Distribution:
Warranty Department,

PINK copy: Distributor

YELLOW copy: Owner's Representative

K-625 (1/13)

Generator Set/Transfer Switch Installation Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Complete the Installation Checklist before performing the initial startup checks. Refer to Service Bulletin 616 for Warranty Startup Procedure Requirements regarding generator set models with ECM-controlled engines.

Yes / Does Not Apply

☑ ☐ 1. Verify that the engine is filled with oil and the cooling system is filled with coolant/antifreeze.
☑ ☐ 2. Prime the fuel system.
☑ ☐ 3. Open all water and fuel valves. Temporarily remove the radiator cap to eliminate air in the cooling system. Replace radiator cap in step 21.
☑ ☐ 4. Place the generator set master switch in the OFF/RESET position. Observe Not-in-Auto lamp and alarm, if equipped, on the controller.
☑ ☐ 5. Press the lamp test, if equipped on controller. Do all the alarm lamps on the panel illuminate?
☑ ☐ 6. Open the main line circuit breakers, open the safeguard breaker, and/or remove fuses connected to the generator set output leads.
☐ ☑ 7. Turn down the speed control (electronic governor) or speed screw (mechanical governor).*
☑ ☐ 8. Verify the presence of lube oil in the turbocharger, if equipped. See the engine and/or generator set operation manual.
☑ ☐ 9. Place the generator set master switch in the RUN position. Allow the engine to start and run for several seconds.
☐ ☑ 10. Verify that the day tank, if equipped, is energized.
☑ ☐ 11. Place the generator set master switch in the OFF/RESET position. Check for oil, coolant, and exhaust leaks.
☑ ☐ 12. Turn on the water/oil heaters and fuel lift pumps.
☑ ☐ 13. Check the battery charger ammeter for battery charging indication.
☑ ☐ 14. Place the generator set master switch in the RUN position. Verify whether there is sufficient oil pressure. Check for oil, coolant, and exhaust leaks.
☑ ☐ 15. Close the safeguard circuit breaker. Adjust the engine speed to 50/60 Hz if equipped with an electronic governor or to 52.8/63 Hz if equipped with a mechanical governor.*
☐ ☑ 16. If the speed is unstable, adjust according to the appropriate engine and/or governor manual.*
☑ ☐ 17. Adjust the AC output voltage to match the load voltage using the voltage adjusting control. See the generator set/controller operation manual.
☑ ☐ 18. Allow the engine to reach normal operating coolant temperature.
☑ ☐ 19. Check the operating temperature on city water-cooled models and adjust the thermostatic valve as necessary.
☐ ☑ 20. Manually overspeed the engine to cause an engine shutdown (68-70 Hz on 60 Hz models and 58-60 Hz on 50 Hz models). Place the generator set master switch in the OFF/RESET position.*
☑ ☐ 21. Check the coolant level, add coolant as necessary, and replace the radiator cap. Verify that all hose clamps are tight and secure.
☑ ☐ 22. Place the generator set master switch in the RUN position.
☑ ☐ 23. Verify the engine low oil pressure and high coolant temperature shutdowns.*
☑ ☐ 24. Check the overcrank shutdown.*
☑ ☐ 25. Place the generator set master switch in the OFF/RESET position.
☐ ☑ 26. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐ ☑ 27. Disconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐ ☑ 28. Manually transfer the load to the emergency source.
☐ ☑ 29. Close the normal source circuit breaker or replace fuses to the transfer switch.
☐ ☑ 30. Check the normal source voltage, frequency, and phase sequence on three-phase models. The normal source must match the load.
☐ ☑ 31. Open the normal source circuit breaker or remove fuses to the transfer switch.
☐ ☑ 32. Manually transfer the load to the normal source.
☐ ☑ 33. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐ ☑ 34. Place the generator set master switch in the RUN position.
☐ ☑ 35. Check the generator set voltage, frequency, and phase sequence on three-phase models. The generator set must match normal source and load.
☐ ☑ 36. Place the generator set master switch in the OFF/RESET position.
☐ ☑ 37. Open the generator set main line circuit breakers, open the safeguard breaker, and/or remove the fuses connected to the transfer switch.
☐ ☑ 38. Reconnect the power switching device and logic controller wire harness at the inline disconnect plug at the transfer switch.
☐ ☑ 39. Close the normal source circuit breaker or replace fuses to the transfer switch. Place the generator set master switch to the AUTO position.
☐ ☑ 40. Close the generator set main line circuit breakers, close the safeguard breaker, and/or replace the fuses connected to the transfer switch.
☐ ☑ 41. Place the transfer switch in the TEST position (load test or open normal source circuit breaker). **NOTE:** Obtain permission from the building authority before proceeding. This procedure tests transfer switch operation and connects building load to generator set power.
☐ ☑ 42. Readjust frequency to 50 or 60 Hz with total building loads.*
☐ ☑ 43. Verify that the current phase is balanced for three phase systems.
☐ ☑ 44. Release the transfer switch test switch or close the normal circuit breaker. The transfer switch should retransfer to the normal source after appropriate time delay(s).
☐ ☑ 45. Allow the generator set to run and shut down automatically after the appropriate cool down time delay(s).
☐ ☑ 46. Set the plant exerciser to the customer's required exercise period, if equipped.
☐ ☑ 47. Verify that all options on the transfer switch are adjusted and functional for the customer's requirements.
☑ ☐ 48. If possible, run the building loads on the generator set for several hours or perform the load bank test if required. 1 Hour
☐ ☑ 49. Verify that all the wire connections from the generator set to the transfer switch and optional accessories are tight and secure.
☑ ☐ 50. Verify that the customer has the appropriate engine/generator set and transfer switch literature. Instruct the customer in the operation and maintenance of the power system.
☑ ☐ 51. Fill out the startup notification at this time and send the white copy to the Generator Warranty Dept. Include the warranty form if applicable.

* Some models with an Engine Electronic Control Module (ECM) may limit or prohibit adjusting the engine speed or testing shutdowns. Refer to appropriate documentation available from the manufacturer.

Generator Set/Transfer Switch Installation Checklist

This document has generic content and some items may not apply to some applications. Check only the items that apply to the specific application. Read and understand all of the safety precautions found in the Operation and Installation Manuals. Make the following installation checks before performing the Startup Checklist.

Note: Use this form as a general guide, along with any applicable codes or standards. Comply with all applicable codes and standards. Improper installation voids the warranty.

Equipment Room or Weather Housing

Yes / Does Not Apply

☑ ☐ 1. Is the equipment installed in a fire-resistant room (made of non-combustible material) or in an outdoor weather housing?

☑ ☐ 2. Is there adequate clearance between the engine and floor for service maintenance?

☐ ☑ 3. Is there emergency lighting available at the equipment room or weather housing?

☑ ☐ 4. Is there adequate heating for the equipment room or outdoor weather housing?

☐ ☑ 5. Is the equipment room clean with all materials not related to the emergency power supply system removed?

☐ ☑ 6. Is the equipment room protected with a fire protection system?

Engine and Mounting

☐ ☑ 7. Is the mounting surface(s) properly constructed and leveled?

☐ ☑ 8. Is the mounting surface made from non-combustible material?

☐ ☑ 9. Was the generator-to-engine alignment performed after attaching the skid to the mounting base? Generator sets with two-bearing generators require alignment.

Lubrication

☑ ☐ 10. Is the engine crankcase filled with the specified oil?

Cooling and Ventilation

☑ ☐ 11. Is the cooling system filled with the manufacturer's specified coolant/antifreeze and purged of air?

☐ ☑ 12. Is there adequate inlet and outlet air flow (electric louvers adjusted and ventilation fan motor(s) connected to the corresponding voltage)?

☑ ☐ 13. Is the radiator duct properly sized and connected to the air vent or louver?

☑ ☐ 14. Are flexible sections installed in the cooling water lines?

Fuel

☑ ☐ 15. Is there an adequate/dedicated fuel supply?

☑ ☐ 16. Are the fuel filters installed?

☑ ☐ 17. Are the fuel tanks and piping installed in accordance with applicable codes and standards?

☐ ☑ 18. Is there adequate fuel transfer tank pump lift capacity and is the pump motor connected to the corresponding voltage?

☐ ☑ 19. Is the fuel transfer tank pump connected to the emergency power source?

☑ ☐ 20. Are flexible fuel lines installed between the engine fuel inlet and fuel piping?

☐ ☑ 21. Is the specified gas pressure available at the fuel regulator inlet?

☐ ☑ 22. Does the gas solenoid valve function?

☐ ☑ 23. Are the manually operated fuel and cooling water valves installed allowing manual operation or bypass of the solenoid valves?

Exhaust

☑ ☐ 24. Is the exhaust line sized per guidelines and does it have flexible connector(s)? Is the flexible connector(s) straight?

Yes / Does Not Apply

☐ ☑ 25. Is there an exhaust line condensate trap with a drain installed?

☑ ☐ 26. Is the specified silencer installed and are the hanger and mounting hardware tightened?

☐ ☑ 27. Is a heat-isolating thimble(s) installed at points where exhaust lines pass through combustible wall(s) or partition(s)?

☑ ☐ 28. Is the exhaust line free of excessive bends and restrictions? Is the backpressure within specifications?

☐ ☑ 29. Is the exhaust line installed with a downward pitch toward the outside of the building?

☑ ☐ 30. Is the exhaust line protected from entry by rain, snow, and animals?

☐ ☑ 31. Does the exhaust system outlet location prevent entry of exhaust gases into buildings or structures?

☑ ☐ 32. Are individuals protected from exposure to high temperature exhaust parts and are hot parts safety decals present?

AC Electrical System

☐ ☑ 33. Does the nameplate voltage/frequency of the generator set and transfer switch match normal/utility source ratings?

☐ ☑ 34. Do the generator set load conductors have adequate ampacity and are they correctly connected to the circuit breakers and/or the emergency side of the transfer switch?

☐ ☑ 35. Are the load conductors, engine starting cables, battery charger cables, and remote annunciator leads installed in separate conduits?

☑ ☐ 36. Is the battery charger AC circuit connected to the corresponding voltage?

Transfer Switch, Remote Control System, Accessories

☐ ☑ 37. Is the transfer switch mechanism free of binding? **Note:** Disconnect all AC sources and operate the transfer switch manually.

☐ ☑ 38. Are the transfer switch AC conductors correctly connected? Verify lead designations using the appropriate wiring diagrams.

☐ ☑ 39. Is all other wiring connected, as required?

Batteries and DC Electrical System

☑ ☐ 40. Does the battery(ies) have the specified CCA rating and voltage?

☑ ☐ 41. Is the battery(ies) filled with electrolyte and connected to the battery charger?

☑ ☐ 42. Are the engine starting cables connected to the battery(ies)?

☑ ☐ 43. Do the engine starting cables have adequate length and gauge?

☑ ☐ 44. Is the battery(ies) installed with adequate air ventilation?

☑ ☐ 45. Are the ends of all spark plug wires properly seated onto the coil/distributor and the spark plug?

Special Requirements

☐ ☑ 46. Is the earthquake protection adequate for the equipment and support systems?

☐ ☑ 47. Is the equipment protected from lightning damage?

Load Test / Vibration Analysis Form

Frontier POWER PRODUCTS

W/O #	69256	**Date:**	2017-06-14	**Customer:**	Western Pacific		
Eng. Model #	4045	**Eng. S/N#**	PE4045R097273	**Gen. Model #**	QAS90 MVT	**Gen. S/N#**	HOP103121

	Load		**Amperage**			**Voltage**			**Freq**	**Power Factor**	**Coolant Temp.**	**Oil Pressure**	**Oil Temp.**	**Ambient Temp.**
Time	**%**	**Kw**	**L1 - L2**	**L2 - L3**	**L3 - L1**	**L1**	**L2**	**L3**	**Hz**	**(PF)**	**ºF**	**psi**	**ºF**	**ºC**
Start	0	0	0	0	0	602	602	602	60	1	135	66	N/A	14
5 min	99	70	67	68	67	601	601	601	60	1	167	59	N/A	14
10 min	99	70	67	68	67	601	601	601	60	1	181	55	N/A	14
15 min	99	70	67	68	67	601	601	601	60	1	183	53	N/A	14
30 min	99	70	67	68	67	601	601	601	60	1	183	52	N/A	14
45 min	99	70	67	68	67	601	601	601	60	1	183	52	N/A	14
1.0 hr	99	70	67	68	67	601	601	601	60	1	183	52	N/A	14

Notes

Site Load test and Demo.

Technician:	Brian Blagdon	**Signed off by:**	

WESTERN PACIFIC ENTERPRISES LTD.
PWGSC No. R.057890.003
CONTRACT No. EZ108-170397

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
			The following tests form part of the overall Stand-by Power Generation System testing and Commissioning. The test results will be signed off by the commissioning agent and provided to the Electrical Consultant for review and sign off to the Owner.	PWGSC/AES				
	1.00		Safety tailboard. Review of Person in Charge, First Aid, Emergency Response, Muster Stations, Scope of Work, Task Hazards, Controls, Safety Checklists	All	✓	16/09/2017	7:30	15
	1.01	1	Review & inspection of previously installed and checked work, Set up test equipment	WPE/TTI/PE	✓	16/09/2017	7:45	60
		2	Shut down EGD (large loads) by PWGSC procedures note: 25/12SES CB1 (DND Utility) to remain viable, Temp Power to SES substation via Existing Power Generator	PWGSC				
		3	Open and Rack out all 25/12SES circuit breakers	PWGSC				
	1.02		***25/12SES CB-2 Block Close-Live Generator Dead Bus***		✓	16/09/2017	8:45	5
		4	Rack into test position Breaker 25/12SES CB-2 Generator Breaker	PWGSC				
		5	Rack in and Close 25/12SES CB-1 DND Utility Breaker	PWGSC				
		6	Attempt to Close 25/12SES CB-2 (Breaker should not close) via SCADA / BRK / TCP switch / Sync	WPE/TTI/SCH				
		7	Verify 25/12SES CB-1 remained Closed	WPE/TTI/SCH				
	1.03		***25/12SES CB-2 Synchronism Block Close – 25/12SES CB-1 must be "Closed"***		✓	16/09/2017	8:50	10
		8	Confirm 25/12SES CB-2 Generator Breaker is in Test Position (see item 4)	PWGSC				
		9	Manually start all Generators (x3)	WPE/TTI/SCH				
		10	Synchronize all Generators to Generator Buss	WPE/TTI/SCH				
		11	Attempt to Close 25/12SES CB-2 Generator Breaker via SCADA / BRK / TCP when not in sync with 25/12SES CB-1 DND Utility	WPE/TTI/SCH				
		12	Verify 25/12SES CB-2 did not close and 25/12 SES CB-1 remained Closed	WPE/TTI/SCH				
	1.04		***25/12SES CB-1 Synchronism Block Close and DLLB Block Closed***		✓	16/09/2017	9:00	15
		13	Open and rack out 25/12SES CB-1 DND Utility Breaker to "Test" position (see item 5)	PWGSC				
		14	Fully Rack in 25/12SES CB-2 (see item 8)	PWGSC				
		15	Manually start all Generators (x3)	WPE/TTI				
		16	Synchronize all Generators to Generator Buss	WPE/TTI/SCH				
		17	Close 25/12SES CB-2 Generator Breaker energizing Buss 1 from Generator supply	WPE/TTI/SCH				
		18	Observe all voltages are in range	WPE/TTI/SCH				
		19	Check for alarm/trip status on protection relays	WPE/TTI/SCH				
		20	Verify 25/12SES CB-1 cannot be closed without synchronism via SCADA / BRK / TCP switch / Sync	WPE/TTI/SCH				
		21	Open Fuse Blocks for 25/12SES PT1 secondary fuses	PE				
		22	Verify 25/12SES CB-1 cannot be closed - manually or remote	WPE/TTI/SCH				
		23	Open 25/12SES CB-2 Generator Breaker	PWGSC				
		24	Close Fuse Blocks for 25/12SES PT1 secondary fuses	PE				
		25	Manually stop all Generators (x3)	WPE/TTI/SCH				
	1.05		***Test Mode Open Transition 25/12SES CB-1 to 25/12SES CB-2 – System in Auto***		✓	16/09/2017	9:15	10
		26	Confirm 25/12SES CB-1 DND Utility Breaker in "Test" position (see item 13)	PWGSC				
		27	Manually close 25/12SES CB-1 DND Utility Breaker	PWGSC				
		28	Initiate Test Mode Open Transition	WPE/TTI/SCH				
		29	Generator start sequence should begin (**3** generators)	WPE/TTI/SCH				
		30	Breaker 25/12SES CB-1 DND Utility Breaker should Open	WPE/TTI/SCH				
		31	Breaker 25/12SES CB-2 Generator Breaker should Close	WPE/TTI/SCH				
	1.06		***Test Mode Open Transition 25/12SES CB-2 to 25/12SES CB-1 – System in Auto***		✓	16/09/2017	9:25	10
		32	Verify Open Transition from 25/12SES CB-1 DND Utility Breaker to 25/12SES CB-2 Generator Breaker is correct (see test 1.05)	WPE/TTI/SCH				
		33	Terminate Test Mode and return TCS system to Normal	WPE/TTI/SCH				
		34	Breaker 25/12SES CB-2 Generator Breaker should Open (see item 31)	WPE/TTI/SCH				

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
		35	Breaker 25/12SES CB-1 DND Utility Breaker should Close (see item 30)	WPE/TTI/SCH				
		36	Generator stop & begins cool down (if loaded)	WPE/TTI/SCH				
	1.07	*Open Transition 25/12SES CB-1 to 25/12SES CB-2 – System in Auto*			✓	16/09/2017	9:35	10
		37	Confirm - 25/12SES CB-1 DND Utility breaker Closed in test position (see item 35)	PWGSC				
		38	Open Fuse Blocks for 25/12SES PT1 secondary fuses	PE				
		39	Breaker 25/12SES CB-1 DND Utility breaker should Open	WPE/TTI/SCH				
		40	Generator start sequence should begin (only 1 generator required)	WPE/TTI/SCH				
		41	Breaker 25/12SES CB-2 Generator Breaker should Close (see item 34)	WPE/TTI/SCH				
	1.08	*Open Transition 25/12SES CB-2 to 25/12SES CB-1 – System in Auto*			✓	16/09/2017	9:45	10
		42	Verify Open Transition from 25/12SES CB-1 DND Utility Breaker to 25/12SES CB-2 Generator Breaker is correct (see item 1.07)	WPE/TTI/SCH				
		43	Close Fuse Blocks for 25/12SES PT1 secondary fuses (see item 38)	WPE/TTI/PE				
		44	Breaker 25/12SES CB-2 Generator Breaker should Open (see item 41)	WPE/TTI/SCH				
		45	Breaker 25/12SES CB-1 DND Utility Breaker should Close (see item 39)	WPE/TTI/SCH				
		46	Generator stop & begins cool down (if loaded)	WPE/TTI/SCH				
		Coffee Break				16/09/2017	9:55	15
	1.09	*Close Transition 25/12SES CB-2 (Generator Breaker) Phasing Checks – Performed by others - TPS to assist with switchgear*			✓	16/09/2017	10:10	20
		47	Open & Rack out completely 25/12SES CB-1 DND Utility Breaker	PWGSC				
		48	Rack out & remove Breaker 25/12SES CB-2 Generator Breaker from SWBD	PWGSC				
		49	Open Shutters at Breaker 25/12SES CB-2 Generator Breaker - for voltage checks	PE				
		50	Rack in and Close 25/12SES CB-1 DND Utility Breaker	PWGSC				
		51	Initiate Test Mode "Close Transition" from DND Utility to Generator Supply	WPE/TTI/SCH				
		52	Generators start sequence should begin (only 1 generator required)	WPE/TTI/SCH				
		53	Observe all Generator voltages are in range	WPE/TTI/SCH				
		54	Verify voltage A-A, B-B, C-C when in synchronism permissive (should be close to 0V) (PPE required as per activity work plan)	PE				
		55	Review failed attempt to close 25/12SES CB-2 Generator Breaker by HMI and related alarms	WPE/TTI/SCH				
		56	Cancel Test Mode Generators stop & cool down sequence begins (if loaded)	WPE/TTI				
		57	Open and rack out and remove 25/12SES CB-1 DND Utility Breaker	PWGSC				
		58	Close the shutters of 25/12SES CB-2 Generator breaker	PE				
	1.10	*Close Transition 25/12SES CB-1 Phasing Checks – Performed by others - TPS to assist with switchgear operation*			✓	16/09/2017	10:30	60
		59	Place System control in Manual	WPE/TTI				
		60	Verify Breaker 25/12SES CB-1 DND Utility Breaker removed from SWBD (see previous test item 57)	PWGSC				
		61	Open and Lock out DND re-closure Switch	DND/PWGSC/PE				
		62	Open the shutters of 25/12SES CB-1 DND Utility Breaker	PE				
		63	Remove Lock out and close DND re-closure Switch	DND/PWGSC/PE				
		64	Rack in 25/12SES CB-2 Generator Breaker	PWGSC				
		65	Place System control in Auto "closed transition"	WPE/TTI/SCH				
		66	Generator start sequence should begin (only 1 generator required)	WPE/TTI/SCH				
		67	After min. Generator(s) are on line 25/12SES CB-2 should Close	WPE/TTI/SCH				
		68	Verify voltage A-A, B-B, C-C when in synchronism permissive (should be close to 0V) (PPE required as per activity work plan)	WPE/TTI/SCH/PE				
		69	Review failed attempt to close 25/12SES CB-1 DND Utility Breaker by HMI and related alarms	WPE/TTI/SCH				
			Schneider re-named *failed to close* alarm to *fail to sync / close*					
		70	Place System control in Manual "open transition"	WPE/TTI/SCH				
		71	Manually Stop all Generator(s) (generators begin cool down if loaded)	WPE/TTI/SCH				
			AES requested that TTI program HMI notification that generators were manually stopped and that cool down has begun					
			(there was no inditcation that the generators stopped when the stop button was pushed as cool down engaged)					

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
		72	25/12SES CB-2 Generator Breaker should open	WPE/TTI/SCH				
		73	Open and Lock out DND re-closure Switch	DND/PWGSC/PE				
		74	Close the shutters of 25/12SES CB-1 DND Utility Breaker (PPE required as per activity work plan)	PE				
		75	Rack into test position 25/12SES CB-1 DND utility Breaker and verify open position	PWGSC				
		76	Remove Lock out and close DND re-closure Switch	DND/PWGSC/PE				
	1.11		***Closed Transition 25/12SES CB-1 to 25/12SES CB-2 – Manual Transfer***		✓	16/09/2017	11:30	15
		77	Rack out 25/12SES CB-2 Generator Breaker to "Test" position (see 72)	PWGSC				
		78	Rack in fully and Close 25/12SES CB-1 DND Utility Breaker (see item 75)	PWGSC				
		78a	Place System control in Auto Mode	WPE/TTI/SCH				
		78b	At PLC HMI Switch to closed transition	WPE/TTI/SCH				
		79	Initiate a closed transition transfer to Generator supply	WPE/TTI/SCH				
		80	Generator(s) start sequence should begin (only 1 generator required)	WPE/TTI/SCH				
		81	Breaker 25/12SES CB-2 Generator Breaker should close	WPE/TTI/SCH				
			TTI improved timing for generator sync to DND					
		82	Breaker 25/12SES CB-1 DND Utility Breaker should Open	WPE/TTI/SCH				
		83	Manually Stop the generator(s) (generator begin cool down if loaded)	WPE/TTI/SCH				
		84	Breaker 25/12SES CB-2 Generator Breaker should Open	WPE/TTI/SCH				
		85	Breaker 25/12SES CB-1 DND Utility Breaker should Close	WPE/TTI/SCH				
	1.12		***Closed Transition 25/12SES CB-2 to 25/12SES CB-1 – Manual Transfer***		✗	16/09/2017	11:45	15
			Manual closed transition not possible, TTI to update within O&M accordingly					
		86	Open and Rack out 25/12SES CB-1 DND Utility Breaker to "Test" position (see item 78)	PWGSC				
		87	Fully Rack in 25/12SES CB-2 Generator Breaker (see item 77)	PWGSC				
		88	Manually Start Generators (only 1 generator required)	WPE/TTI/SCH				
		89	Close 25/12SES CB-2 Generator Breaker (energize buss 1 via Generator supply)	WPE/TTI/SCH				
		90	Initiate a closed transition transfer from Generator to Utility supply	WPE/TTI/SCH				
		91	Breaker 25/12SES CB-1 DND Utility Breaker should Close	WPE/TTI/SCH				
		92	Breaker 25/12SES CB-2 Generator Breaker should Open	WPE/TTI/SCH				
		93	Generator(s) stop and cool down sequence begins (if loaded)	WPE/TTI/SCH				
			Lunch Break			16/09/2017	12:00 PM	30
	1.13		***Closed Transition Loss of Utility - System in Auto***		✓	16/09/2017	12:30	15
		94	Confirm 25/12SES CB-1 DND Utility Breaker is Closed and in Test position (see item 91)	PWGSC				
		95	Confirm 25/12SES CB-2 Generator Breaker is fully racked in and Open (see item 92)	PWGSC				
		96	Place TCS in to Automatic Closed Transition Mode	WPE/TTI/SCH				
		97	Open Fuse Blocks for 25/12SES PT1 secondary fuses	PE				
		98	Breaker 25/12SES CB-1 DND Utility Breaker should Open	WPE/TTI/SCH				
		99	Generator start sequence should begin (only 1 generator required)	WPE/TTI/SCH				
		100	Breaker 25/12SES CB-2 Generator Breaker should Close (energizing Buss via Generator utility)	WPE/TTI/SCH				
		101	Close Fuse Blocks for 25/12SES PT1 secondary fuses (simulating return of Utility Source)	WPE/TTI/SCH				
		102	After 3 minute time delay Generator bus will sync to Utility source	WPE/TTI/SCH				
		103	Breaker 25/12SES CB-1 DND Utility Breaker should close (Load Shed function is not available due to 25/12SES CB-1 DND Utility breaker in Test position)	WPE/TTI/SCH				
		104	Breaker 25/12SES CB-2 Generator Breaker should Open	WPE/TTI/SCH				
		105	Return TSC Controls to Manual	WPE/TTI/SCH				
			Test Mode Open Transition 25/12SES CB-3 BCH-1 to 25/12SES CB-2 Generator Breaker – System in Auto					
		106	Verify System control in Manual (see item 105)	WPE/TTI/SCH				
		107	Open and Rack out 25/12SES CB-1 DND Utility Breaker (see item 103)	PWGSC				

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
	1.14	108	Open Fuse Block for 25/12SES PT1 secondary fuses	WPE/TTI/PE	✓	16/09/2017	12:45	15
		109	Rack out Breaker 25/12SES CB-2 Generator Breaker to Test position (see item 104)	PWGSC				
		110	Rack in Breaker 25/12SES CB-3 BCH-1 to test position (see item 3)	PWGSC				
		111	Simulate healthy voltage to Breaker 25/12SES CB-3 BCH-1	WPE/PE				
		112	Return System Control to Auto - Open Transition	WPE/TTI/SCH				
		113	Breaker 25/12SES CB-3 BCH-1 should Close	WPE/TTI/SCH				
		114	Simulate healthy voltage to Buss 1	WPE/PE				
		115	Initiate Test Mode	WPE/TTI/SCH				
		116	Generator start sequence should begins (only 1 generator required)	WPE/TTI/SCH				
		117	When Gen Buss is ready Breaker 25/12SES CB-3 BCH-1 should Open	WPE/TTI/SCH				
		118	Remove simulated voltage to Buss 1	WPE/PE				
		119	Breaker 25/12SES CB-2 Generator Breaker should Close	WPE/TTI/SCH				
		120	Restore simulated voltage to Buss 1	WPE/PE				
	1.15		***Test Mode Open Transition 25/12SES CB-2 Generator Breaker to 25/12SES CB-3 BCH-1 – System in Auto***		✓	16/09/2017	13:00	15
		121	Verify test 1.14 is complete and successful	WPE/TTI/SCH				
		122	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 107)	PWGSC				
		123	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 108)	PE				
		124	Maintain healthy voltage to Breaker 25/12SES CB-3 BCH-1	WPE/PE				
		125	Cancel Test Mode	WPE/TTI/SCH				
		126	Breaker 25/12SES CB-2 should Open (see item 119)	WPE/TTI/SCH				
		127	Remove simulated voltage to Buss 1	WPE/PE				
		128	Breaker 25/12SES CB-3 should Close (see item 117)	WPE/TTI/SCH				
		129	Restore simulated voltage to Buss 1	WPE/PE				
		130	Generator stops and start cool down sequence (if loaded)	WPE/TTI/SCH				
	1.16		***Open Transition 25/12SES CB-3 BCH-1 to 25/12SES CB-2 Generator Breaker – System in Auto***		✓	16/09/2017	13:15	15
		131	Place System control in Manual	WPE/TTI/SCH				
		132	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 122)	PWGSC				
		133	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 123)	PE				
		134	Verify Breaker 25/12SES CB-2 is Open (see item 126)	PWGSC				
		135	Verify Breaker 25/12SES CB-2 is in Test position (see item 109)	PWGSC				
		136	Verify Breaker 25/12SES CB-3 BCH-1 is Closed and in test position (see item 128)	PWGSC				
		137	Maintain healthy voltage to Breaker 25/12SES CB-3 BCH-1	WPE/PE				
		138	Maintain healthy voltage to Buss 1	WPE/PE				
		139	Return System Control to Auto - Open Transition	WPE/TTI/SCH				
		140	Breaker 25/12SES CB-3 BCH-1 should remain Close (see item 128)	WPE/TTI/SCH				
		141	Remove healthy voltage to Breaker 25/12SES CB-3 BCH-1	WPE/PE				
		142	Generator start sequence should start (only 1 generator required)	WPE/TTI/SCH				
		143	Breaker 25/12SES CB-3 BCH-1 should Open (see item 139)	WPE/TTI/SCH				
		144	Remove simulated voltage to Buss 1	WPE/PE				
		145	Breaker 25/12SES CB-2 Generator Breaker should Close when min. num. of Gen is reached	WPE/TTI/SCH				
		146	Restore simulated voltage to Buss 1	WPE/PE				
		147	Observe Alarms and indication on HMI screen	WPE/TTI/SCH				
			Open Transition 25/12SES CB-2 to 25/12SES CB-3 – System in Auto					
		148	Verify previous test 1.16 is completed and successful	WPE/TTI/SCH				
		149	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 132)	PWGSC				
		150	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 133)	PE				

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
	1.17	151	Simulate healthy voltage to Breaker 25/12SES CB-3 BCH-1	WPE/PE	✓	16/09/2017	13:30	15
		152	Breaker 25/12SES CB-2 Generator Breaker should Open (after Utility return delay)	WPE/TTI/SCH				
		153	Remove simulated voltage to Buss 1	WPE/PE				
		154	Breaker 25/12SES CB-3 BCH-1 should Close	WPE/TTI/SCH				
		155	Restore simulated voltage to Buss 1	WPE/PE				
		156	Generator stops and start cool down sequence (if loaded)	WPE/TTI/SCH				
	1.18	***Close Transition 25/12SES CB-3 to 25/12SES CB-2 – System in Auto***			✓	16/09/2017	13:45	15
		157	Verify Breaker 25/12SES CB-2 Generator Breaker and Breaker 25/12SES CB-3 BCH-1 are Racked out into test position	PWGSC				
		158	Simulate healthy voltage to Breaker 25/12SES CB-3 BCH-1	WPE/PE				
		159	Breaker 25/12SES CB-3 BCH-1 should Close	WPE/TTI/SCH				
		160	Simulate healthy voltage to Buss 1	WPE/PE				
		161	Initiate Test Mode – Close Transition	WPE/TTI/SCH				
		162	Generator start sequence should start (only 1 generator required)	WPE/TTI/SCH				
		163	After synchronization with Buss 1 Breaker 25/12SES CB-2 Generator Breaker should Close	WPE/TTI/SCH				
		164	Breaker 25/12SES CB-3 BCH-1 should Open	WPE/TTI/SCH				
		165	After Breaker 25/12SES CB-3 BCH-1 opens replace Buss 1 supply (see Note 1)	WPE/PE				
			NOTE 1: *After synchronization and supply replacement supply to Buss 1 should be switched from 25/12SES CB-3 source to 25/12SES CB-2 source to avoid 25/12SES CB-2 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.*	WPE/PE				
	1.19	***Close Transition 25/12SES CB-2 to 25/12SES CB-3 – System in Auto***			✓	16/09/2017	14:00	15
		166	Verify Breaker 25/12SES CB-2 Generator Breaker and Breaker 25/12SES CB-3 BCH-1 are Racked out into test position	PWGSC				
		167	Maintain healthy supply to Breaker 25/12SES CB-3 BCH-1	WPE/PE				
		168	System still in Test Mode – Close Transition from previous test (see test 1.18)	WPE/TTI/SCH				
		169	Verify Generators are supplying healthy voltage to Breaker 25/12SES CB-2 Generator Breaker	WPE/TTI/SCH				
		170	Verify Breaker 25/12SES CB-2 Generator Breaker should be Closed (see item 163)	WPE/TTI/SCH				
		171	Simulated voltage to Buss 1 (normal Generator supply - simulation)	WPE/PE				
		172	Terminate Test Mode – Close Transition	WPE/TTI/SCH				
		173	After synchronization with Buss 1 Breaker 25/12SES CB-3 BCH-1 should Close	WPE/TTI/SCH				
		174	Breaker 25/12SES CB-2 Generator Breaker should Open	WPE/TTI/SCH				
		175	After Breaker 25/12SES CB-2 Generator Breaker opens replace Buss 1 supply (see Note 2)	WPE/PE				
			NOTE 2: *After synchronization and supply replacement supply to Buss 1 should be switched from 25/12SES CB-2 source to 25/12SES CB-3 source to avoid 25/12SES CB-3 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.*	WPE/PE				
	1.20	***Test Mode Open Transition Breaker 25/12SES CB-4 BCH-2 to Breaker 25/12SES CB-2 Generator Breaker– System in Auto***			✓	16/09/2017	14:15	15
		176	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 149)	PWGSC				
		177	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 150)	PE				
		178	Place System control in Manual	WPE/TTI/SCH				
		179	Rack in and close Breaker 25/12SES CB-5 Tie Breaker	PWGSC				
		180	Verify Breaker 25/12SES CB-2 Generator Breaker in test position and open (see item 175)	PWGSC				
		181	Rack in Breaker 25/12SES CB-4 BCH-2 to Test position	PWGSC				
		182	Simulate healthy voltage to Breaker 25/12SES CB-4 BCH-2	WPE/PE				
		183	Return System Control to Auto - Open Transition	WPE/TTI/SCH				
		184	Breaker 25/12SES CB-4 BCH-2 should Close	WPE/TTI/SCH				
		185	Simulate healthy voltage to Buss 1	WPE/PE				
		186	Initiate Test Mode	WPE/TTI/SCH				
		187	Generator start sequence should start (only 1 generator required)	WPE/TTI/SCH				

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
		188	Breaker 25/12SES CB-4 BCH-2 should Open	WPE/TTI/SCH				
		189	Remove simulated voltage to Buss 1	WPE/PE				
		190	Breaker 25/12SES CB-2 Generator Breaker should Close	WPE/TTI/SCH				
		191	Restore simulated voltage to Buss 1 (from Gen supply)	WPE/PE				
			Coffee Break			16/09/2017	14:30	15
	1.21		***Test Mode Open Transition 25/12SES CB-2 to 25/12SES CB-4 – System in Auto***		✓	16/09/2017	14:45	15
		192	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 176)	PWGSC				
		193	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 177)	PE				
		194	Verify 25/12SES CB-5 Bus Tie Breaker is in Closed position (see item 179)	PWGSC/SCH				
		195	Verify Breakers 25/12SES CB-2 Generator Breaker and Breaker 25/12SES CB-4 BCH-2 racked to Test position (see item 180)	PWGSC				
		196	Simulate healthy voltage to 25/12SES CB-4	WPE/PE				
		197	Cancel Test Mode	WPE/TTI/SCH				
		198	Breaker 25/12SES CB-2 Generator Breaker should Open	WPE/TTI/SCH				
		199	Remove simulated voltage to Buss 1	WPE/PE				
		200	Breaker 25/12SES CB-4 BCH-2 should Close	WPE/TTI/SCH				
		201	Restore simulated voltage to Buss 1 (from 25/12SES CB-4 supply)	WPE/PE				
		202	Generator start cool down sequence (if loaded)	WPE/TTI/SCH				
	1.22		***Open Transition 25/12SES CB-4 to 25/12SES CB-2 – System in Auto***		✓	16/09/2017	15:00	15
		203	Place System control in Manual	WPE/TTI/SCH				
		204	Verify 25/12SES CB-5 is in Closed position (see item 194)	PWGSC/SCH				
		205	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 192)	PWGSC				
		206	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 193)	PE				
		207	Verify Breaker 25/12SES CB-2 Generator Breaker racked to Test position (see item 180)	PWGSC				
		208	Verify Breaker 25/12SES CB-4 BCH-2 racked to Test position (see item 181)	PWGSC				
		209	Simulate healthy voltage to 25/12SES CB-4 BCH-2	WPE/PE				
		210	Return System Control to Auto - Open Transition	WPE/TTI/SCH				
		211	Breaker 25/12SES CB-4 BCH-2 should Close	WPE/TTI/SCH				
		212	Simulate healthy voltage to Buss 1	WPE/PE				
		213	Remove healthy voltage to 25/12SES CB-4 BCH-2	WPE/PE				
		214	Generator start sequence should start (only 1 generator required)	WPE/TTI/SCH				
		215	Breaker 25/12SES CB-4 BCH-2 should Open	WPE/TTI/SCH				
		216	Remove simulated voltage to Buss 1	WPE/PE				
		217	Breaker 25/12SES CB-2 Generator Breaker should Close	WPE/TTI/SCH				
		218	Restore simulated voltage to Buss 1 (from Gen supply)	WPE/PE				
		219	Observe Alarms and indication on HMI screen	WPE/TTI/SCH				
	1.23		***Open Transition 25/12SES CB-2 to 25/12SES CB-4 – System in Auto***		✓	16/09/2017	15:15	15
		220	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 205)	PWGSC				
		221	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 206)	PE				
		222	Verify 25/12SES CB-5 is in Closed position (see item 204)	PWGSC/SCH				
		223	Verify Breaker 25/12SES CB-2 Generator Breaker racked to Test position (see item 207)					
		224	Verify Breaker 25/12SES CB-4 BCH-2 racked to Test position (see item 208)	PWGSC				
		225	Simulate healthy voltage to Breaker 25/12SES CB-4 BCH-2	WPE/PE				
		226	Breaker 25/12SES CB-2 Generator Breaker should Open (after Utility return delay)	WPE/TTI/SCH				
		227	Remove simulated voltage to Buss 1	WPE/PE				
		228	Breaker 25/12SES CB-4 BCH-4 should Close	WPE/TTI/SCH				
		229	Restore simulated voltage to Buss 1 (from 25/12SES CB-4 supply)	WPE/PE				

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
		230	Generator start cool down sequence (if loaded)	WPE/TTI/SCH				
	1.24		***Close Transition 25/12SES CB-4 to 25/12SES CB-2 – System in Auto***		✓	16/09/2017	15:30	15
		231	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 220)	PWGSC				
		232	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 221)	PE				
		233	Verify 25/12SES CB-5 is in Closed position (see item 222)	PWGSC/SCH				
		234	Verify Breaker 25/12SES CB-2 Generator Breaker racked to Test position (see item 223)	PWGSC				
		235	Verify Breaker 25/12SES CB-4 BCH-2 racked to Test position (see item 224)	PWGSC				
		236	Simulate healthy voltage to 25/12SES CB-4	WPE/PE				
		237	Breaker 25/12SES CB-4 BCH-4 should Close	WPE/TTI				
		238	Restore simulated voltage to Buss 1	WPE/PE				
		239	Initiate Test Mode – Close Transition	WPE/TTI/SCH				
		240	Generator start sequence should start (only 1 generator required for remainder of Sat testing)	WPE/TTI/SCH				
		241	After synchronization with Buss 1 Breaker 25/12SES CB-2 Generator Breaker should Close	WPE/TTI/SCH				
		242	Breaker 25/12SES CB-4 BCH-2 should Open	WPE/TTI/SCH				
		243	After Breaker 25/12SES CB-4 BCH-2 opens replace Buss 1 supply (see Note 3)	WPE/PE				
			NOTE 3: *After synchronization and supply replacement supply to Buss 1 should be switched from 25/12SES CB-4 source to 25/12SES CB-2 source to avoid 25/12SES CB-2 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.*	WPE/PE				
	1.25		***Close Transition 25/12SES CB-2 to 25/12SES CB-4 – System in Auto***		✓	16/09/2017	15:45	15
		244	Verify 25/12SES CB-1 DND Utility Breaker is racked out (see item 231)	PWGSC				
		245	Verify Open Fuse Block for 25/12SES PT1 secondary fuses (see item 232)	PE				
		246	Verify 25/12SES CB-5 is in Closed position (see item 233)	PWGSC/SCH				
		247	Verify Breaker 25/12SES CB-2 Generator Breaker racked to Test position (see item 234)	PWGSC				
		248	Verify Breaker 25/12SES CB-4 BCH-2 racked to Test position (see item 235)	PWGSC				
		249	Maintain healthy supply to 25/12SES CB-4	WPE/PE				
		250	System still in Test Mode – Close Transition from previous test (see item 239)	WPE/TTI/SCH				
		251	Generators are supplying healthy voltage to Breaker 25/12SES CB-2 Generator Breaker	WPE/TTI/SCH				
		252	Breaker 25/12SES CB-2 Generator Breaker should be Closed	WPE/TTI/SCH				
		253	Simulated voltage to Buss 1 (from Gen supply)	WPE/PE				
		254	Terminate Test Mode – Close Transition	WPE/TTI/SCH				
		255	After synchronization with Buss 1 Breaker 25/12SES CB-4 BCH-2 should Close	WPE/TTI/SCH				
		256	Breaker 25/12SES CB-2 Generator Breaker should Open	WPE/TTI/SCH				
		257	After Breaker 25/12SES CB-2 Generator Breaker opens replace Buss 1 supply (see Note 4)	WPE/PE				
			NOTE 4: *After synchronization and supply replacement supply to Buss 1 should be switched from 25/12SES CB-2 source to 25/12SES CB-4 source to avoid 25/12SES CB-4 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.*	WPE/PE				
	2.13		***Load Shed - Fail utility to force plant load to generators***		✗	16/09/2017	16:00	30
			Confirm Load Shed transfer to Generators on Dead Bus indication	WPE/SCH				
			Confirm Load Shed transfer to Generators on Overload indication	WPE/SCH				
			Confirm Load Shed transfer to Generators on Under frequency indication	WPE/SCH				
			Confirm Load Shed transfer to Generators on Live analog values	WPE/SCH				
			Confirm Load Shed transfer to Generators on Dead Bus indication	WPE/SCH				
	1.25		Contingency			16/09/2017	16:30	60
	1.26		**Control Testing Completed, Review of test procedures and documentation**	WPE/TTI/SCH	✓	16/09/2017	17:30	30
	1.27		Re-dress control wiring, cleanup test equipment	WPE/TTI	✓	16/09/2017	18:00	30

Saturday Sept 16, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
	1.27		Restore EGD to Normal Power Condition	PWGSC	✓	10/09/2017	10:00	30
				Overlapping activities		Total hrs		11.0

Test Preformed by : Chris Heesterman

Signature:________________________ Date: Sept 16, 2017

Witnessed by: Lorne Cowley

Signature:________________________ Date: Sept 16, 2017

Notes:
Text in Bold Red = field modifications in test plan activity
Text Highlighted Yellow = Additional Tests preformed
Text Highlighted Red = Test not performed as agreed on site
Test Highlighted Green = WPE/AES test comments

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Date: ~~12-Sep-17~~ 16-SEPT-17.

Time: 730AM

Meeting; Generator Fianl Test and Commissioning Sept 16-17, 2017

Name	Company	Signature
GORD WEBSTER	WPE.	
RYAN BOSTWICK	WPE	
Lorne Coulter	WPE/LDC	
Clayton Laughlin	Prime	
Keson Goldsmith	Prime Eng.	
David Engleman	TTI	
Matthew Puscus	SCH	
MIKE LEDSON	PWGSC	
Veysel Aydin	PWGSC	
J. LEZETC	EGD	
JORDNE GOLDSMITH	EGD	
Jesse Curtis	EGD	
M.CAMMIADE	EGD	
Jason Chen	TTI	
Iain Barns	ABS	
STEVE WINDL.	PSPC	

Meeting Attendance Sign in Sheet

PER START

Frontier POWER PRODUCTS
Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

SEPT 16, 2017
GENSET 1,2,3

Checklist Items

☑ Generator must be bolted to the concrete pad.

☑ Radiator must be full of coolant.

☑ Pre-wire service plug for block heater.

☑ Ensure batteries are connected properly.

☑ Radiator duct louvers must be installed and wired.

☑ Area under and around unit must be free of debris.

N/A ☐ Remote annunciator/fire panel installed and wiring in place.

☑ Pre-wire service plug for battery charger.

☑ Exhaust system must be installed and insulated. (If applicable.)

☑ Control wiring should be in a conduit separate from the load conductors. Start wires need to be a minimum of #18 and labeled #3 and #4. They need to be pulled up into the generator controller and to the connection point in the transfer switch. If start wires are in the same conduit as the load conductors, they should be shielded.

☑ ATS line, load and genset connections must be made and terminated. The installing electrician **must** be on site in case wiring verification is required.

☑ Diesel fuel system must be complete and the tank filled to 80% maximum to allow for expansion. 3/4 TANK EA.

☑ Spark ignited engine fuel system must be installed per Kohler installation manual. Gas pressure ***MUST*** be 7 - 11 inches of water column at the generator fuel inlet at all times. Supply volume must be sized for 100% rated load. Volume requirement is supplied on the generator data sheet.

☐ Confirm special site concerns. (Use "Notes" section on previous page.) N/A.

☑ Clear access for service vehicle and load bank will be confirmed. If a load test is to be performed, please indicate the distance in feet from where the load bank can be situated to the connection points.

______ Feet FIXED UNIT

Notes

- The above checklist is to help ensure that the start-up of the emergency power system goes smoothly.
- Fire alarm connections will be made at this time. Fire alarm personnel must be available or subsequent visits will be chargeable. N/A. ENGINE OIL LEVELS GOOD @ EACH
- Power interruptions are inevitable. They will be kept to a minimum, and announced where possible.

* If any of the above items are not complete at the time of start-up **costs will be chargeable** to the contractor.

Our technicians are on site to commission the components supplied by Frontier Power Products only. All code, safety compliance and testing of the complete power system are the responsibility of the owner (s) and their representatives.

Note: The sales person has verified that the contractor's account is in good standing. Before a commissioning date will be set the account must be up to date. ☐

Representative: GORD WEBSTER

Sales Person: __________

Signature:

SEPT 16, 2017
7:00AM

Signature: __________

Sunday Sept 17, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
			The following tests form part of the overall Stand-by Power Generation System testing and Commissioning. The test results will be signed off by the commissioning agent, witnessed by the Owners representative, provided to the Electrical Consultant for review and sign off to the Owner.	PWGSC/AES				
			AUTO - Utility Failure and Retransfer Sequence of Operation *- System begins as per section 4.1 Utility failure described in Section 4.2. Utility retransfer described in section 4.3.*					
	2.00		Safety tailboard. Review of Person in Charge, First Aid, Emergency Response, Muster Stations, Scope of Work, Task Hazards, Controls, Safety Checklists	All	✓	17/09/2017	7:30	15
	2.01	1	Review of previously checked work, Set up test equipment as required	WPE/TTI/PE	✓	17/09/2017	7:45	45
		2		PWGSC				
		3	SES Substation 25KV SWBD breakers to be in "a normal work day mode" (i.e.; open if normally open, closed if normally closed)	PWGSC				
	2.02	***AUTO - Utility Failure and Retransfer DND Preferred Utility - Utility Retransfer (Open Transition / Manual Retransfer)***			✓	17/09/2017	8:00	60
		4	Place system in Auto Mode - Open Transition	WPE/TTI/SCH				
		5	Open DND Re-closure Utility feed to 25/12SES CB-1 DND Utility Breaker (i.e. simulation of utility failure)	DND				
		6	Verify all SSES 25KV breakers open	WPE/SCH				
		7	Verify generators start sequence initiated	WPE/TTI/SCH				
		8	After min. number of Generators are on line 25/12SES CB-2 Generator Breaker should Close - record minimum run time	WPE/SCH				
		9	Re-energize existing loads by priority loading sequence (SCADA in Test Mode priority loading disabled)	WPE/SCH				
		10	Confirm/record existing loads are re-energized and generator power is stabilized (SCADA logging)	WPE/SCH				
		11	Place System control in Manual	WPE/TTI				
		12	Close DND Re-closure Utility feed to 25/12SES CB-1 DND Utility Breaker	DND				
		13	Manually Stop all Generators	WPE/TTI				
		14	Confirm 25/12SES CB-2 Generator Breaker opens	WPE/TTI/SCH				
		15	Generators begins cool down (if loaded)	WPE/TTI				
		16	Close 25/12SES CB-1 DND Utility Breaker	PWGSC				
		17	Place system in Auto Mode - Open Transition	WPE/TTI				
		18	Re-energize existing loads by priority loading sequence (SCADA in Test Mode priority loading disabled)	WPE/SCH				
	2.03	***AUTO - Utility Failure and Retransfer DND Preferred Utility - Utility Retransfer (Open Transition / Auto Retransfer)***			✓	17/09/2017	9:00	60
		19	Verify DND Preferred Utility Open Transition / Manual Retransfer is correct (see test 2.02)	WPE/TTI/SCH				
		20	Place system in Auto Mode - Open Transition	WPE/TTI/SCH				
		21	Open DND Re-closure Utility feed to 25/12SES CB-1 DND Utility Breaker (i.e. simulation of utility failure)	DND				
		22	Verify all SSES 25KV breakers open	WPE/SCH				
		23	Verify generators start sequence initiated	WPE/TTI/SCH				
		24	After min. number of Generators are on line 25/12SES CB-2 Generator Breaker should Close - record minimum run time	WPE/SCH				
		25	Re-energize existing loads by priority loading sequence (SCADA in Test Mode priority loading disabled)	WPE/SCH				
		26	Confirm/record existing loads are re-energized and generator power is stabilized (SCADA logging)	WPE/SCH				
		27	Close DND Re-closure Utility feed to 25/12SES CB-1 DND Utility Breaker - simulation of viable Utility source	DND				
		28	Verify utility power monitoring for 3 minutes of stable power	WPE/SCH				
		29	Verify all closed Load breakers - open	WPE/SCH				
		31	Verify 25/12SES CB-2 Generator breaker - open	WPE/SCH				
		32	Verify 600v generator breakers - open	WPE/TTI/SCH				
		33	Generators begins cool down (if loaded)	WPE/TTI/SCH				
		34	Verify 25/12SES CB-1 DND Utility Breakers Closed after 25/12SES CB-2 Generator breaker opened	WPE/SCH				
		35	Re-energize existing loads by priority loading sequence (SCADA in Test Mode priority loading disabled)	WPE/SCH				
		35A	Repeat 2.03 w/ SCADA in normal mode - tested priority loading with full breaker operation of CB's 11/12/14					

Sunday Sept 17, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
		Coffee Break				17/09/2017	10:00	15
	2.04	*PLC 'Optimum Load' Control*			✓	17/09/2017	10:15	45
		35	Place system in Auto Mode - Open Transition	WPE/TTI/SCH				
		36	Open breaker 25/12SES CB-1 DND Utility Breaker & open Fuse Blocks for 25/12SES PT1 secondary fuses	PWGSC/PE				
		37	On power failure open transition transfer scheme starts	WPE/SCH				
		38	Confirm/record existing loads are re-energized and generator power is stabilized	WPE/SCH				
		39	Set the 'Optimum Gen Load (%)' to 85%	WPE/TTI				
		40	Take note of the resolved 'Optimum Load' in kW as noted on the load bank section of the SLD screen	WPE/SCH				
		41	Loadbank Steps will be added or removed (by PLC) until the total generator kW is within 50kW of the 'Optimum Load'	WPE/TTI				
		42	Load demand begins timing to remove a generator	WPE/SCH				
		43	Confirm PSS indicates anticipated load is not online yet	WPE/SCH				
	2.05	*Generator Load Demand - Reducing Generator Capacity*			✓	17/09/2017	11:00	45
		44	Verify previous test is complete and successful (see test 2.04)	WPE/TTI/SCH				
		45	Confirm/record existing loads are re-energized and generator power is stabilized	WPE/SCH				
		46	Set generator priorities G1=1, G2=2, G3=3, (future G4=4)	WPE/SCH				
		47	Decrease generator bus load below the 'stop' set point	WPE/SCH				
		48	After delay times out verify G3 leaves the bus	WPE/SCH				
		49	After another delay times out, verify G2 leaves the bus	WPE/SCH				
		50	Verify G1 remains on the bus regardless of bus load	WPE/SCH				
		51	Repeat steps 46 through 50 for each generator if requested	WPE/TTI/SCH				
	2.06	*Generator Load Demand - Increasing Generator Capacity*			✗	17/09/2017	11:45	45
			TTI HMI calculating load demand from 12.5kV bus and not 600V bus consequently inhibiting load demand via load					
			bank in auto mode. AES advised TTI to modify program to caluclate off 600V bus and prove functionality at a later date					
		52	Verify previous test is complete and successful (see test 2.05)	WPE/TTI/SCH				
		53	Increase generator bus load above the 'start' set point	WPE/SCH				
		54	After delay times out, verify G2 comes online	WPE/SCH				
		55	Maintain bus load so that no further generators come online	WPE/SCH				
		56	Close breaker 25/12SES CB-1 DND Utility Breaker & Close Fuse Blocks for 25/12SES PT1 secondary fuses	PWGSC/PE				
		57	Verify utility power monitoring for 3 minutes of stable power	WPE/SCH				
		58	Verify all closed Load breakers - open	WPE/SCH				
		59	Verify 25/12SES CB-2 Generator Breaker - open	WPE/SCH				
		60	Verify 600v generator breakers - open	WPE/TTI/SCH				
		61	Generators begins cool down (if loaded)	WPE/TTI/SCH				
		62	Re-energize existing loads by priority loading sequence (SCADA in Test Mode priority loading disabled)	WPE/SCH				
		63	Re-set the 'Optimum Gen Load (%)' to 85%	WPE/TTI/SCH				
			Lunch Break			17/09/2017	12:30	30
	2.07	*Total Anticipated Load*			✓	17/09/2017	13:00	15
		64	Place system in Auto Mode - Open Transition	WPE/TTI/SCH				
		65	Open breaker 25/12SES CB-1 DND Utility Breaker & open Fuse Blocks for 25/12SES PT1 secondary fuses	PWGSC/PE				
		66	Verify all SSES 25KV breakers open	WPE/SCH				
		67	Verify generators start sequence initiated	WPE/TTI/SCH				
		68	After min. number of Generators are on line 25/12SES CB-2 Generator Breaker should Close	WPE/SCH				
		69	Re-energize existing loads by priority loading sequence (SCADA in Test Mode priority loading disabled)	WPE/SCH				
		70	Confirm/record existing loads are re-energized and generator power is stabilized	WPE/SCH				
		71	Verify previous test is complete and successful (see test 2.06)	WPE/TTI/SCH				

Sunday Sept 17, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
		72	Via Modscan, apply anticipated 1000kW 'Main Dewatering Pump' load (750kW running load)	WPE/SCH				
		73	Verify G2 comes online; G3 may come online if initial load was high	WPE/SCH				
		74	Via Modscan, ensure to remove the anticipated 1000kW load (750kW running load)	WPE/SCH				
		75	Verify added generator(s) comes off line, cool down, shut down sequence begins	WPE/SCH				
	2.08	***N+1 Redundancy***			✓	17/09/2017	13:15	10
		76	Verify previous test is complete and successful (see test 2.07)	WPE/TTI/SCH				
		77	Note the number of online generators	WPE/TTI/SCH				
		78	Enable N+1 Redundancy	WPE/SCH				
		79	Verify one additional generator is brought online	WPE/SCH				
		80	Remove N+1 Redundancy	WPE/SCH				
	2.09	***Supplemental live Equipment Run Reaction Test***			✓	17/09/2017	12:55:00	255
		81	Verify previous test is complete and successful (see test 2.08)	WPE/TTI/SCH				
		82	Verify system in Auto Mode - Open Transition (see item 64)	WPE/TTI/SCH				
		83	Remove all building (baseline load), disable North & South Standby generators	PWGSC				
		84	Start 'Auxiliary Dewatering Pump' load (150kW running load) run time dictated as per site conditions	PWGSC				
		85	Confirm/record generator loading (SCADA logging)	WPE/SCH				
		86	Stop 'Auxiliary Dewatering Pump' load (150kW running load) run time dictated as per site conditions	PWGSC				
		87	Start 'Air Compressor #7" (smallest load @ 300HP)	PWGSC				
		88	Confirm/record generator loading (SCADA logging)	WPE/SCH				
		89	Start '**Air Compressor #3**" (largest load @ **300HP**)	PWGSC				
		90	Confirm/record generator loading (SCADA logging)	WPE/SCH				
		90A	While Air Compressors #7 & #3 running, add the following loads:					
		90B	30t crane - travel, swing and pick 4t load					
		90C	30t crane and 150t crane travel					
		90D	150t crane - travel, swing and pick 4t load					
		91	Stop 'Air Compressor # 7 & #4'	PWGSC				
		92	Start 'Main Dewatering Pump #1' run time dictated as per site conditions	PWGSC				
		93	Confirm/record generator loading (SCADA logging) **623A peak, 100A steady**	WPE/SCH				
		94	Start 'Main Dewatering Pump #2' run time dictated as per site conditions	PWGSC				
		95	Confirm/record generator loading (SCADA logging) **648 peak, 103A steady**	WPE/SCH				
		95A	While Main Dewatering Pumps #1 & #2 running, add the following loads:					
		95B	150t crane - travel, swing and boom					
		95C	Air Compressors #7 & #4 and 30t crane - travel, swing and boom **TCS peaked at 1550kW**					
		96	Stop 'Main Dewatering Pump #1 & #2	PWGSC				
		Coffee Break 15minutes						
		97	Start 30ton Kone Travelling Crane, (power regeneration capability) relocate crane un-loaded run time dictated as per site conditions	Equipment not available				
		98	30ton Kone Travelling Crane, (power regeneration capability) stop travel and make 1st lift up/down	Equipment not available				
		99	30ton Kone Travelling Crane, (power regeneration capability) full funtional test	Equipment not available				
		100	Confirm/record generator loading (SCADA logging)	Equipment not available				
		101	Stop 30ton Kone Travelling Crane	Equipment not available				
		102	Start 30ton Ebco Travelling Crane, (power regeneration capability) relocate crane un-loaded run time dictated as per site conditions	PWGSC				
		103	30ton Ebco Travelling Crane, (power regeneration capability) stop travel and make 1st lift up/down	PWGSC				
		104	30ton Ebco Travelling Crane, (power regeneration capability) full funtional test	PWGSC				

Sunday Sept 17, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
		105	Confirm/record generator loading (SCADA logging)	WPE/SCH				
		106	Stop 30ton Ebco Travelling Crane	PWGSC				
		107	Start 150ton Travelling Crane, (power regeneration capability) relocate crane un-loaded run time dictated as per site conditions	PWGSC				
		108	150ton Travelling Crane, (power regeneration capability) stop travel and make 1st lift up/down	PWGSC				
		109	150ton Travelling Crane, (power regeneration capability) full funtional test	PWGSC				
		110	Confirm/record generator loading (SCADA logging)	WPE/SCH				
		111	Stop 150ton Travelling Crane	PWGSC				
		111A	In N+1 (Generators 2 & 3 running), start Main Dewatering Pump #1 P1 **GEN 2 & 3 breakers tripped**					
			***This was AES expectations and confirmed 3 generator start up on utility power fail requirement**					
	2.10	***Replacing Failed Generators***			✓	17/09/2017	17:10	15
		112	Verify previous test is complete and successful (see test 2.09)	WPE/TTI/SCH				
		113	Cause a 'common shutdown' on G2	WPE/TTI				
		114	Verify G2 breaker opens and generator shuts down	WPE/TTI/SCH				
		115	Verify that G3 starts, sync, and comes online	WPE/TTI/SCH				
		116	Remove and reset the 'common shutdown' on G2	WPE/TTI				
		117	Verify G2 starts, sync, and comes online	WPE/TTI/SCH				
		118	Once G2 is online, verify G3 leaves the bus	WPE/TTI/SCH				
		119	Repeat steps 112 through 118 for each generator if requested	WPE/TTI/SCH				
	2.11	***Generator Low Fuel Alarm***			✓	17/09/2017	17:25	30
		120	Verify previous test is complete and successful (see test 2.10)	WPE/TTI/SCH				
		121	Simulate the fuel level via Modscan communications	WPE/TTI/SCH				
		122	Cause a low fuel alarm on G2	WPE/TTI/SCH				
		123	Verify that G3 starts, sync, and comes online	WPE/SCH				
		124	Verify G2 breaker opens and generator shuts down	WPE/SCH				
		125	Remove and reset the low fuel alarm on G2	WPE/TTI/SCH				
		126	Verify G2 starts, sync, and comes online	WPE/SCH				
		126	Once G2 is online, verify G3 leaves the bus	WPE/SCH				
		127	Repeat steps 121 through 126 for each generator if requested	WPE/TTI/SCH				
		128	Close breaker 25/12SES CB-1 DND Utility Breaker & Close Fuse Blocks for 25/12SES PT1 secondary fuses	PWGSC/PE				
		129	Verify utility power monitoring for 3 minutes of stable power	WPE/SCH				
		130	Verify all closed Load breakers - open	WPE/SCH				
		131	Verify 25/12SES CB-2 Generator Breaker - opens	WPE/SCH				
		132	Verify 600v generator breakers - open	WPE/TTI/SCH				
		133	Generators begins cool down (if loaded)	WPE/TTI/SCH				
		134	Verify 25/12SES CB-1 DND Utility Breaker - close	WPE/SCH				
		135	Re-energize existing loads by priority loading sequence (SCADA in Test Mode priority loading disabled)	WPE/SCH				
	2.12		Contingency		✓	17/09/2017	17:55	60
	2.13		**Testing and Demonstartions Completed, Review of test results and documentation**	WPE/TTI/SCH/PWGSC	✓	17/09/2017	18:55	30
	2.14		Re-dress control wiring, cleanup test equipment	WPE/TTI	✓	17/09/2017	19:25	30
			Restore EGD to Normal Power Condition	PWGSC				
				Overlapping activities		Total hrs		13.4

Sunday Sept 17, 2017 DND Shut Down - SSES Standby Generator Operations Rev 3
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration

Abbreviation Table	
EGD	Esquimalt Graving Dock
PWGSC	Public Works and Government Services Canada
DND	Department of National Defense
BCH	British Columbia Hydro
AES	Applied Engineering Solutions
WPE	Western Pacific Enterprises
TTI	Thomson Power Systems
PE	Prime Engineering
SCH	Schneider Electric
SES	Service Entrance Substation

Test Preformed by : Chris Heesterman

Signature:__________ Date: Sept 17, 2017

Witnessed by: Lorne Cowley

Signature:__________ Date: Sept 17, 2017

Notes:
Text in Bold Red = field modifications in test plan activity
Text Highlighted Yellow = Additional Tests preformed
Text Highlighted Red = Test not performed as agreed on site
Test Highlighted Green = WPE/AES test comments

Site Test Verification Record – Esquimalt Graving Dock

GCS 2200 Generator Control System

C-054107, W-095112/095113 REV.2 17/09/17

SUPPLIER:

THOMSON POWER SYSTEMS
9087A 198th St
Langley BC

W-095112	GCS 2200 Generator Control Panel
W-095113	LBO-1000H-600V-3-C Load Bank

Site Test Verification Record – Esquimalt Graving Dock

GCS 2200 Generator Control System

C-054107, W-095112/095113 **REV.2** **17/09/17**

DATE: Sept 16th & 17th 2017

TEST WITNESS (*If Applicable*):

NAME	COMPANY	TITLE
Gord Webster	**Western Pacific Enterprises Ltd.**	Project Manager
Chris Heesterman	**Western Pacific Ent Ltd**	Superintendent

TEST VALIDATION:

Tests Verified to be Acceptable (except as noted)

NAME	INITIALS

COMMENTS:

Refer to WPE SSES Standby Generator Operations Rev. 3

Sept. 16th and 17th 2017 shutdown.

PWGSC No. R.057890.003
Contract No. EZ108-170397

TPS TEST PERSONNEL:

NAME	TITLE
David Engleman	Service Technician
Jason Chen	Service Technician

Table of Contents

1. Physical Inspection

The following sections outline the physical details to be inspected on each piece of equipment.

1.1. Generator Control Sections Inspection

Procedure:

- **Analog Meter** – VM, KW, VAR, FM, PF, AM, VMS, AMS, SS, SW1. Apply generator and bus voltage (208/120VAC secondary) and generator current (5A secondary). Confirm each meter indicates properly. Confirm operation of the switches and resulting meter indication. Enter a check (√) in the test form column. (Tested with load bank per reference – Manual operation)

- **Digital Meter** – Apply generator voltage (208/120VAC secondary) and generator current (5A secondary). Confirm meter indicates properly (voltage, current, frequency, power). Simulate digital inputs and confirm. Enter a check (√) in the test form column. (Tested with load bank per reference – Manual operation)

- **Generator Protection Relay / Lockout Relay** - Apply generator voltage (208/120VAC secondary) and generator current (5A secondary). Confirm relay indicates properly (voltage, current, frequency, power). Enter a check (√) in the test form column after performing the following tests.

    - Apply phase current greater than 4.5A secondary. Confirm the 86 lockout relay activates.
    - With 120VAC generator and bus voltage in phase, ensure the sync check output (OUT301) is closed. Reverse phase A and B of the generator and ensure the sync check output (OUT301) is open.
    - With the generator breaker simulated closed, lower the frequency of the generator below 58Hz. Confirm the bus under frequency output (OUT302) closes. (All Protection Relay parameters as per coordination study – by others – and tested – by others). Third party company to be hired by Customer (WPE).

- **Generator Controls** – Verify using the lights and relay status. If correct, enter a check (√) in the test form column.

    - **Manual Start / Stop** - Press the START pushbutton. Verify the ESX1 relay energizes and latches. Press the STOP pushbutton. Verify the ESX1 relay de-energizes.
    - **Tripped Light** – Manually activate the 86 lockout relay. Verify the TRIPPED light illuminates.

  - **Auto Light** – Simulate the engine controller in and not in auto mode. Verify the AUTO light.
  - **Running Light**– Simulate the engine controller running and not running. Verify the RUNNING light.
  - **Alarm Light** – Simulate the engine controller alarm. Verify the ALARM light.
  - **Shutdown Light** – Simulate the engine controller shutdown. Verify the SHUTDOWN light.
  - **Emergency Stop** - Press the emergency stop pushbutton. Confirm the contact to the engine controller opens.

- **Breaker Close / Open** – Start the generator and bring to rated speed and voltage. While the generator bus is dead, press the CLOSE pushbutton. The breaker (simulated) should close. The breaker CLOSED light should illuminate. Press the TRIP pushbutton. The breaker (simulated) should open. The breaker open light should illuminate. If correct, enter a check (√) in the test form column.

- **Sync / Close** – Start the generator and bring to rated speed and voltage. While the generator bus is live, press and hold the sync / close pushbutton. The breaker (simulated) should close. If correct, enter a check (√) in the test form column.

- **Lamacoids / Test Blocks** – confirm the presence of the test block or lamacoid as per approved As Built Drawings. If present, enter a check (√) in the test form column.

Control	Result Pass(√) Fail(x)	Notes
Section 1		
Analog Metering / Switches	√	
Digital Meter	√	
Gen Protection Relay / 86	√	
Generator Controls	√	
Breaker Open / Close	√	
Sync / Close	√	
Test Blocks	√	
Lamacoids	√	
Section 2		
Analog Metering / Switches	√	
Digital Meter	√	
Gen Protection Relay / 86	√	

Generator Controls	√	
Breaker Open / Close	√	
Sync / Close	√	
Test Blocks	√	
Lamacoids	√	
Section 3		
Analog Metering / Switches	√	
Digital Meter	√	
Gen Protection Relay / 86	√	
Generator Controls	√	
Breaker Open / Close	√	
Sync / Close	√	
Test Blocks	√	
Lamacoids	√	
Section 4		
Analog Metering / Switches	√	
Digital Meter	√	
Gen Protection Relay / 86	√	
Generator Controls	√	
Breaker Open / Close	√	
Sync / Close	√	
Test Blocks	√	
Lamacoids	√	

1.2. Master Control Section Inspection

Procedure:

- **“Power Available” Lights** – Apply utility or generator bus voltage (208/120VAC secondary). Confirm the applicable light illuminates. If correct, enter a check (√) in the test form column.

- **Sync Metering** – Apply utility or generator bus voltage (208/120VAC secondary). The apply load bus voltage (208/120VAC secondary). Confirm the VM, FM and SS metering indicates properly and the SW3 switch selects each of the incoming sources. If the meters read correctly, enter a check (√) in the test form column.

- **HMI Display** – Verify S2400 tags and if all displayed properly enter a check (√) in the test form column.

- **Auto / Manual Switch** – Move the switch to each of the four positions and confirm the HMI Display indicates the proper mode. If correct, enter a check (√) in the test form column.

- **Alarm Light / Horn / Reset** – Clear all alarms from the system. The alarm light should extinguish. Trigger one alarm. The alarm light should illuminate and the horn should sound. Press the reset button and the horn should be silenced, but the alarm light should stay lit. Trigger another alarm. The horn should sound again. Clear all alarms. The horn should silence and the alarm light should extinguish. If correct, enter a check (√) in the test form column.

- **Transition Mode Switch** – Move the switch to each of the two modes and confirm the HMI Display indicates the proper mode. Confirm the switch is lockable and key removable in both positions. If correct, enter a check (√) in the test form column.

- **Breaker Close / Open** – BCH-1, BCH-2, DND, GM. Press the CLOSE pushbutton. The breaker should close (breakers in racked out in “Test” position). The breaker CLOSED light should illuminate. Press the TRIP pushbutton. The breaker (breakers in racked out in “Test” position should open). The breaker open light should illuminate. If correct, enter a check (√) in the test form column after performing the following test.

  - **Interlock** – A hardwired interlock prevents the generators being manually paralleled with a utility (and vice versa).

    - Manually close generator main breaker. Confirm BCH-1, BCH-2, DND breakers cannot be closed.
    - Open generator main and manually close BCH-1. Confirm generator main cannot be closed.

  - Open BCH-1 and manually close BCH-2. Confirm generator main cannot be closed.
  - Open BCH-3 and manually close DND. Confirm generator main cannot be closed.
  - BCH-1 and BCH-2 supply will be simulated as the two utilities are currently not supplied nor connected.
- **Functional Interlock** – Verify possible scenarios preventing connection to Buss 1 from alternate source prior to verification.

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.09 ********************

Close Transition 25/12SES CB-2 Phasing Checks – Performed by others - TPS to assist with switchgear operation

Open and rack out completely 25/12SES CB-2 .... √
Open the shutters of 25/12SES CB-2 .... √
Rack in and Close 25/12SES CB-1 .... √
Initiate a Test Mode Close Transition from Utility to Generator Supply .... √
Generators start sequence should begin .... √
Observe all voltages are in range .... √
Verify voltage A-A, B-B, C-C when in synch permissive (should be close to 0V) .... √
Review failed attempt to close by HMI and related alarms .... √
Cancel Test Mode .... √

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.10 ********************

Close Transition 25/12SES CB-1 Phasing Checks – Performed by others - TPS to assist with switchgear operation

Place System control in Manual .... √
Open and rack out completely 25/12SES CB-1 .... √
Open the shutters of 25/12SES CB-1.. √
Rack in 25/12SES CB-2 .... √
Place System control in Auto .... √
Generators start sequence should begin .... √
After min. number of Generators are on line 25/12SES CB-2 should Close .... √

Verify voltage A-A, B-B, C-C when in synch permissive (should be close to 0V) ....√
Review failed attempt to close by HMI and related alarms ....√
Place System control in Manual ....√
Manually Stop all Generators ....√
Rack in 25/12SES CB-1 ....√
Return System control to Auto ....√
After slight delay 25/12SES CB-2 should Open ....√
After 25/12 SES CB-2 Opens 25/12SES CB-2 should Close ....√
Generators start cooldown sequence (if loaded) ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.02 ********************

25/12SES CB-2 Block Close

25/12SES CB-1 Closed ....√
Rack out 25/12SES CB-2 in Test Position ....√
Attempt to Close 25/12SES CB-2 (Breaker should not close) ....√
Verify 25/12SES CB-1 remained Closed ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.03 ********************

25/12SES CB-2 Synchronism Block Close – 25/12SES CB-1 must be "Closed"

Manually start all Generators ....√
Synchronize all Generators to Generator Buss ....√
Rack out 25/12SES CB-2 in Test Position ....√
Attempt to Close 25/12SES CB-2 when not in sync with 25/12SES CB-1 ....√
Verify 25/12SES CB-2 did not close and 25/12 SES CB-1remained Closed ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.04 ********************

25/12SES CB-1 Synchronism Block Close

Open and rack out 25/12SES CB-1 to "Test" position ....√
Rack in 25/12SES CB-2 ....√
Manually start all Generators ....√

Synchronize all Generators to Generator Buss ....√
Close 25/12SES CB-2 energizing Buss 1 from Generators supply ....√
Observe all voltages are in range ....√
Check for alarm/trip status on protection relays ....√
Verify 25/12SES CB-1 cannot be closed without synchronism ....√
Open Test Blocks for 25/12SES PT1 secondary fuses ....√
Ensure 25/12SES CB-1 cannot be closed ....√
Rack in 25/12SES CB-1 Breaker ....√
Open 25/12SES CB-2 Breaker ....√
Close Test Blocks for 25/12SES PT1 secondary fuses ....√
Close 25/12SES CB-1 Breaker ....√
Manually stop all Generators ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.05 ********************

Test Mode Open Transition 25/12SES CB-1 to 25/12SES CB-2 – System in Auto

Rack out 25/12SES CB-1 to “Test” position ....√
Manually close 25/12SES CB-1…… ....√
Initiate Test Mode Open Transition ....√
Generators start sequence should begin ....√
Breaker 25/12SES CB-1 should Open ....√
Breaker 25/12SES CB-2 should Close ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.06 ********************

Test Mode Open Transition 25/12SES CB-2 to 25/12SES CB-1 – System in Auto

Verify Open Transition from 25/12SES CB-1 to 25/12SES CB-2 is correct ……....……√
Terminate Test Mode and return system to Normal..√
Breaker 25/12SES CB-2 should Open..√
Breaker 25/12SES CB-1 should Close ....√
Generators begins cooldown (if loaded) ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.07 ********************

Open Transition 25/12SES CB-1 to 25/12SES CB-2 – System in Auto

Rack out 25/12SES CB-1 to "Test" position ....√
Manually close 25/12SES CB-1…… ....√
Open Test Blocks for 25/12SES PT1 secondary fuses ....√
Generators start sequence should begin ....√
Breaker 25/12SES CB-1 should Open ....√
Breaker 25/12SES CB-2 should Close ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.08 ********************

Open Transition 25/12SES CB-2 to 25/12SES CB-1 – System in Auto

Verify Open Transition from 25/12SES CB-1 to 25/12SES CB-2 is correct …………….√
Close Test Blocks for 25/12SES PT1 secondary fuses ....√
Breaker 25/12SES CB-2 should Open ....√
Breaker 25/12SES CB-1 should Close ....√
Generators begins cooldown (if loaded) ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.11 ********************

Closed Transition 25/12SES CB-1 to 25/12SES CB-2 – System in Auto

Rack out 25/12SES CB-1 to "Test" position ....√
Manually close 25/12SES CB-1…… ....√
Open Test Blocks for 25/12SES PT1 secondary fuses ....√
Generators start sequence should begin ....√
Breaker 25/12SES CB-2 should Close ....√
Breaker 25/12SES CB-1 should Open ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.11 continued *******

Closed Transition 25/12SES CB-2 to 25/12SES CB-1 – System in Auto

Verify Open Transition from 25/12SESCB-1 to 25/12SES CB-2 is correct …………….√
Close Test Blocks for 25/12SES PT1 secondary fuses ....√

Initiate Test Mode Open Transition ....√
Breaker 25/12SES CB-1 should Close ....√
Breaker 25/12SES CB-2 should Open ....√
Generators begins cooldown (if loaded) ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.12 ********************

Closed Transition 25/12SES CB2 to 25/12SES CB1 – Manual Transfer
Note: *Closed transition testing to DND utility source not available as requested by PWGSC*

Open & Rack out 25/12SES CB1 DND Utility Breaker to Test position ....√
Fully Rack in 25/12SES CB-2 Generator Breaker ....√
Manually Start Generators (only 1 generator required) ....√
Close 25/12SES CB-2 Generator Breaker (energize buss 1 via Generator supply) ....√
Initiate a closed transition transfer from Generator to Utility supply................................√
Breaker 25/12SES CB-1 DND Utility Breaker should Close ....√
Breaker 25/12SES CB-2 Generator Breaker should Open ....√
Generator(s) stop and cooldown sequence begins (if loaded) ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.13 ********************

Closed Transition Loss of Utility System in Auto
Note*: Simulated Closed transition testing to DND utility as requested by PWGSC*

Confirm 25/12SES CB-1 DND Utility Breaker is Closed and in Test position.................√
Confirm 25/12SES CB-2 Generator Breaker is fully racked in and Open......................√
Place TCS into Automatic Closed Transition Mode ....√
Open Fuse Blocks for 25/12SES PT1 secondary fuses...√
Breaker 25/12SES CB-1 DND Utility Breaker should Open...√
Generator start sequence should begin (only 1 generator required) ....√
Breaker 25/12SES CB-2 Generator Breaker should Close (energizing Bus via Generator utility) ....√
Close Fuse Blocks for 25/12SES PT1 secondary fuses (simulating return of Utility Source) ....√
After 3 minute time delay Generator bus will sync to Utility source...............................√
Breaker 25/12SES CB-1 DND Utility Breaker should close (Load Shed function is not available due to 25/12SES CB-1 DND breaker in Test position) ....√

Breaker 25/12SES CB-2 Generator Breaker should Open……………………………….√
Return TSC controls to Manual………………………………………………….…..√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.14 ********************

<u>Test Mode Open Transition 25/12SES CB-3 to 25/12SES CB-2 – System in Auto</u>

Place System control in Manual ....√
Verify 25/12SES CB-1 is racked out ....√
Open Test Block for 25/12SES PT1 secondary fuses ....√
Rack out 25/12SES CB-2 to Test position ……………………..................................√
Simulate healthy voltage to 25/12SES CB-3 ....√
Return System Control to Auto - Open Transition ....√
Breaker 25/12SES CB-3 should Close ....√
Simulate healthy voltage to Buss 1 ....√
Initiate Test Mode ....√
Generator start sequence should start ....√
When Gen Buss is ready Breaker 25/12SES CB-3 should Open ....√
Remove simulated voltage to Buss 1 ....√
Breaker 25/12SES CB-2 should Close ....√
Restore simulated voltage to Buss 1 ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.15 ********************

<u>Test Mode Open Transition 25/12SES CB-2 to 25/12SES CB-3 – System in Auto</u>

Verify previous test is complete and successful ....√
Verify 25/12SES CB-1 is racked out ....√
Open Test Block for 25/12SES PT1 secondary fuses ....√
Maintain healthy voltage to 25/12SES CB-3 ....√
Cancel Test Mode ....√
Breaker 25/12SES CB-2 should Open ....√
Remove simulated voltage to Buss 1 ....√
Breaker 25/12SES CB-3 should Close ....√
Restore simulated voltage to Buss 1 ....√
Generator start cooldown sequence (if loaded) ....√

Cross ref. to:

Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.16 ********************

<u>Open Transition 25/12SES CB-3 to 25/12SES CB-2 – System in Auto</u>

Place System control in Manual ....√
Verify 25/12SES CB-1 is racked out ....√
Open Test Block for 25/12SES PT1 secondary fuses ....√
Rack out 25/12SES CB-2 to Test position ....√
Simulate healthy voltage to 25/12SES CB-3 ....√
Return System Control to Auto - Open Transition ....√
Breaker 25/12SES CB-3 should Close ....√
Simulate healthy voltage to Buss 1 ....√
Remove healthy voltage to 25/12SES CB-3 ....√
Generator start sequence should start ....√
Breaker 25/12SES CB-3 should Open ....√
Remove simulated voltage to Buss 1 ....√
Breaker 25/12SES CB-2 should Close when min. num. of Gen is reached ....√
Restore simulated voltage to Buss 1 ....√
Observe Alarms and indication on HMI screen..√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.17 ********************

<u>Open Transition 25/12SES CB-2 to 25/12SES CB-3 – System in Auto</u>

Verify previous test is completed and successful ....√
Verify 25/12SES CB-1 is racked out ....√
Open Test Block for 25/12SES PT1 secondary fuses ....√
Simulate healthy voltage to 25/12SES CB-3 ....√
Breaker 25/12SES CB-2 should Open (after Utility return delay) ....√
Remove simulated voltage to Buss 1 ....√
Breaker 25/12SES CB-3 should Close ....√
Restore simulated voltage to Buss 1 ....√
Generator start cooldown sequence (if loaded) ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.18 ********************

<u>Close Transition 25/12SES CB-3 to 25/12SES CB-2 – System in Auto</u>

Rack out 25/12SES CB-2 and 25/12SES CB-3 ....√
Simulate healthy voltage to 25/12SES CB-3 ....√
Breaker 25/12SES CB-3 should Close ....√
Simulate healthy voltage to Buss 1 ....√
Initiate Test Mode – Close Transition ....√
Generator start sequence should start ....√
After synchronization with Buss 1 Breaker 25/12SES CB-2 should Close ……………..√
Breaker 25/12SES CB-3 should Open ....√
After 25/12SES CB-3 opens replace Buss 1 supply (see Note 1) ....√

NOTE 1: After synchronization and supply replacement supply to Buss 1 should be switched from 25/12SES CB-3 source to 25/12SES CB-2 source to avoid 25/12SES CB-2 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.19 ********************

Close Transition 25/12SES CB-2 to 25/12SES CB-3 – System in Auto

Verify that 25/12SES CB-2 and 25/12SES CB-3 are racked out ....√
Maintain healthy supply to 25/12SES CB-3 ....√
System still in Test Mode – Close Transition from previous test.....................................√
Generators are supplying healthy voltage to 25/12SES CB-2 ....√
Breaker 25/12SES CB-2 should be Closed ....√
Simulated voltage to Buss 1 (should be supplied from Generator supply) ………………√
Terminate Test Mode – Close Transition ....√
After synchronization with Buss 1 Breaker 25/12SES CB-3 should Close ……………..√
Breaker 25/12SES CB-2 should Open ....√
After 25/12SES CB-2 opens replace Buss 1 supply (see Note 2) ....√

NOTE 2: After synchronization and supply replacement supply to Bus 1 should be switched from 25/12SES CB-2 source to 25/12SES CB-3 source to avoid 25/12SES CB-3 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.20 ********************

Test Mode Open Transition 25/12SES CB-4 to 25/12SES CB-2 – System in Auto

Place System control in Manual .... √
Verify 25/12SES CB-5 is in Closed position .... √
Verify 25/12SES CB-1 is racked out .... √
Open Test Block for 25/12SES PT1 secondary fuses .... √
Rack out 25/12SES CB-2 and 25/12SES CB-4 to Test position .... √
Simulate healthy voltage to 25/12SES CB-4 .... √
Return System Control to Auto - Open Transition .... √
Breaker 25/12SES CB-4 should Close .... √
Simulate healthy voltage to Buss 1 .... √
Initiate Test Mode .... √
Generator start sequence should start .... √
Breaker 25/12SES CB-4 should Open .... √
Remove simulated voltage to Buss 1 .... √
Breaker 25/12SES CB-2 should Close .... √
Restore simulated voltage to Buss 1 (from Gen supply) .... √

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.21 ********************

Test Mode Open Transition 25/12SES CB-2 to 25/12SES CB-4 – System in Auto

Verify 25/12SES CB-1 is racked out .... √
Verify 25/12SES CB-5 is in Closed position .... √
Open Test Block for 25/12SES PT1 secondary fuses .... √
Rack out 25/12SES CB-2 and 25/12SES CB-4 to Test position .... √
Simulate healthy voltage to 25/12SES CB-4 .... √
Cancel Test Mode .... √
Breaker 25/12SES CB-2 should Open .... √
Remove simulated voltage to Buss 1 .... √
Breaker 25/12SES CB-4 should Close .... √
Restore simulated voltage to Buss 1 (from 25/12SES CB-4 supply) .... √
Generator start cooldown sequence (if loaded) .... √

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.22 ********************

Open Transition 25/12SES CB-4 to 25/12SES CB-2 – System in Auto

Place System control in Manual .... √
Verify 25/12SES CB-5 is in Closed position .... √

Verify 25/12SES CB-1 is racked out ....√
Open Test Block for 25/12SES PT1 secondary fuses ....√
Rack out 25/12SES CB-2 and 25/12SES CB-4 to Test position ....√
Simulate healthy voltage to 25/12SES CB-4 ....√
Return System Control to Auto - Open Transition ....√
Breaker 25/12SES CB-4 should Close ....√
Simulate healthy voltage to Buss 1 ....√
Remove healthy voltage to 25/12SES CB-4 ....√
Generator start sequence should start ....√
Breaker 25/12SES CB-4 should Open ....√
Remove simulated voltage to Buss 1 ....√
Breaker 25/12SES CB-2 should Close ....√
Restore simulated voltage to Buss 1 (from Gen supply) ....√
Observe Alarms and indication on HMI screen...√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.23 ********************

Open Transition 25/12SES CB-2 to 25/12SES CB-4 – System in Auto

Verify 25/12SES CB-1 is racked out ....√
Verify 25/12SES CB-5 is in Closed position ....√
Open Test Block for 25/12SES PT1 secondary fuses ....√
Rack out 25/12SES CB-2 and 25/12SES CB-4 to Test position ....√
Simulate healthy voltage to 25/12SES CB-4 ....√
Breaker 25/12SES CB-2 should Open (after Utility return delay) ....√
Remove simulated voltage to Buss 1 ....√
Breaker 25/12SES CB-4 should Close ....√
Restore simulated voltage to Buss 1 (from 25/12SES CB-4 supply) ....√
Generator start cooldown sequence (if loaded) ....√

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 1.24 ********************

Close Transition 25/12SES CB-4 to 25/12SES CB-2 – System in Auto

Rack out 25/12SES CB-2 and 25/12SES CB-2 ....√
Verify 25/12SES CB-5 is in Closed position ....√
Rack out 25/12SES CB-2 and 25/12SES CB-4 to Test position ....√
Simulate healthy voltage to 25/12SES CB-4 ....√
Breaker 25/12SES CB-4 should Close ....√

Restore simulated voltage to Buss 1 ....√
Initiate Test Mode – Close Transition ....√
Generator start sequence should start ....√
After synchronization with Buss 1 Breaker 25/12SES CB-2 should Close ……………..√
Breaker 25/12SES CB-4 should Open ....√
After 25/12SES CB-4 opens replace Buss 1 supply (see Note 3) ....√

NOTE 3: After synchronization and supply replacement supply to Buss 1 should be switched from 25/12SES CB-4 source to 25/12SES CB-2 source to avoid 25/12SES CB-2 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.

Cross ref. to:
Saturday Sept 16, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
******************* SECTION 1.25 ********************

Close Transition 25/12SES CB-2 to 25/12SES CB-4 – System in Auto

Verify that 25/12SES CB-2 and 25/12SES CB-2 are racked out ....√
Verify 25/12SES CB-5 is in Closed position ....√
Rack out 25/12SES CB-2 and 25/12SES CB-4 to Test position ………………………....√
Maintain healthy supply to 25/12SES CB-4 ....√
System still in Test Mode – Close Transition from previous test......................................√
Generators are supplying healthy voltage to 25/12SES CB-2 ....√
Breaker 25/12SES CB-2 should be Closed ....√
Simulated voltage to Buss 1 (from Gen supply) ....√
Terminate Test Mode – Close Transition ....√
After synchronization with Buss 1 Breaker 25/12SES CB-4 should Close ………………√
Breaker 25/12SES CB-2 should Open ....√
After 25/12SES CB-2 opens replace Buss 1 supply (see Note 4) ....√

NOTE 4: After synchronization and supply replacement supply to Buss 1 should be switched from 25/12SES CB-2 source to 25/12SES CB-4 source to avoid 25/12SES CB-4 to Open if system is out of sync due to natural shift on the generators that will continue to happen if source is not the same after breaker closure.

- Transformer Lockout / Tripped Light – Manually activate the 86 lockout relay. Verify the TRIPPED light illuminates.

- Lamacoids – confirm the presence of the lamacoids. If present, enter a check (√) in the test form column.

Site Test Verification Record – Esquimalt Graving Dock

GCS 2200 Generator Control System

C-054107, W-095112/095113 REV.2 17/09/17

Control	Result Pass(√) Fail(x)	Notes
Section 5		
Power Available Lights		
Sync Metering		
HMI Display		
Auto / Manual Switch		
Alarm Light / Horn / Reset		
Transition Mode Switch		
GM Breaker Controls		
DND Breaker Controls		
BCH-1 Breaker Controls		
BCH-2 Breaker Controls		
Interlock (electrical – man.)		
Functional Interlocks		
Transformer Lockout / Light		
Lamacoids		

2. Operational Sequences

All automatic control functions shall be simulated and tested using the HMI. All combinations of equipment operation shall be simulated to test the PLC control functions. Where equipment is not present nor installed (Gen 4, BCH1 and BCH2) necessary supplies and feedbacks will be simulated for the purpose of these tests.

2.1. Simulation Environment

When/Where needed the following equipment will be used to simulate the system for SAT testing purposes:

- Test computer loaded with RSLogix5000 programming software
- 3-phase variable power supply (provided by others)
- 3-phase 5A current injector (provided by others)
- Switches to simulate digital inputs; lights to indicate field contact outputs
- All Future options will be activated for the purpose of these test but ONLY current available option will be left active at the end of the tests.

2.2. Automatic Logic Test Scenarios

The following sections outline the automatic testing scenarios, with Pass/Fail results and corrective actions or comments where applicable.

All test should be performed with breakers in normal operating conditions (supply simulated as needed) with load available when applicable (NOT on simulated supply).

Each section refers to the Sequence of Operation section that fully describes the intended operation. For each sequence, enter a check (√) next to each step as it executes successfully.

For all operations, HMI interaction is with the S2400 software.

2.3. AUTO - Utility Failure and Retransfer

Sequence of Operation - System begins as per section 4.1 Utility failure described in Section 4.2. Utility retransfer described in section 4.3.

DND Preferred Utility

Utility Failure ....√

Cross ref. to:

Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.02 ********************

Utility Retransfer (Open Transition / Manual Retransfer) ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.03 ********************

Utility Retransfer (Open Transition / Auto Retransfer) ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.02 continued*******

<u>Open Transition</u>
Control Switch to TEST ....√
Confirm transfer to generators ....√
Control Switch to AUTO..√
Confirm transfer to utility ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.10 & 2.11 ***********

2.5.5 Generator Fail During Test

Control Switch to TEST ....√
Confirm transfer to generators ....√
Shutdown all generators ....√
Confirm automatic transfer to utility ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.05 & 2.06 ***********

2.6 Load Bank Control

Sequence of Operation – Section 4.7

Simulate the load bank controller to be in the AUTO mode (digital input).

2.6.1 PLC ‘Manual Steps’ Control

Manually run generators to energize the generator bus.

Use the ‘CLOSE’ buttons to energize load steps...................................√
Use the ‘OPEN’ buttons to de-energize load steps................................√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.04 ********************

2.6.2 PLC ‘Optimum Load’ Control

- Fail a utility so the generators take plant load.
- Set the ‘Optimum Gen Load (%)’ to 85%.
- Take note of the resolved ‘Optimum Load’ in kW as noted on the load bank section of the SLD screen.
- Simulate the total generator kW by adjusting the individual generator 4-20mA kW signals
- Steps will be added or removed until the total generator kW is within 50kW of the ‘Optimum Load’.

Total generator kW level below ‘Optimum Load’ kW. Add steps...........√

Total generator kW level above ‘Optimum Load’ kW. Remove steps ...√

- All load steps will be quickly removed in the following situations:

Load demand begins timing to remove a generator................................√

PSS indicates anticipated load is not online yet......................................√

Utility retransfer initiated ....√

2.7 Generator Load Demand

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down

SSES Standby Generator Operations Rev 3
****************** SECTION 2.05 ********************

Sequence of Operation – Section 4.8

- Set generator priorities G1=1, G2=2, G3=3, G4=4
- Load Demand – Enable
- N+1 Redundancy – Disable (will enable below)
- Low Fuel Action – Replace Generator
- Gen Alarm Action – Replace Generator

2.7.1 Minimum Run Time

Fail utility (transfer to generators) ....√

Verify that all available generators close to the bus ....√

2.7.2 Reducing Generator Capacity

Decrease generator bus load below the ‘stop’ setpoint..........................√

After delay times out, verify G4 leaves the bus.......................................√

After another delay times out, verify G3 leaves the bus..........................√

After another delay times out, verify G2 leaves the bus..........................√

Verify G1 remains on the bus regardless of bus load ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.06 ********************

2.7.3 Increasing Generator Capacity

Increase generator bus load above the ‘start’ setpoint ....√

After delay times out, verify G2 comes online..√

Maintain bus load so that no further generators come online ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.07 ********************

2.7.4 Total Anticipated Load

Via Modscan, apply 1000kW ‘Main Dewatering Pump’ load ....√

Verify G2 comes online; G3 may come online if initial load was high ....√

Via Modscan, ensure to remove the 1000kW anticipated load ....√

Repeat for ‘Auxiliary Dewatering Pump’ load...√

Repeat for ‘Travelling Crane’ load ....√

Repeat for ‘Air Compressor’ load...√

Repeat for ‘Building Load’ load..√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.08 ********************

2.7.5 N+1 Redundancy

Note the number of online generators. Enable N+1 Redundancy.

One additional generator is brought online ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.09 ********************

Supplemental live Equipment Run Reaction Test

Verify system in Auto Mode Open Transition ....√

Remove all building (baseline load), disable North & South Standby generators....√

Start ‘Auxiliary Dewatering Pump’ load (150kW running load) run time dictated as per site conditions …………………………………..√

Confirm/record generator loading (SCADA logging) ....√

Stop ‘Auxiliary Dewatering Pump’ load (150kW running load) run time dictated as per site conditions ……………………………………………………………………√

Start ‘Air Compressor #7" (smallest load @ 300HP) ....√

Confirm/record generator loading (SCADA logging) ....√

Start ‘Air Compressor #3" (largest load @ 300HP) ....√

Confirm/record generator loading (SCADA logging) ....√

While Air Compressors #7 & #3 running, add the following loads: ....√

30t crane travel, swing and pick 4t load ....√

30t crane and 150t crane travel.....√

150t crane travel, swing and pick 4t load ....√

Stop ‘Air Compressor # 7 & #4”’ ...√

Start ‘Main Dewatering Pump #1’ run time dictated as per site conditions..............√

Confirm/record generator loading (SCADA logging) 623A peak, 100A steady........√

Start ‘Main Dewatering Pump #2’ run time dictated as per site conditions..............√

Confirm/record generator loading (SCADA logging) 648 peak, 103A steady..........√

While Main Dewatering Pumps #1 & #2 running, add the following loads: ....√

150t crane travel, swing and boom ....√

Air Compressors #7 & #4 and 30t crane ....√

2.7.6 Replacing Failed Generators

Cause a ‘common shutdown’ on G2 ....√

Verify G2 breaker opens and generator shuts down.............................√

Verify that G3 starts and comes online ....√

Remove and reset the ‘common shutdown’ on G2 ....√

Verify G2 starts and comes online ....√

Once G2 is online, verify G3 leaves the bus ....√

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.10 & 2.11 *************

2.7.7 Generator Low Fuel Alarm

Simulate the fuel level via Modscan communications.
Cause a low fuel alarm on G2..√

Verify that G3 starts and comes online ....√

Verify G2 breaker opens and generator shuts down..............................√

Remove and reset the low fuel alarm on G2..√

Verify G2 starts and comes online ....√

Once G2 is online, verify G3 leaves the bus ....√

3. Communications

3.1 Device Configuration

Confirm all devices have been configured with the proper IP / subnet address. If correct, enter a check (√) in the test form column.

Ethernet HMI			**IP Address**	**Result Pass(√) Fail(x)**
Subnet 255.255.255.0				
Default Gateway 192.168.250.3				
PLC CPU	20.019	1756-L72/B		√
PLC Ethernet	10.007	1756-EN2T/D		√
PLC Modbus	Prosoft	MVI56-MNET		√
HMI	IEI	PPC5190		√
Gen 1 DMS	Schneider	ION-7650		√
Gen 2 DMS	Schneider	ION-7650		√
Gen 3 DMS	Schneider	ION-7650		√
Gen 4 DMS	Schneider	ION-7650		√
Load Bank DMS	Schneider	PM8240		*n/a*
Gen 1 700G	SEL	700G		√
Gen 2 700G	SEL	700G		√
Gen 3 700G	SEL	700G		√
Gen 4 700G	SEL	700G		√
Ethernet Woodward			**IP Address**	
Subnet 255.255.255.0				
Gen 1 DSLC-2	Woodward	DSLC-2		√
Gen 2 DSLC-2	Woodward	DSLC-2		√
Gen 3 DSLC-2	Woodward	DSLC-2		√
Gen 4 DSLC-2	Woodward	DSLC-2		√
DND Utility MSLC-2	Woodward	MSLC-2		√

BCH-1 Utility MSLC-2	Woodward	MSLC-2		√
BCH-2 Utility MSLC-2	Woodward	MSLC-2		√
Gen Main MSLC-2	Woodward	MSLC-2		√

3.2 PSS Write

As per the table in the Sequence of Operations section 8.1, use Modscan to connect a remote PC to write each value into the PLC. If confirmed, enter a check (√) in the test form column.

PSS Write..................... ....√

3.3 PSS Read

As per the table in the Sequence of Operations section 8.2, use Modscan to connect a remote PC to read values from the PLC. If confirmed, enter a check (√) in the test form column.

PSS Read ....√

4 Additional Tests

Cross ref. to:
Sunday Sept 17, 2017 DND Shut Down
SSES Standby Generator Operations Rev 3
****************** SECTION 2.09 ********************

- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐
- ______________________________ ☐

- ____________________ ☐
- ____________________ ☐
- ____________________ ☐

Site Test Verification Record – Esquimalt Graving Dock

GCS 2200 Generator Control System

C-054107, W-095112/095113 REV.2 17/09/17

5 FAT Test Notes, Comments or Observations

No deficiencies (unless listed below)		

DEFICIENCIES: (☐ Refer to attached Deficiency List)
☒ **None**

Item No.	Description	Action By	Due Date	Rectified	
				(Tester Initials)	(Date)

Site Test Verification Record – Esquimalt Graving Dock

GCS 2200 Generator Control System

C-054107, W-095112/095113 REV.2 17/09/17

COMMENTS / RECOMMENDATIONS: (☐ Refer to attached detailed Service Report)

WITNESS TEST / VALIDATION

		VERIFIED **(Tester Signature)**	**(Date)**
Factory Tested By:	Jason Chen David Engleman		2017-10-18
	(Technician Name/Title)		

----------------------- *If Applicable* ----------------

	(Witness Signature)	***(Date)***
Witness Tested By:		
(Customer Name/Title)		

Schneider Canada Services & Projects

Document Ref: 1.0

Esquimalt Graving Dock: SCADA Load Restoration Testing

Q2C: 39022265-001/002

Date: 29/09/2017

Revision: 1.0

Branch office:
Schneider Electric Canada, Inc.
Energy Management and Sustainability Services
2195 Keating Cross Road
Canada V8M 2A5
Tel: 250-652-7100

Main office:
Schneider Electric Canada, Inc.
5985 McLaughlin Road
Mississauga, ON L5R 1B8
Tel: 1-800-565-6699
www.schneider-electric.com

Revision no.	**Date**	**Comments**
1.0	Sept 29, 2017	Initial document

Table of Contents

1 Introduction

On September 16n and 17th, 2017 a scheduled shutdown was performed at the Esquimalt Graving Dock in order to perform final testing and demonstrations for the newly commissioning Service Entrance Substation Transfer Control System and SCADA load restoration scheme of breaker as prescribed under the project specifications.

Using live signals from the TSC and injection signals to the utility feeds, the SCADA load restoration scheme was tested and validated to operate under the following summarized conditions:

- Upon loss of preferred utility power and energization of the main 25/12kV bus under generator power
- Upon return of preferred utility power for a stabilized 3 minute period and shutdown of generators

The load restoration scheme under this project only includes automated breaker control for PHS and SES breakers with remote close provisions. The SSSR substation is not included under this project and the other substations (Main, NLW, and SSS) currently do not have any remote breaker control support.

The information contained in this document pertains only to the SCADA system deployment configured by Schneider Electric.

2 TSC register reads/write

The table below summarized the testing of the register tags read from the TCS and registers that are written to the TCS by the EGD SCADA system. Only selected registers are written to the TCS system for use of managing the generation capacity. No other control functions

EQUIPMENT	PSE TAG	TAG DESCTIP	TEST STATUS
TTI PLC Prosoft PLC	SSES_Generator1\Gen_Available	@(Generator Available)	ok
	SSES_Generator1\Gen_Brk_Closed	@(Generator Breaker Closed)	ok
	SSES_Generator1\Gen_Brk_WIthdrwawn	@(Generator Breaker WIthdrawn)	ok
	SSES_Generator1\Gen_Common_Alarm	@(Generator Common Alarm)	ok
	SSES_Generator1\Gen_Common_Shutdown	@(Generator Common Shutdown)	ok
	SSES_Generator1\Gen_DSLC_Alarm	@(Generator DSLC Alarm)	ok
	SSES_Generator1\Gen_Engine_Start	@(Generator Engine Start)	ok
	SSES_Generator1\Gen_Entered_Priority	@(Generator Entered Priority)	ok
	SSES_Generator1\Gen_Fail_to_Close	@(Generator Fail to Close)	ok
	SSES_Generator1\Gen_Fail_to_Open	@(Generator Fail to Open)	ok
	SSES_Generator1\Gen_Fail_to_Start_Alarm	@(Generator Fail to Start Alarm)	ok
	SSES_Generator1\Gen_Fail_to_Unload	@(Generator Fail to Unload)	ok
	SSES_Generator1\Gen_Fuel_Consumption	@(Generator Fuel Consumption)	ok
	SSES_Generator1\Gen_Fuel_Time_Rem_Hour	@(Generator Fuel Time Remaining Hours)	ok
	SSES_Generator1\Gen_Fuel_Time_Rem_Min	@(Generator Fuel Time Remaining Minutes)	ok
	SSES_Generator1\Gen_Local_Brk_Open	@(Generator Local Breaker Open)	ok
	SSES_Generator1\Gen_Low_Fuel_Alarm	@(Generator Low Fuel Alarm)	ok
	SSES_Generator1\Gen_Not_In_Auto	@(Generator Not In Auto)	ok
	SSES_Generator1\Gen_Protectiion_Relay_Alarm	@(Generator Protection Relay Alarm)	ok
	SSES_Generator1\Gen_Protection_Tripped	@(Generator Protection Tripped)	ok
	SSES_Generator1\Gen_Running	@(Generatror Running)	ok

	SSES_Generator1\Gen_Sync_Attempts	@(Generator Sync Attempts)	ok
	SSES_Generator1\Gen_Sync_Time	@(Generator Sync Time)	ok
	SSES_Generator1\Gen_Sync_to_Bus	@(Generator Sync to Bus)	ok
	SSES_Generator1\Gen_Warmup_Time	@(Generator WarmupTime)	ok
	SSES_Generator1\MMXU1\TotW	@(Active Power)	ok
	SSES_M01\Gen_Battery_VDC	'@Generator Battery Voltage DC)	ok
	SSES_M01\Gen_Coolant_Temp	'@(Generator Coolant Temp)	ok
	SSES_M01\Gen_Engine_Speed	'@(Engine Speed RPM)	ok
	SSES_M01\Gen_Fuel_Volume	@(Generator Fuel Volume %)	ok
	SSES_M01\Gen_Fuel_Volume_L	@(Generator Fuel Volume L)	ok
TTI PLC Prosoft PLC	SSES_Generator2\Gen_Available	@(Generator Available)	ok
	SSES_Generator2\Gen_Brk_Closed	@(Generator Breaker Closed)	ok
	SSES_Generator2\Gen_Brk_WIthdrwawn	@(Generator Breaker WIthdrawn)	ok
	SSES_Generator2\Gen_Common_Alarm	@(Generator Common Alarm)	ok
	SSES_Generator2\Gen_Common_Shutdown	@(Generator Common Shutdown)	ok
	SSES_Generator2\Gen_DSLC_Alarm	@(Generator DSLC Alarm)	ok
	SSES_Generator2\Gen_Engine_Start	@(Generator Engine Start)	ok
	SSES_Generator2\Gen_Entered_Priority	@(Generator Entered Priority)	ok
	SSES_Generator2\Gen_Fail_to_Close	@(Generator Fail to Close)	ok
	SSES_Generator2\Gen_Fail_to_Open	@(Generator Fail to Open)	ok
	SSES_Generator2\Gen_Fail_to_Start_Alarm	@(Generator Fail to Start Alarm)	ok
	SSES_Generator2\Gen_Fail_to_Unload	@(Generator Fail to Unload)	ok
	SSES_Generator2\Gen_Fuel_Consumption	@(Generator Fuel Consumption)	ok
	SSES_Generator2\Gen_Fuel_Time_Rem_Hour	@(Generator Fuel Time Remaining Hours)	ok
	SSES_Generator2\Gen_Fuel_Time_Rem_Min	@(Generator Fuel Time Remaining Minutes)	ok
	SSES_Generator2\Gen_Local_Brk_Open	@(Generator Local Breaker Open)	ok
	SSES_Generator2\Gen_Low_Fuel_Alarm	@(Generator Low Fuel Alarm)	ok
	SSES_Generator2\Gen_Not_In_Auto	@(Generator Not In Auto)	ok
	SSES_Generator2\Gen_Protectiion_Relay_Alarm	@(Generator Protection Relay Alarm)	ok
	SSES_Generator2\Gen_Protection_Tripped	@(Generator Protection Tripped)	ok
	SSES_Generator2\Gen_Running	@(Generatror Running)	ok
	SSES_Generator2\Gen_Sync_Attempts	@(Generator Sync Attempts)	ok
	SSES_Generator2\Gen_Sync_Time	@(Generator Sync Time)	ok
	SSES_Generator2\Gen_Sync_to_Bus	@(Generator Sync to Bus)	ok
	SSES_Generator2\Gen_Warmup_Time	@(Generator WarmupTime)	ok
	SSES_Generator2\MMXU1\TotW	@(Active Power)	ok
	SSES_M02\Gen_Battery_VDC	'@Generator Battery Voltage DC)	ok
	SSES_M02\Gen_Coolant_Temp	'@(Generator Coolant Temp)	ok
	SSES_M02\Gen_Engine_Speed	'@(Engine Speed RPM)	ok
	SSES_M02\Gen_Fuel_Volume	@(Generator Fuel Volume %)	ok
	SSES_M02\Gen_Fuel_Volume_L	@(Generator Fuel Volume L)	ok
TTI PLC Prosoft PLC	SSES_Generator3\Gen_Available	@(Generator Available)	ok
	SSES_Generator3\Gen_Brk_Closed	@(Generator Breaker Closed)	ok
	SSES_Generator3\Gen_Brk_WIthdrwawn	@(Generator Breaker WIthdrawn)	ok
	SSES_Generator3\Gen_Common_Alarm	@(Generator Common Alarm)	ok
	SSES_Generator3\Gen_Common_Shutdown	@(Generator Common Shutdown)	ok

	SSES_Generator3\Gen_DSLC_Alarm	@(Generator DSLC Alarm)	ok
	SSES_Generator3\Gen_Engine_Start	@(Generator Engine Start)	ok
	SSES_Generator3\Gen_Entered_Priority	@(Generator Entered Priority)	ok
	SSES_Generator3\Gen_Fail_to_Close	@(Generator Fail to Close)	ok
	SSES_Generator3\Gen_Fail_to_Open	@(Generator Fail to Open)	ok
	SSES_Generator3\Gen_Fail_to_Start_Alarm	@(Generator Fail to Start Alarm)	ok
	SSES_Generator3\Gen_Fail_to_Unload	@(Generator Fail to Unload)	ok
	SSES_Generator3\Gen_Fuel_Consumption	@(Generator Fuel Consumption)	ok
	SSES_Generator3\Gen_Fuel_Time_Rem_Hour	@(Generator Fuel Time Remaining Hours)	ok
	SSES_Generator3\Gen_Fuel_Time_Rem_Min	@(Generator Fuel Time Remaining Minutes)	ok
	SSES_Generator3\Gen_Local_Brk_Open	@(Generator Local Breaker Open)	ok
	SSES_Generator3\Gen_Low_Fuel_Alarm	@(Generator Low Fuel Alarm)	ok
	SSES_Generator3\Gen_Not_In_Auto	@(Generator Not In Auto)	ok
	SSES_Generator3\Gen_Protectiion_Relay_Alarm	@(Generator Protection Relay Alarm)	ok
	SSES_Generator3\Gen_Protection_Tripped	@(Generator Protection Tripped)	ok
	SSES_Generator3\Gen_Running	@(Generatror Running)	ok
	SSES_Generator3\Gen_Sync_Attempts	@(Generator Sync Attempts)	ok
	SSES_Generator3\Gen_Sync_Time	@(Generator Sync Time)	ok
	SSES_Generator3\Gen_Sync_to_Bus	@(Generator Sync to Bus)	ok
	SSES_Generator3\Gen_Warmup_Time	@(Generator WarmupTime)	ok
	SSES_Generator3\MMXU1\TotW	@(Active Power)	ok
	SSES_M03\Gen_Battery_VDC	'@Generator Battery Voltage DC)	ok
	SSES_M03\Gen_Coolant_Temp	'@(Generator Coolant Temp)	ok
	SSES_M03\Gen_Engine_Speed	'@(Engine Speed RPM)	ok
	SSES_M03\Gen_Fuel_Volume	@(Generator Fuel Volume %)	ok
	SSES_M03\Gen_Fuel_Volume_L	@(Generator Fuel Volume L)	ok
TTI PLC Prosoft PLC	SSES_Generator4\Gen_Available	@(Generator Available)	n/a
	SSES_Generator4\Gen_Brk_Closed	@(Generator Breaker Closed)	n/a
	SSES_Generator4\Gen_Brk_WIthdrwawn	@(Generator Breaker WIthdrawn)	n/a
	SSES_Generator4\Gen_Common_Alarm	@(Generator Common Alarm)	n/a
	SSES_Generator4\Gen_Common_Shutdown	@(Generator Common Shutdown)	n/a
	SSES_Generator4\Gen_DSLC_Alarm	@(Generator DSLC Alarm)	n/a
	SSES_Generator4\Gen_Engine_Start	@(Generator Engine Start)	n/a
	SSES_Generator4\Gen_Entered_Priority	@(Generator Entered Priority)	n/a
	SSES_Generator4\Gen_Fail_to_Close	@(Generator Fail to Close)	n/a
	SSES_Generator4\Gen_Fail_to_Open	@(Generator Fail to Open)	n/a
	SSES_Generator4\Gen_Fail_to_Start_Alarm	@(Generator Fail to Start Alarm)	n/a
	SSES_Generator4\Gen_Fail_to_Unload	@(Generator Fail to Unload)	n/a
	SSES_Generator4\Gen_Fuel_Consumption	@(Generator Fuel Consumption)	n/a
	SSES_Generator4\Gen_Fuel_Time_Rem_Hour	@(Generator Fuel Time Remaining Hours)	n/a
	SSES_Generator4\Gen_Fuel_Time_Rem_Min	@(Generator Fuel Time Remaining Minutes)	n/a
	SSES_Generator4\Gen_Local_Brk_Open	@(Generator Local Breaker Open)	n/a
	SSES_Generator4\Gen_Low_Fuel_Alarm	@(Generator Low Fuel Alarm)	n/a
	SSES_Generator4\Gen_Not_In_Auto	@(Generator Not In Auto)	n/a
	SSES_Generator4\Gen_Protectiion_Relay_Alarm	@(Generator Protection Relay Alarm)	n/a
	SSES_Generator4\Gen_Protection_Tripped	@(Generator Protection Tripped)	n/a

	SSES_Generator4\Gen_Running	@(Generatror Running)	n/a
	SSES_Generator4\Gen_Sync_Attempts	@(Generator Sync Attempts)	n/a
	SSES_Generator4\Gen_Sync_Time	@(Generator Sync Time)	n/a
	SSES_Generator4\Gen_Sync_to_Bus	@(Generator Sync to Bus)	n/a
	SSES_Generator4\Gen_Warmup_Time	@(Generator WarmupTime)	n/a
	SSES_Generator4\MMXU1\TotW	@(Active Power)	n/a
	SSES_M04\Gen_Battery_VDC	'@Generator Battery Voltage DC)	n/a
	SSES_M04\Gen_Coolant_Temp	'@(Generator Coolant Temp)	n/a
	SSES_M04\Gen_Engine_Speed	'@(Engine Speed RPM)	n/a
	SSES_M04\Gen_Fuel_Volume	@(Generator Fuel Volume %)	n/a
	SSES_M04\Gen_Fuel_Volume_L	@(Generator Fuel Volume L)	n/a
TTI PLC Prosoft PLC	SSES_PLC\BCH1\Breaker_Closed	@(Utility BCH1 Breaker Closed)	ok
	SSES_PLC\BCH1\fail_time	@(Utility BCH1 Fail Time)	ok
	SSES_PLC\BCH1\fail_to_close	@(Utility BCH1 Fail to Close/Sync)	ok
	SSES_PLC\BCH1\fail_to_open	@(Utility BCH1 Fail to Open)	ok
	SSES_PLC\BCH1\fail_to_unload	@(Utility BCH1 Fail to Unload)	ok
	SSES_PLC\BCH1\kW	@(Utility BCH1 kW)	ok
	SSES_PLC\BCH1\mslc_alarm	@(Utility BCH1 MSLC Alarm)	ok
	SSES_PLC\BCH1\out_of_limits	@(Utility BCH1 Out of Limits)	ok
	SSES_PLC\BCH1\preferred	@(Utility BCH1 Preferred)	ok
	SSES_PLC\BCH1\protection_tripped	@(Utility BCH1 Protection Tripped)	ok
	SSES_PLC\BCH1\retransfer_time	@(Utility BCH1 Retransfer Time)	ok
	SSES_PLC\BCH1\sync_attempts	@(Utility BCH1 Sync Attempts)	ok
	SSES_PLC\BCH1\sync_output	@(Utility BCH1 Synchronize Output)	ok
	SSES_PLC\BCH1\sync_time	@(Utility BCH1 Sync Time)	ok
	SSES_PLC\BCH1\utility_failed	@(Utility BCH1 Utility Failed)	ok
	SSES_PLC\BCH1\utility_na	@(Utility BCH1 N/A)	ok
	SSES_PLC\BCH2\Breaker_Closed	@(Utility BCH2 Breaker Closed)	ok
	SSES_PLC\BCH2\Fail_Time	@(Utility BCH2 Fail Time)	ok
	SSES_PLC\BCH2\Fail_to_Close	@(Utility BCH2 Fail to Close/Sync)	ok
	SSES_PLC\BCH2\Fail_to_Open	@(Utility BCH2 Fail to Open)	ok
	SSES_PLC\BCH2\Fail_to_Unload	@(Utility BCH2 Fail to Unload)	ok
	SSES_PLC\BCH2\kW	@(Utility BCH2 kW)	ok
	SSES_PLC\BCH2\MSLC_Alarm	@(Utility BCH2 MSLC Alarm)	ok
	SSES_PLC\BCH2\Out_of_Limits	@(Utility BCH2 Out of Limits)	ok
	SSES_PLC\BCH2\Preferred	@(Utility BCH2 Preferred)	ok
	SSES_PLC\BCH2\Protection_Tripped	@(Utility BCH2 Protection Tripped)	ok
	SSES_PLC\BCH2\Retransfer_Time	@(Utility BCH2 Retransfer Time)	ok
	SSES_PLC\BCH2\Sync_Attempts	@(Utility BCH2 Sync Attempts)	ok
	SSES_PLC\BCH2\Sync_Output	@(Utility BCH2 Synchronize Output)	ok
	SSES_PLC\BCH2\Sync_Time	@(Utility BCH2 Sync Time)	ok
	SSES_PLC\BCH2\utility_failed	@(Utility BCH2 Utility Failed)	ok
	SSES_PLC\BCH2\Utility_NA	@(Utility BCH2 N/A)	ok
	SSES_PLC\DND\Breaker_Closed	@(Utility DND Breaker Closed)	ok
	SSES_PLC\DND\Fail_Time	@(Utility DND Fail Time)	ok
	SSES_PLC\DND\Fail_to_Close	@(Utility DND Fail to Close/Sync)	ok

	SSES_PLC\DND\Fail_to_Open	@(Utility DND Fail to Open)	ok
	SSES_PLC\DND\Fail_to_Unload	@(Utility DND Fail to Unload)	ok
	SSES_PLC\DND\kW	@(Utility DND kW)	ok
	SSES_PLC\DND\MSLC_Alarm	@(Utility DND MSLC Alarm)	ok
	SSES_PLC\DND\Out_of_Limits	@(Utility DND Out of Limits)	ok
	SSES_PLC\DND\Preferred	@(Utility DND Preferred)	ok
	SSES_PLC\DND\Protection_Tripped	@(Utility DND Protection Tripped)	ok
	SSES_PLC\DND\Retransfer_Time	@(Utility DND Retransfer Time)	ok
	SSES_PLC\DND\Sync_Attempts	@(Utility DND Sync Attempts)	ok
	SSES_PLC\DND\Sync_Output	@(Utility DND Synchronize Output)	ok
	SSES_PLC\DND\Sync_Time	@(Utility DND Sync Time)	ok
	SSES_PLC\DND\utility_failed	@(Utility DND Utility Failed)	ok
	SSES_PLC\DND\Utility_NA	@(Utility DND N/A)	ok
	SSES_PLC\GENBUS\capacity_online_gens	@(600V Gen Bus Capacity of Online Gens)	ok
	SSES_PLC\GENBUS\gen_bus_load	@(600V Gen Bus Load)	ok
	SSES_PLC\GENBUS\gen_bus_load_perc	@(600V Gen Bus Load %)	ok
	SSES_PLC\GENBUS\gen_bus_reserve	@(600V Gen Bus Reserve kW)	ok
	SSES_PLC\GENBUS\HMI_load_dmd_dly_strt	@(600V Gen Bus Load Dmd HMI Load Dmd Dly Strt)	ok
	SSES_PLC\GENBUS\HMI_load_dmd_im_start	@(600V Gen Bus Load Dmd HMI Load Dmd Im Start)	ok
	SSES_PLC\GENBUS\HMI_load_dmd_stop	@(600V Gen Bus Load Dmd HMI Load Dmd Stop)	ok
	SSES_PLC\GENBUS\HMI_load_dmd_stop_time	@(600V Gen Bus Load Dmd HMI Load Dmd Stop Time)	ok
	SSES_PLC\GENBUS\HMI_load_dmd_strt_dly_t	@(600V Gen Bus Load Dmd HMI Load Dmd Dly Strt T)	ok
	SSES_PLC\GENBUS\load_shed_loads_shed	@(600V Gen Bus Load Shed Loads have been Shed)	ok
	SSES_PLC\GENBUS\load_shed_on_dead_bus	@(600V Gen Bus Load Shed Load Shed on Dead Bus)	ok
	SSES_PLC\GENBUS\load_shed_on_overload	@(600V Gen Bus Load Shed Load Shed on Overload)	ok
	SSES_PLC\GENBUS\load_shed_on_under_freq	@(600V Gen Bus Load Shed Load Shed on Under F)	ok
	SSES_PLC\GENBUS\num_gens_online	@(600V Gen Bus No of Generators Online)	ok
	SSES_PLC\LOADBANK\ALARM	@(Load Bank Alarm)	ok
	SSES_PLC\LOADBANK\DUMPOP	@(Load Bank Dump Output)	ok
	SSES_PLC\LOADBANK\ENLST1	@(Load Bank Energize Load Step 1)	ok
	SSES_PLC\LOADBANK\ENLST10	@(Load Bank Energize Load Step 10)	ok
	SSES_PLC\LOADBANK\ENLST11	@(Load Bank Energize Load Step 11)	ok
	SSES_PLC\LOADBANK\ENLST12	@(Load Bank Energize Load Step 12)	ok
	SSES_PLC\LOADBANK\ENLST13	@(Load Bank Energize Load Step 13)	ok
	SSES_PLC\LOADBANK\ENLST14	@(Load Bank Energize Load Step 14)	ok
	SSES_PLC\LOADBANK\ENLST15	@(Load Bank Energize Load Step 15)	ok
	SSES_PLC\LOADBANK\ENLST16	@(Load Bank Energize Load Step 16)	ok
	SSES_PLC\LOADBANK\ENLST17	@(Load Bank Energize Load Step 17)	ok
	SSES_PLC\LOADBANK\ENLST18	@(Load Bank Energize Load Step 18)	ok
	SSES_PLC\LOADBANK\ENLST19	@(Load Bank Energize Load Step 19)	ok
	SSES_PLC\LOADBANK\ENLST2	@(Load Bank Energize Load Step 2)	ok
	SSES_PLC\LOADBANK\ENLST20	@(Load Bank Energize Load Step 20)	ok
	SSES_PLC\LOADBANK\ENLST3	@(Load Bank Energize Load Step 3)	ok
	SSES_PLC\LOADBANK\ENLST4	@(Load Bank Energize Load Step 4)	ok
	SSES_PLC\LOADBANK\ENLST5	@(Load Bank Energize Load Step 5)	ok
	SSES_PLC\LOADBANK\ENLST6	@(Load Bank Energize Load Step 6)	ok

	SSES_PLC\LOADBANK\ENLST7	@(Load Bank Energize Load Step 7)	ok
	SSES_PLC\LOADBANK\ENLST8	@(Load Bank Energize Load Step 8)	ok
	SSES_PLC\LOADBANK\ENLST9	@(Load Bank Energize Load Step 9)	ok
	SSES_PLC\LOADBANK\LBKWCALC	@(Load Bank Load Bank kW Calculated)	ok
	SSES_PLC\LOADBANK\LSO	@(Load Bank Load Steps Online)	ok
	SSES_PLC\LOADBANK\LSR	@(Load Bank Load Steps Required)	ok
	SSES_PLC\LOADBANK\MCRE	@(Load Bank Master Control Relay is Energized)	ok
	SSES_PLC\LOADBANK\MCS1	@(Load Bank Manual Close Step 1)	ok
	SSES_PLC\LOADBANK\MCS10	@(Load Bank Manual Close Step 10)	ok
	SSES_PLC\LOADBANK\MCS11	@(Load Bank Manual Close Step 11)	ok
	SSES_PLC\LOADBANK\MCS12	@(Load Bank Manual Close Step 12)	ok
	SSES_PLC\LOADBANK\MCS13	@(Load Bank Manual Close Step 13)	ok
	SSES_PLC\LOADBANK\MCS14	@(Load Bank Manual Close Step 14)	ok
	SSES_PLC\LOADBANK\MCS15	@(Load Bank Manual Close Step 15)	ok
	SSES_PLC\LOADBANK\MCS16	@(Load Bank Manual Close Step 16)	ok
	SSES_PLC\LOADBANK\MCS17	@(Load Bank Manual Close Step 17)	ok
	SSES_PLC\LOADBANK\MCS18	@(Load Bank Manual Close Step 18)	ok
	SSES_PLC\LOADBANK\MCS19	@(Load Bank Manual Close Step 19)	ok
	SSES_PLC\LOADBANK\MCS2	@(Load Bank Manual Close Step 2)	ok
	SSES_PLC\LOADBANK\MCS20	@(Load Bank Manual Close Step 20)	ok
	SSES_PLC\LOADBANK\MCS3	@(Load Bank Manual Close Step 3)	ok
	SSES_PLC\LOADBANK\MCS4	@(Load Bank Manual Close Step 4)	ok
	SSES_PLC\LOADBANK\MCS5	@(Load Bank Manual Close Step 5)	ok
	SSES_PLC\LOADBANK\MCS6	@(Load Bank Manual Close Step 6)	ok
	SSES_PLC\LOADBANK\MCS7	@(Load Bank Manual Close Step 7)	ok
	SSES_PLC\LOADBANK\MCS8	@(Load Bank Manual Close Step 8)	ok
	SSES_PLC\LOADBANK\MCS9	@(Load Bank Manual Close Step 9)	ok
	SSES_PLC\LOADBANK\NIAUTOALRM	@(Load Bank Not In Auto Alarm)	ok
	SSES_PLC\LOADBANK\OK2ASIMAN	@(Load Bank Okay to Add Steps in MANUAL)	ok
	SSES_PLC\LOADBANK\OK2ASSIA	@(Load Bank Okay to Add/Subtract Steps in AUTO)	ok
	SSES_PLC\LOADBANK\OLSPKWI	@(Load Bank Optimum Load Setpoint Internal)	ok
	SSES_PLC\LOADBANK\PLCCONAUTO	@(Load Bank PLC Control AUTO)	ok
	SSES_PLC\LOADBANK\PLCCONMAN	@(Load Bank PLC Control MANUAL)	ok
	SSES_PLC\LOADBANK\SWAUTO	@(Load Bank Switch in AUTO)	ok
	SSES_PLC\MAINBRK\gen_main_brk_closed	@(25kV Gen Main Breaker Closed)	ok
	SSES_PLC\MISCBRK\gen_main_brk_close_fail	@(25kV Gen Main Breaker Fail to Close)	ok
	SSES_PLC\MISCBRK\gen_main_brk_kw	@(25kV Gen Main Breaker kW)	ok
	SSES_PLC\MISCBRK\gen_main_brk_MSLC	@(25kV Gen Main Breaker MSLC Alarm)	ok
	SSES_PLC\MISCBRK\gen_main_brk_open_fail	@(25kV Gen Main Breaker Fail to Open)	ok
	SSES_PLC\MISCBRK\gen_main_brk_sync_att	@(25kV Gen Main Breaker Sync Attempts)	ok
	SSES_PLC\MISCBRK\gen_main_brk_sync_time	@(25kV Gen Main Breaker Sync Time)	ok
	SSES_PLC\MISCBRK\gen_main_brk_tripped	@(25kV Gen Main Breaker Protection Tripped)	ok
	SSES_PLC\MISCBRK\gen_main_brk_unload_fail	@(25kV Gen Main Breaker Fail to Unload)	ok
	SSES_PLC\MISCBRK\loadbank_brk_closed	@(Load Bank Breaker Breaker Closed)	ok
	SSES_PLC\MISCBRK\loadbank_brk_kw	@(Load Bank Breaker Power)	ok
	SSES_PLC\MISCBRK\main_gen_brk_sync	@(25kV Gen Main Breaker Synchronize Output)	ok

	SSES_PLC\MISCBRK\SES6_SP2_closed	@(Feeder Breaker 6SES-SP-2 Closed)	ok
	SSES_PLC\MISCBRK\tie_brk_close_fail	@(25kV Bus Tie Breaker Fail to Close)	ok
	SSES_PLC\MISCBRK\tie_brk_closed	@(25kV Bus Tie Breaker Closed)	ok
	SSES_PLC\MISCBRK\tie_brk_fail_open	@(25kV Bus Tie Breaker Fail to Open)	ok
	SSES_PLC\MISCBRK\tie_brk_tripped	@(25kV Bus Tie Breaker Protection Tripped)	ok
	SSES_PLC\PSSWRITE\ABNOAC_R	@(Anticipated But Not Online Read - Air Compressors)	ok
	SSES_PLC\PSSWRITE\ABNOAC_W	@(Anticipated But Not Online Write - Air Compressors)	ok
	SSES_PLC\PSSWRITE\ABNOAD_R	@(Anticipated But Not Online Read - Aux Dewatering)	ok
	SSES_PLC\PSSWRITE\ABNOAD_W	@(Anticipated But Not Online Write - Aux Dewatering)	ok
	SSES_PLC\PSSWRITE\ABNOBL_R	@(Anticipated But Not Online Read - Building Loads)	ok
	SSES_PLC\PSSWRITE\ABNOBL_W	@(Anticipated But Not Online Write - Building Loads)	ok
	SSES_PLC\PSSWRITE\ABNOMD_R	@(Anticipated But Not Online Read - Main Dewatering)	ok
	SSES_PLC\PSSWRITE\ABNOMD_W	@(Anticipated But Not Online Write - Main Dewatering)	ok
	SSES_PLC\PSSWRITE\ABNOTC_R	@(Anticipated But Not Online Read - Travelling Crane)	ok
	SSES_PLC\PSSWRITE\ABNOTC_W	@(Anticipated But Not Online Write - Travelling Crane)	ok
	SSES_PLC\PSSWRITE\ALAC	@(Anticipated Load Write - Air Compressors)	ok
	SSES_PLC\PSSWRITE\ALADP	@(Anticipated Load Write - Aux Dewatering Pumps)	ok
	SSES_PLC\PSSWRITE\ALBL	@(Anticipated Load Write - Building Loads)	ok
	SSES_PLC\PSSWRITE\ALMDP	@(Anticipated Load Write - Main Dewatering Pumps)	ok
	SSES_PLC\PSSWRITE\ALTC	@(Anticipated Load Write - Travelling Cranes)	ok
	SSES_PLC\PSSWRITE\WV	@(Generator 1 Fuel Volume Write)	ok
	SSES_PLC\PSSWRITE\Gen_1_Fuel_Vol_L	@(Generator 1 Fuel Volume Write)	ok
	SSES_PLC\PSSWRITE\Gen_2_Fuel_Vol_L	@(Generator 2 Fuel Volume Write)	ok
	SSES_PLC\PSSWRITE\Gen_3_Fuel_Vol_L	@(Generator 3 Fuel Volume Write)	ok
	SSES_PLC\SETPOINTS\CLOSEDTRANS	@(Closed Transition Selected)	ok
	SSES_PLC\SETPOINTS\COMALRMACT	@(Common Alarm Action)	ok
	SSES_PLC\SETPOINTS\F2CDLY	@(Fail to Close Delay Preset)	ok
	SSES_PLC\SETPOINTS\F2ODLY	@(Fail to Open Delay Preset)	ok
	SSES_PLC\SETPOINTS\F2STRTDLY	@(Fail to Start Delay Preset)	ok
	SSES_PLC\SETPOINTS\F2SYNCDLY	@(Fail to Sync Delay Preset)	ok
	SSES_PLC\SETPOINTS\F2ULDLY	@(Fail to Unload Delay Preset)	ok
	SSES_PLC\SETPOINTS\FAILSTART	@(Fail to Start Action)	ok
	SSES_PLC\SETPOINTS\FAILSYNC	@(Fail to Sync Action)	ok
	SSES_PLC\SETPOINTS\FDRULSP	@(Feeder Unloaded Setpoint)	ok
	SSES_PLC\SETPOINTS\GENEXTRT	@(Gen Extended Runtime Preset)	ok
	SSES_PLC\SETPOINTS\GENWARMUPTIME	@(Gen Warm Up Time Preset)	ok
	SSES_PLC\SETPOINTS\LBDLY	@(Live Bus Delay Preset)	ok
	SSES_PLC\SETPOINTS\LBINITDLY	@(Load Bank Initial Delay Timer Preset)	ok
	SSES_PLC\SETPOINTS\LBSTEPADDDLY	@(Load Bank Step Add Delay Timer Preset)	ok
	SSES_PLC\SETPOINTS\LBSTEPFSUBDLY	@(Load Bank Step Fast Subtract Delay Timer Pres)	ok
	SSES_PLC\SETPOINTS\LBSTEPSUBDLY	@(Load Bank Step Subtract Delay Timer Preset)	ok
	SSES_PLC\SETPOINTS\LDDLYSTP	@(Load Demand Delayed Stop Timer Preset)	ok
	SSES_PLC\SETPOINTS\LDMDALEN	@(Load Demand - Anticipated Loads Enabled)	ok
	SSES_PLC\SETPOINTS\LDMDDLYSTPSP	@(Load Demand Delayed Stop Setpoint)	ok
	SSES_PLC\SETPOINTS\LDMDDLYSTRT	@(Load Demand Delayed Start Timer Preset)	ok
	SSES_PLC\SETPOINTS\LDMDDLYSTRTSP	@(Load Demand Delayed Start Setpoint)	ok

	SSES_PLC\SETPOINTS\LDMDEN	@(Load Demand Enabled)	ok
	SSES_PLC\SETPOINTS\LDMDIMSTRTSP	@(Load Demand Immediate Start Setpoint)	ok
	SSES_PLC\SETPOINTS\LDMDN1EN	@(Load Demand - N+1 Redundancy Enabled)	ok
	SSES_PLC\SETPOINTS\LFSP	@(Low Fuel Alarm Setpoint)	ok
	SSES_PLC\SETPOINTS\LOADBANKOPTSP	@(Load Bank Optimum Load Setpoint)	ok
	SSES_PLC\SETPOINTS\LOADSHEDDBUS	@(Load Shed on Dead Bus Enabled)	ok
	SSES_PLC\SETPOINTS\LOADSHEDOL	@(Load Shed on Overload Enabled)	ok
	SSES_PLC\SETPOINTS\LOADSHEDOLSP	@(Load Shed Overload Setpoint)	ok
	SSES_PLC\SETPOINTS\LOADSHEDUFREQ	@(Load Shed on Underfrequency Enabled)	ok
	SSES_PLC\SETPOINTS\LOWFUEL	@(Low Fuel Action)	ok
	SSES_PLC\SETPOINTS\MINRT	@(Minimum Run Time Preset)	ok
	SSES_PLC\SETPOINTS\NDLY	@(Neutral Delay Preset)	ok
	SSES_PLC\SETPOINTS\NGENREQ4TRAN	@(Number of generators required for transfer)	ok
	SSES_PLC\SETPOINTS\SRCFDLY	@(Source Failure Delay Preset)	ok
	SSES_PLC\SETPOINTS\UTILRETRANAUTO	@(Utility Retransfer in Auto)	ok
	SSES_PLC\SETPOINTS\UTILRETRANDLY	@(Utility Retransfer Delay Preset)	ok
	SSES_PLC\SETPOINTS\W4REQGEN	@(Wait For Required Gens Timer Preset)	ok
	SSES_PLC\SYSPLC\B1LIVE	@(25kV Bus 1 Live Bus)	ok
	SSES_PLC\SYSPLC\B2LIVE	@(25kV Bus 2 Live Bus)	ok
	SSES_PLC\SYSPLC\BSTM	@(Block the System TEST Mode)	ok
	SSES_PLC\SYSPLC\GENBLIVE	@(600V Generator Bus Live Bus)	ok
	SSES_PLC\SYSPLC\SMSA	@(System Mode Switch - AUTO)	ok
	SSES_PLC\SYSPLC\SMSM	@(System Mode Switch - MANUAL)	ok
	SSES_PLC\SYSPLC\SMSS	@(System Mode Switch - START)	ok
	SSES_PLC\SYSPLC\SMST	@(System Mode Switch - TEST)	ok
ION7650 Generator 1	SSES_M01\Gen_Battery_VDC	@(Kholer Controller - Gen Battery Voltage)	ok
	SSES_M01\Gen_Coolant_Temp	@(Kholer Controller - Gen Coolant Temp	ok
	SSES_M01\Gen_Engine_Speed	@(Kholer Controller - Gen Speed RPM)	ok
	SSES_M01\Gen_Fuel_Volume	@(Kholer Controller - Gen Fuel Remaing %)	ok
	SSES_M01\Gen_Fuel_Volume_L	@(Calculated - Gen Fuel Remaing L)	ok
	SSES_M01\GGIO1\Ind1	@(Input 01 Status)	ok
	SSES_M01\GGIO1\Ind2	@(Input 02 Status)	ok
	SSES_M01\GGIO1\Ind3	@(Input 03 Status)	ok
	SSES_M01\GGIO1\Ind4	@(Input 04 Status)	ok
	SSES_M01\GGIO1\Ind5	@(Input 05 Status)	ok
	SSES_M01\GGIO1\Ind6	@(Input 06 Status)	ok
	SSES_M01\GGIO1\Ind7	@(Input 07 Status)	ok
	SSES_M01\GGIO1\Ind8	@(Input 08 Status)	ok
	SSES_M01\MMXU1\A\zavg	@(Current Average)	ok
	SSES_M01\MMXU1\Hz	@(Frequency)	ok
	SSES_M01\MMXU1\PPV\zavg	@(Voltage Average)	ok
	SSES_M01\MMXU1\TotPF	@(Power Factor Total)	ok
	SSES_M01\MMXU1\TotVA	@(Apparent Power Total)	ok
	SSES_M01\MMXU1\TotW	@(Real Power Total)	ok
	SSES_M01\MSTA1\AvVA	@(Apparent Power SWD)	ok
	SSES_M01\MSTA1\AvW	@(Real Power SWD)	ok
ION7650 Generator 2	SSES_M02\Gen_Battery_VDC	@(Kholer Controller - Gen Battery Voltage)	ok
	SSES_M02\Gen_Coolant_Temp	@(Kholer Controller - Gen Coolant Temp	ok
	SSES_M02\Gen_Engine_Speed	@(Kholer Controller - Gen Speed RPM)	ok

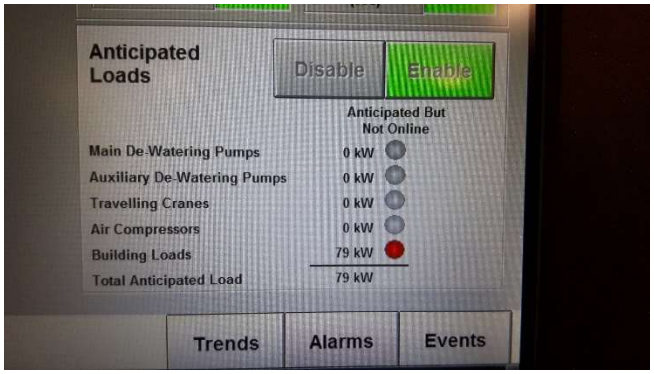
	SSES_M02\Gen_Fuel_Volume	@(Kholer Controller - Gen Fuel Remaing %)	ok
	SSES_M02\Gen_Fuel_Volume_L	@(Calculated - Gen Fuel Remaing L)	ok
	SSES_M02\GGIO1\Ind1	@(Input 01 Status)	ok
	SSES_M02\GGIO1\Ind2	@(Input 02 Status)	ok
	SSES_M02\GGIO1\Ind3	@(Input 03 Status)	n/a
	SSES_M02\GGIO1\Ind4	@(Input 04 Status)	n/a
	SSES_M02\GGIO1\Ind5	@(Input 05 Status)	n/a
	SSES_M02\GGIO1\Ind6	@(Input 06 Status)	n/a
	SSES_M02\GGIO1\Ind7	@(Input 07 Status)	n/a
	SSES_M02\GGIO1\Ind8	@(Input 08 Status)	ok
	SSES_M02\MMXU1\A\zavg	@(Current Average)	ok
	SSES_M02\MMXU1\Hz	@(Frequency)	ok
	SSES_M02\MMXU1\PPV\zavg	@(Voltage Average)	ok
	SSES_M02\MMXU1\TotPF	@(Power Factor Total)	ok
	SSES_M02\MMXU1\TotVA	@(Apparent Power Total)	ok
	SSES_M02\MMXU1\TotW	@(Real Power Total)	ok
	SSES_M02\MSTA1\AvVA	@(Apparent Power SWD)	ok
	SSES_M02\MSTA1\AvW	@(Real Power SWD)	ok
ION7650 Generator 3	SSES_M03\Gen_Battery_VDC	@(Kholer Controller - Gen Battery Voltage)	ok
	SSES_M03\Gen_Coolant_Temp	@(Kholer Controller - Gen Coolant Temp	ok
	SSES_M03\Gen_Engine_Speed	@(Kholer Controller - Gen Speed RPM)	ok
	SSES_M03\Gen_Fuel_Volume	@(Kholer Controller - Gen Fuel Remaing %)	ok
	SSES_M03\Gen_Fuel_Volume_L	@(Calculated - Gen Fuel Remaing L)	ok
	SSES_M03\GGIO1\Ind1	@(Input 01 Status)	ok
	SSES_M03\GGIO1\Ind2	@(Input 02 Status)	ok
	SSES_M03\GGIO1\Ind3	@(Input 03 Status)	n/a
	SSES_M03\GGIO1\Ind4	@(Input 04 Status)	n/a
	SSES_M03\GGIO1\Ind5	@(Input 05 Status)	n/a
	SSES_M03\GGIO1\Ind6	@(Input 06 Status)	n/a
	SSES_M03\GGIO1\Ind7	@(Input 07 Status)	n/a
	SSES_M03\GGIO1\Ind8	@(Input 08 Status)	ok
	SSES_M03\MMXU1\A\zavg	@(Current Average)	ok
	SSES_M03\MMXU1\Hz	@(Frequency)	ok
	SSES_M03\MMXU1\PPV\zavg	@(Voltage Average)	ok
	SSES_M03\MMXU1\TotPF	@(Power Factor Total)	ok
	SSES_M03\MMXU1\TotVA	@(Apparent Power Total)	ok
	SSES_M03\MMXU1\TotW	@(Real Power Total)	ok
	SSES_M03\MSTA1\AvVA	@(Apparent Power SWD)	ok
	SSES_M03\MSTA1\AvW	@(Real Power SWD)	ok
ION7650 Generator 4	SSES_M03\Gen_Battery_VDC	@(Kholer Controller - Gen Battery Voltage)	n/a
	SSES_M03\Gen_Coolant_Temp	@(Kholer Controller - Gen Coolant Temp	n/a
	SSES_M03\Gen_Engine_Speed	@(Kholer Controller - Gen Speed RPM)	n/a
	SSES_M03\Gen_Fuel_Volume	@(Kholer Controller - Gen Fuel Remaing %)	n/a
	SSES_M03\Gen_Fuel_Volume_L	@(Calculated - Gen Fuel Remaing L)	n/a
	SSES_M04\GGIO1\Ind1	@(Input 01 Status)	n/a
	SSES_M04\GGIO1\Ind2	@(Input 02 Status)	n/a
	SSES_M04\GGIO1\Ind3	@(Input 03 Status)	n/a
	SSES_M04\GGIO1\Ind4	@(Input 04 Status)	n/a
	SSES_M04\GGIO1\Ind5	@(Input 05 Status)	n/a
	SSES_M04\GGIO1\Ind6	@(Input 06 Status)	n/a
	SSES_M04\GGIO1\Ind7	@(Input 07 Status)	n/a
	SSES_M04\GGIO1\Ind8	@(Input 08 Status)	n/a
	SSES_M04\MMXU1\A\zavg	@(Current Average)	n/a
	SSES_M04\MMXU1\Hz	@(Frequency)	n/a

	SSES_M04\MMXU1\PPV\zavg	@(Voltage Average)	n/a
	SSES_M04\MMXU1\TotPF	@(Power Factor Total)	n/a
	SSES_M04\MMXU1\TotVA	@(Apparent Power Total)	n/a
	SSES_M04\MMXU1\TotW	@(Real Power Total)	n/a
	SSES_M04\MSTA1\AvVA	@(Apparent Power SWD)	n/a
	SSES_M04\MSTA1\AvW	@(Real Power SWD)	n/a
PM8240 Load Bank	SSES_M05\GGIO1\SPCSO1\ctlVal	@(Breaker Status)	n/a
	SSES_M05\MMXU1\A\zavg	@(Currenet Averagel)	ok
	SSES_M05\MMXU1\PPV\zavg	@(Voltage Average)	ok
	SSES_M05\MMXU1\TotPF	@(Power Factor Total)	ok
	SSES_M05\MMXU1\TotW	@(Real Power Total)	ok

An "ok" entry indicates data point is read correctly comparing to the TCS HMI. While an "N/A" value indicates that testing for this tag was not available or no test was able to be done at the time.

All data points integrated into the SCADA system from the TCS, metering and protection relay equipment have been successfully tested and confirmed.

Writing off values to the TCS controller was also valided. The TCS was able to accept Modbus Write for fuel levels and anticipated load values using a Modbus Tester (ModScan) and he PSS.



Anticipated Loads

		Anticipated But Not Online
Main De-Watering Pumps	0 kW	●
Auxiliary De-Watering Pumps	0 kW	●
Travelling Cranes	0 kW	●
Air Compressors	0 kW	●
Building Loads	79 kW	🔴
Total Anticipated Load	79 kW	

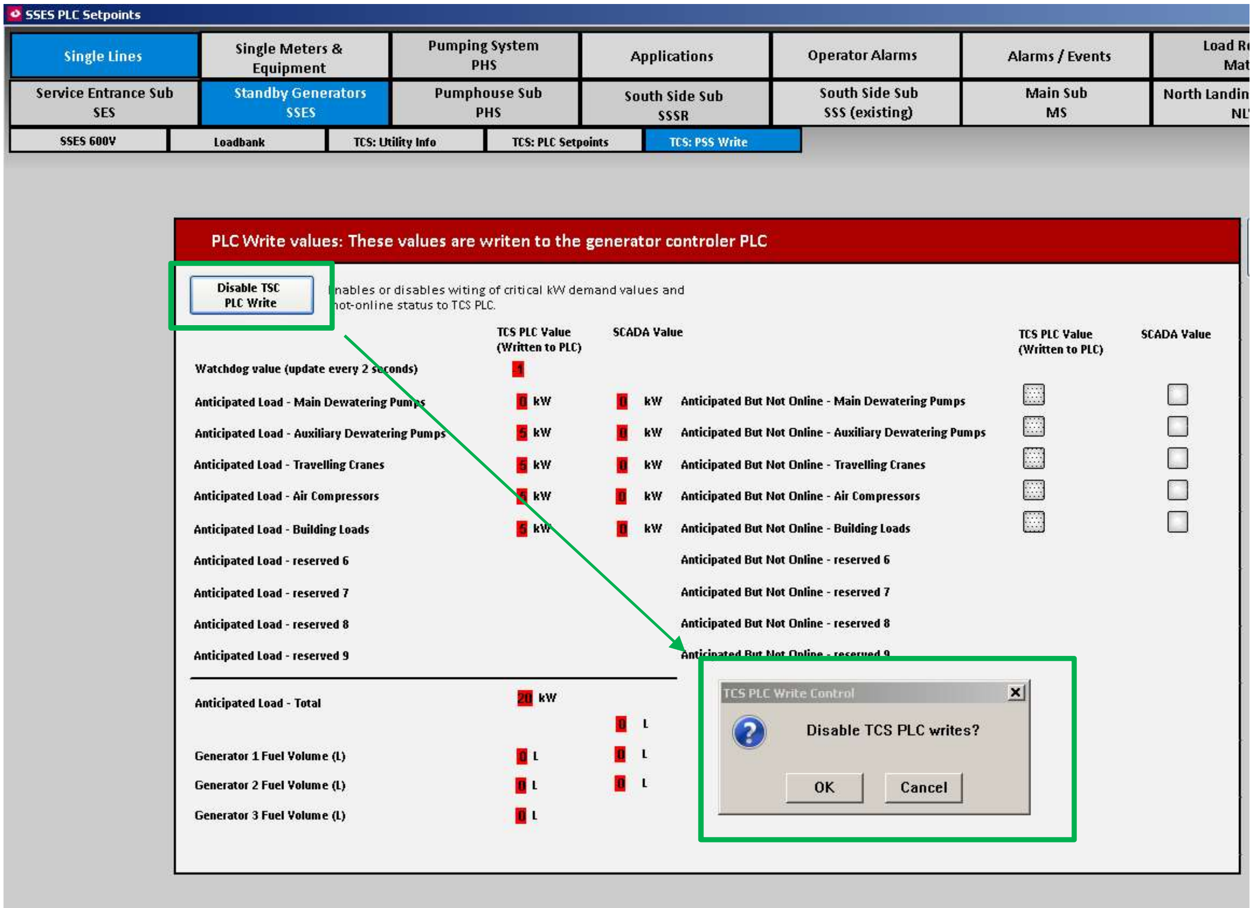
The "enable" of the anticipated loads function via the HMI appears to only enable the inclusion and calculation of the anticipated total loads. These values are constantly written to the TCS PLC unless the write enable function is disabled from the SCADA screen.

Anticipated loads are calculated as follows:

- Main Dewatering Pump: 750kW (per pump)
- Auxilliary Dewatering Pump: 150W (per pump)
- Travelling Cranes:
    - 30T Cranes: 250kW (per crane)
    - 150T Crane: 300kW
- Air Compressors: 280kW (per unit)
- Building loads:
    - Weekdays 7AM – 4PM: 1000kW
    - Weekdays 4PM – 7AM: 500kW
    - Weekends: 500kW

These loading figures are to serve a peak power demand for loads. Sufficient capacity must be reserved for in rush of loads being brought on-line. The generator control system will manage the optimal generation capacity based on actual loading.

When the SCADA system has observed power draw on the dedicated meters to each load within the previous 5 minutes, it will set the flag that the load has been active and that operation will be required if/when under generator supply.



PLC Write values: These values are writen to the generator controler PLC

Enables or disables witing of critical kW demand values and not-online status to TCS PLC.

	TCS PLC Value (Written to PLC)	SCADA Value
Watchdog value (update every 2 seconds)	1	
Anticipated Load - Main Dewatering Pumps	0 kW	0 kW
Anticipated Load - Auxiliary Dewatering Pumps	5 kW	0 kW
Anticipated Load - Travelling Cranes	5 kW	0 kW
Anticipated Load - Air Compressors	5 kW	0 kW
Anticipated Load - Building Loads	5 kW	0 kW
Anticipated Load - reserved 6		
Anticipated Load - reserved 7		
Anticipated Load - reserved 8		
Anticipated Load - reserved 9		
Anticipated Load - Total	20 kW	
		0 L
Generator 1 Fuel Volume (L)	0 L	0 L
Generator 2 Fuel Volume (L)	0 L	0 L
Generator 3 Fuel Volume (L)	0 L	

	TCS PLC Value (Written to PLC)	SCADA Value
Anticipated But Not Online - Main Dewatering Pumps	☐	☐
Anticipated But Not Online - Auxiliary Dewatering Pumps	☐	☐
Anticipated But Not Online - Travelling Cranes	☐	☐
Anticipated But Not Online - Air Compressors	☐	☐
Anticipated But Not Online - Building Loads	☐	☐
Anticipated But Not Online - reserved 6		
Anticipated But Not Online - reserved 7		
Anticipated But Not Online - reserved 8		
Anticipated But Not Online - reserved 9		

TCS PLC Write Control

Disable TCS PLC writes?

3 Load Restoration

The PSS is configure with modes of operation of the load restoration schema:

- Normal Mode: Actual TSC signals are monitored and used to trigger load scheme. Breakers are physically operated according the configured load priority sequence.
- Test Mode: Actual TSC signals are monitored and used to trigger load scheme. Breakers are not physically operated. Breaker close commands are written to variables which are displayed in SCADA HMI to show breaker priority sequence load restoration.

When the load restoration function is enabled, the PSS will continuously evaluate the signals read by the TCS to determine if the system is running normally or when the system is should initiate the load restoration sequence.

loss of preferred utility power and under generator power / return of preferred utility power and generators are shutting down, and

There are scenarios where the load restoration sequence will be utilized:

Loss of preferred utility power and under generator power:

1. If the load restoration function enabled
2. The preferred utility failed: function checks the flag for the preferred utility read from the TCS has failed. A “utility failed” indication is supplied primarily from the protection relay SES 25/12 CB-01.
3. Are the generators online and is the 600V bus energized: when X generators have been brought online and the generator breaker(s) have been closed, the TCS will determine if the 600V generator bus has been energized. The PSS will read this flag.
4. The main generator feed breaker has been closed and the bus is live: the TCS will have full control over the main generator breaker SES 25/12 CB-02. When the breaker is closed and bus is energized the load restoration sequence will commence after the prescribed delay.

When the above conditions are met, a program will be executed to commence the load restoration sequence for breakers that are configured into the load restoration program.

Once the sequence has completed, a flag will be set to indicate the load restoration under generator power has been completed. This flag will be used to enable the load restoration function upon return to the preferred utility power.

When utility supply is available, the standy generators may begin a shut down sequence where loads are ready to be transferred back over to utility support. All of the main protection relays will trip the breakers upon loss of buss voltage (generator breaker open). At this point the load restoration sequence would be ready to re-initialize.

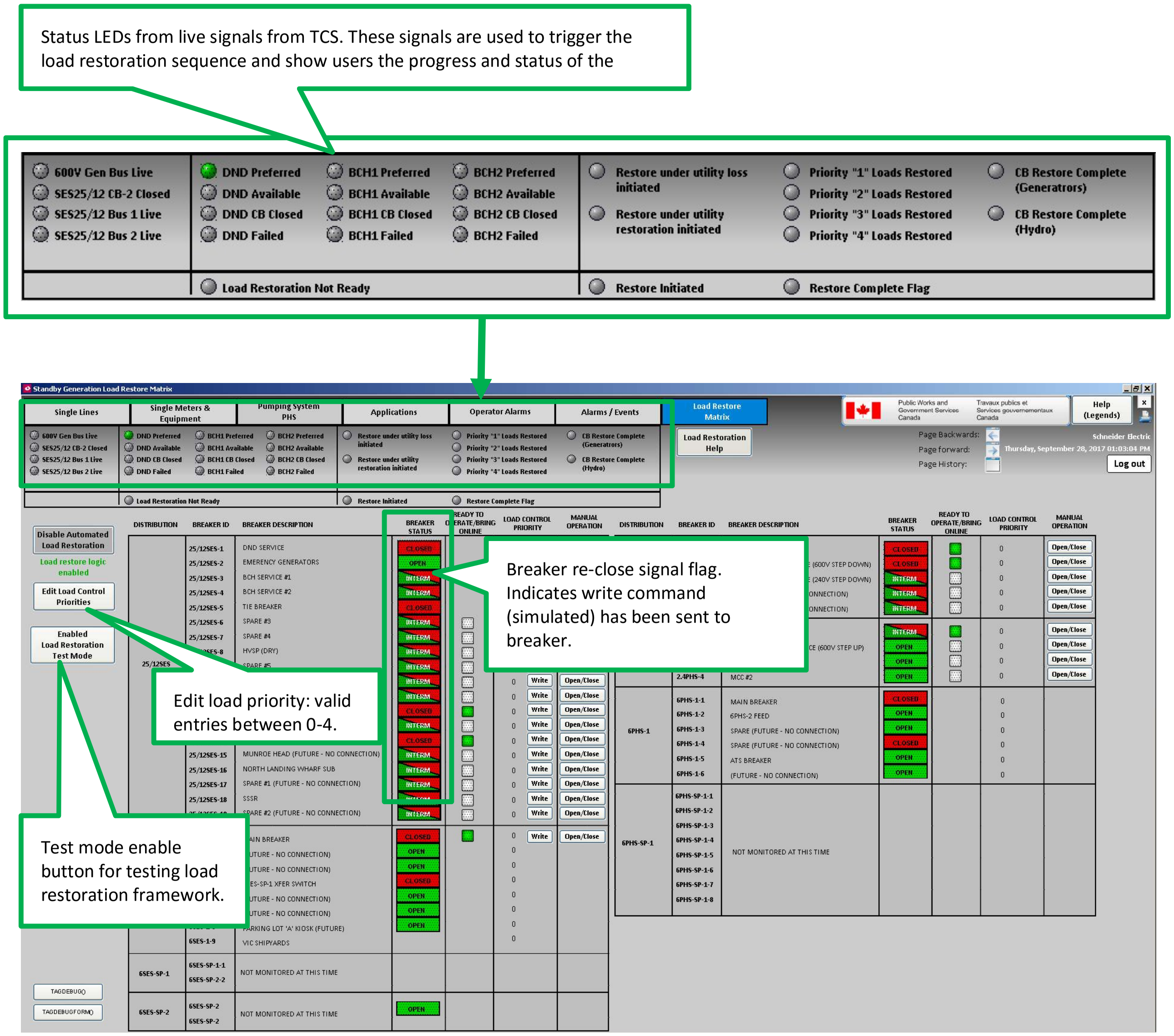
Return of preferred utility power and generator shutting down:

1. Is the load restoration function enabled
2. The preferred utility is online and stable for 3 minutes: Dedicated meters for DND and future BCH utility feeds monitor for a stable voltage level.
3. Generators main breakers is open and generators are beginning shut down sequence
4. The preferred utility breaker is closed. When the breaker is closed and bus is energized the load restoration sequence will commence after the prescribed delay.

Once the sequence has completed, a flag will be set to indicate the load restoration under return to utility power has been completed. This flag will be used to enable the load restoration function upon loss to the preferred utility power once again.

The Load Restoration screen has an edit mode which enables users to configure the load control priority which is used for both normal and test modes. Breakers configured with a load control priority of 0 are ignored. All of the events are time-stamped and are observable in the PSS event log.

Refer to the screen shots below for details on the information displayed:



Status LEDs from live signals from TCS. These signals are used to trigger the load restoration sequence and show users the progress and status of the

Breaker re-close signal flag. Indicates write command (simulated) has been sent to breaker.

Edit load priority: valid entries between 0-4.

Test mode enable button for testing load restoration framework.

The status LEDs will help users observing the system see the condition of the utility and standby generator power as well as the progress of the load restoration sequence.

The events are displayed in the SCADA event log indicating the load restoration sequence has initiated and which breakers have been brought online. Messages in grey are open messages written to the event log from the program executed.

Events from the utility failure test

9/17/2017	12:22:04.656 PM	No Time Sync Information			Event	Interface ...	25/12SES CB-12 closed (brought back online)
9/17/2017	12:22:01.012 PM	No Time Sync Informa...	SES2512_MET11\...	Breaker Status - Closed	Appearance	Digital	SES2512_MET11\XCBR1\Pos_On - Alarm raised
9/17/2017	12:22:01.012 PM	No Time Sync Informa...	SES2512_MET11\...	Breaker Status - Open	Disappearance	Digital	SES2512_MET11\XCBR1\Pos_Off - Alarm cleared
9/17/2017	12:21:59.656 PM	No Time Sync Information			Event	Interface ...	25/12SES CB-11 closed (brought back online)
9/17/2017	12:21:59.654 PM	No Time Sync Information			Event	Interface ...	Commencing automated load restoration for priority 1 loads.
9/17/2017	12:21:54.652 PM	No Time Sync Information			Event	Interface ...	Commencing load restoration sequence upon utility failure..
9/17/2017	12:21:53.028 PM	No Time Sync Informa...	SES2512_PR18\P...	Undervoltage Trip Level 2	Disappearance	Digital	SES2512_PR18\P_27P2T - Alarm cleared

Events from the utility restoration test

9/17/2017	06:49:40.530 PM	No Time Sync Informa...	PHS_UPS\BYPASS\NA	Bypas N/A	Disappearance	Digital	PHS_UPS\BYPASS\NA - Alarm cleared
9/17/2017	06:49:40.170 PM	No Time Sync Information			Event	Interface ...	25/12SES CB-12 closed (brought back online)
9/17/2017	06:49:36.014 PM	No Time Sync Informa...	SES2512_MET11\...	Breaker Status - Closed	Appearance	Digital	SES2512_MET11\XCBR1\Pos_On - Alarm raised
9/17/2017	06:49:36.014 PM	No Time Sync Informa...	SES2512_MET11\...	Breaker Status - Open	Disappearance	Digital	SES2512_MET11\XCBR1\Pos_Off - Alarm cleared
9/17/2017	06:49:35.170 PM	No Time Sync Information			Event	Interface ...	25/12SES CB-11 closed (brought back online)
9/17/2017	06:49:35.168 PM	No Time Sync Information			Event	Interface ...	Commencing automated load restoration for priority 1 loads.
9/17/2017	06:49:35.015 PM	No Time Sync Informa...	PHS_UPS\INPUT\UV	Input Undervoltage	Disappearance	Digital	PHS_UPS\INPUT\UV - Alarm cleared
9/17/2017	06:49:34.013 PM	No Time Sync Informa...	PHS_CHG_01\COMAL	Common Alarm	Disappearance	Digital	PHS_CHG_01\COMAL - Alarm cleared
9/17/2017	06:49:34.013 PM	No Time Sync Informa...	PHS_CHG_01\ACFA	AC Failure Alarm	Disappearance	Digital	PHS_CHG_01\ACFA - Alarm cleared
9/17/2017	06:49:30.514 PM	No Time Sync Informa...	PHS_UPS\SYSTEM...	System Input Power Problem	Appearance	Digital	PHS_UPS\SYSTEM\SYSPPROB - Alarm raised
9/17/2017	06:49:30.514 PM	No Time Sync Informa...	PHS_UPS\SYSTEM...	Battery Discharging	Appearance	Digital	PHS_UPS\SYSTEM\BATDIS - Alarm raised
9/17/2017	06:49:30.514 PM	No Time Sync Informa...	PHS_UPS\INPUT\UV	Input Undervoltage	Appearance	Digital	PHS_UPS\INPUT\UV - Alarm raised
9/17/2017	06:49:30.162 PM	No Time Sync Information			Event	Interface ...	Commencing load restoration sequence upon utility restoration.
9/17/2017	06:49:30.019 PM	No Time Sync Informa...	PHS24_MCC1_PR0...	Overvoltage Trip Level 2	Appearance	Digital	PHS24_MCC1_PR01\P_59P2T - Alarm raised
9/17/2017	06:49:30.019 PM	No Time Sync Informa...	PHS24_MCC1_PR0...	Undervoltage Trip Level 1	Appearance	Digital	PHS24_MCC1_PR01\P_27P1T - Alarm raised
9/17/2017	06:49:30.018 PM	No Time Sync Informa...	PHS24_MCC2_PR0...	Overvoltage Trip Level 2	Appearance	Digital	PHS24_MCC2_PR06\P_59P2T - Alarm raised
9/17/2017	06:49:30.018 PM	No Time Sync Informa...	PHS24_MCC2_PR0...	Undervoltage Trip Level 1	Appearance	Digital	PHS24_MCC2_PR06\P_27P1T - Alarm raised

4 Final Test Restults

Signals and data values from the TCS and metering equipment were verified.

In the presence of active faults or lock-out enabled on the protection relays, none of the breakers could be remotely operated by the PSS.

During initial testing there were some unforeseen issues with the SCADA load restoration sequence as a result of adding a timing function used to simulated the cool down seqeuence for the generators. After some troubleshooting it was determine the function’s timing loop was not exitting correctly thus preventing the execution of the remainaing functions. This code was removed and the priority load restoration sequence was able to successfully execute.

The load restoration sequence function simulation trigged successfully:

- Test Mode: load restoration upon loss of utilty supply and transfer of supply power to standby generators
- Test Mode: load restoration upon return of utilty supply and transfer of supply power from standby generators
- Normal Mode: load restoration upon loss of utilty supply and transfer of supply power to standby generators
- Normal Mode: load restoration upon return of utilty supply and transfer of supply power from standby generators

Breakers had the ability to be manually controlled when the automated load restoration has been triggered. After test was completed successfully, the load restoration sequence was disabled. EGD staff will have to re-enable the priority load restoration sequence.

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Date: 17-Sep-17

Time: 7:30AM

Meeting; Generator Final Test and Commissioning Sept 16-17, 2017

Name	Company	Signature
GORD WEBSTER	WPE	
Chris Heesterman	WPE	
Lorne Cowley	WPE/LDC	
David Engleman	TTI	
Jason Chen	TTI	
IAN BROWN	AES	
Clayton Laughlin	Prime	
RYAN BESTWICK	WPE	
Kelson Goldsmith	Prime	
MIKE LEDSON	PWGSC	
Jesse Curtis	PWGSC	
M. CAMMIADE	EGD	
STEVE WINDL	PWGSC	
JORDIE COURSIN	PWGSC	
MIKE LEDSON	PWGSC	
ANDREW PETERSON	PWGSC	
Veysel Aydin	PWGSC	

PRE START

Frontier POWER PRODUCTS
Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

SUN SEPT 17, 2017
GEN # 1, 2, 3

Checklist Items

☑ *Generator must be bolted to the concrete pad.*

☑ Radiator must be full of coolant.

☑ Pre-wire service plug for block heater.

☑ Ensure batteries are connected properly.

☑ *Radiator duct louvers must be installed and wired.*

☑ Area under and around unit must be free of debris.

N/A ☒ Remote annunciator/fire panel installed and wiring in place.

☑ Pre-wire service plug for battery charger.

☑ Exhaust system must be installed and insulated. (If applicable.)

☑ Control wiring should be in a conduit separate from the load conductors. Start wires need to be a minimum of #18 and labeled #3 and #4. They need to be pulled up into the generator controller and to the connection point in the transfer switch. If start wires are in the same conduit as the load conductors, they should be shielded.

☑ ATS line, load and genset connections must be made and terminated. The installing electrician **must** be on site in case wiring verification is required.

☑ Diesel fuel system must be complete and the tank filled to 80% maximum to allow for expansion. 3/4 TANK EA

☑ Spark ignited engine fuel system must be installed per Kohler installation manual. Gas pressure ***MUST*** be 7 - 11 inches of water column at the generator fuel inlet at all times. Supply volume must be sized for 100% rated load. Volume requirement is supplied on the generator data sheet.

☑ Confirm special site concerns. (Use "Notes" section on previous page.)

☑ Clear access for service vehicle and load bank will be confirmed. If a load test is to be performed, please indicate the distance in feet from where the load bank can be situated to the connection points.

________ Feet FIXED

Notes

- The above checklist is to help ensure that the start-up of the emergency power system goes smoothly.
- Fire alarm connections will be made at this time. Fire alarm personnel must be available or subsequent visits will be chargeable. N/A - ENGINE OIL LEVEL GOOD/EA
- Power interruptions are inevitable. They will be kept to a minimum, and announced where possible.

* If any of the above items are not complete at the time of start-up **costs will be chargeable** to the contractor.

Our technicians are on site to commission the components supplied by Frontier Power Products only. All code, safety compliance and testing of the complete power system are the responsibility of the owner (s) and their representatives.

Note: The sales person has verified that the contractor's account is in good standing. Before a commissioning date will be set the account must be up to date. ☐

Representative: GORD WEBSTER

Signature:

SEPT 17, 2017.
7:00 AM.

Sales Person: ________

Signature: ________

WESTERN PACIFIC ENTERPRISES LTD.
PWGSC No. R.057890.003
CONTRACT No. EZ108-170397

Sunday Sept 17, 2017 DND Shut Down - SSES Standby Portable Generator Operations Rev 0
Start time 7:30AM

	Test	Item	Description	Action by;	Completed	Scheduled Start Date	Time	Duration
	2.13		***Manual Transfer Switch Test and Commissioning***		✓	17/09/2017	TBA	15
			Megger feeders Gen Connection Box to MTA	WPE				
			Megger feeders MTS to Panel board	WPE				
			Megger feerders from Main Breaker	WPE				
			Confirm Phase rotation of main Breaker feed to MTS	WPE				
			Confirm Phase rotation of Standby Portable generator	WPE				
			Connect Standby Portable generator to Connection box	WPE				
			Energize Standby Portable generator	WPE				
			Open Panel Board Main Breaker	WPE				
			Switch MTS to Alternate power source	WPE				
			Reverse procedure to return system to normal power condition	WPE				
			Restore EGD to Normal Power Condition	PWGSC		17/09/2017		
						Total hrs		15.0

Test Preformed by : Ryan Bestwick

Signature: Ryan B

Date: Sept 17, 2017

Witnessed by:

Signature:

Date: Sept 17, 2017

9 – SSES GENERATOR COORDINATION STUDY

9.1 Generator Coordination Study

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

DOCUMENT:
☐ MEMORANDUM
☐ INSTRUCTION
☐ FIELD REPORT
X SUBMITTAL

FOR:
☒ APPROVAL
☒ YOUR REVIEW
☐ ACTION
☐ YOUR USE
☐ COMMENT
☒ INFORMATION
☒ RECORD
☐ RESUBMITTAL

TO: **PWGSC**
Esquimalt Graving Dock
SSES – Standby Power Generation System
ATTN:{Jamie LeBlanc}

PROJECT: **EQS Power Generation Syst**
OUR REF: C847
DATE: June 23, 2017
FROM: Gord Webster

DOCUMENT / DRAWINGS TRANSMITTAL 059

File Name: **Draw - AIP2PAC – EGD – SSES-SPGS – EGD Standby Generation Coordination and Arc Flash Study Rev1**

THE FOLLOWING DOCUMENTS / DRAWINGS ARE BEING TRANSMITTED:

Number of copies	File Type	File Name and Description	Status
1	PDF	**Coordination and Arc Flash Study R1 (30pg)**	

RVW = Reviewed, RAN = Reviewed as Noted, RAR = Revise & Resubmit, REJ = Rejected

COMMENTS:
Reference Specification Section 01 91 13 item 1.6.12 addendum 04

Sincerely,

Gord Webster
Project Manager
Western Pacific Enterprises GP

Cc: Jamie LeBlanc
Cc: Galen Potash-Kooyman
Cc: Iain Barnes

Sent by: ☐ Mail ☐ Courier ☐ Hand ☐ Fax X Email

NEXTGEN
TECHNOLOGIES LTD.

Applied Engineering Solutions Ltd.
3rd Floor, 1815 Blanshard Street
Victoria, BC V8T 5A4

☒ Reviewed
☐ Revise and Resubmit
☐ Reviewed as Modified
☐ Not Reviewed

This review is only for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on shop drawings during this review do not relieve the contractor from compliance with the requirement of the plans and specifications. Review of the specific item shall not include review of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades; and for performing all Work in a safe and satisfactory manner.

Project No.: 16-008
Date: July 5, 2017
By: Iain Barnes

Esquimalt Graving Dock Standby Power Generation System

Coordination & Arc Flash Study

S. BARAKAT
42251
2017-06-21

WESTERN PACIFIC ENTERPRISES GP- SHOP DRAWINGS
PROJECT: SSES Standby Power
WPE# C847
Date: June 22, 2017
REVIEWED by _GW_

Prepared by:
Soheil Barakat, P. Eng.

Rev	Date	Prepared by	Checked by	Description
0A	2017-05-26	Soheil Barakat		Draft
1	2017-05-30	Soheil Barakat	Craig Bohnet	First Issue
1.1	2017-06-21	Soheil Barakat	Craig Bohnet	Revised Motor Contribution & Bus Names

1.0 Executive Summary

This report contains the analysis and results of a coordination study performed for the Esquimalt Graving Dock (EGD) in Victoria, BC. The purpose of this study is to review the protection coordination of the new standby power generation system at the Service Entrance Substation (SES). This study builds on the short circuit, coordination, and arc flash analysis for the SES and Pump House Substation (PHS) upgrade project performed by Prime Engineering Ltd. In addition to the coordination study, this report includes the results and analysis of an arc flash study performed for the EGD standby power generation system. The purpose of the study is to determine the arc flash hazard of the new equipment being installed in the SES. All other studies are out of scope.

The current generator protection settings, which were provided by others, result in loss of selectivity under fault conditions. In addition, the provided settings will prevent the generators from supplying full load 992 amps due to a definite time overcurrent pick up setting of 900 amps. It is recommended that the settings be reviewed and revised by others. As this report relates to a subset of the EGD SES, it is recommended that the study results herein be evaluated by others to ensure compatibility with downstream equipment.

For the purpose of capturing motor contributions to the arc flash incident energies at 6SES-SP0 and 6SES-SP-2, typical ETAP dynamic modelling values are used to simulate the 1000HP and 250HP dewatering pump motors. A separate review performed by Applied Engineering Solutions determined that the fault contributions of the dewatering motors has minimal impact and would not substantially change the results of the arc flash analysis. See section 5 for detailed incident energy levels and arc flash boundaries, as well as arc flash warning labels. Arc flash ratings for medium voltage equipment downstream of the equipment included in this study will change based on generator supply and must be revisited by others.

2.0 Scope

The scope of the coordination portion of this study is limited to the protection of the EGD standby power generation system at the SES. The study limit is at the interconnection point of the standby service system to Bus 1 of the SES and low voltage bus 6SES-SP-0 and its associated distribution panel 6SES-SP-2. Analysis of other equipment, including 25/12SES switchgear was not within the scope of this study. The objective of the coordination study is to examine the single line diagrams and equipment details and to determine the coordination of the overcurrent devices. Where protective devices with adjustable settings exist, this report will provide core settings for the overcurrent elements in section 4.3.

The scope of the arc flash risk assessment portion of this study is limited to the newly installed equipment of the EGD standby power generation system. The study is bounded by the equipment considered in the coordination portion as well as downstream dewatering pump motors. The objective of this report is to calculate the worst-case arc flash incident energy levels and arc flash boundaries for the equipment where work in the energized state is required. Additionally, this study includes data for arc flash hazard warning labels to be installed on equipment. Production and installation of the labels is to be done by others.

3.0 Data Sources & Assumptions

3.1 Terms and Definitions

CB	Circuit Breaker
CT	Current Transformer
CTR	Current Transformer Ratio
EGD	Esquimalt Graving Dock
LSIG	Long Time, Short Time, Instantaneous, Ground

LV	Low Voltage
LVCB	Low Voltage Circuit Breaker
PHS	Pump House Substation
PN	Protection
POI	Point of Interconnection
PPE	Personal Protective Equipment
PU	Pickup
SES	Station Entrance Substation
TCC	Time Coordination Curve
TD	Time Dial

3.2 Assumptions

The following assumptions were made in the generation of the ETAP model and this report:

- All information provided to Nextgen by clients, contractors, and all other parties is up-to-date and accurate.
- Transformer inrush is 10 x full load current.
- Transformer T25/12SES-2 protection (differential, overcurrent, etc.) previously set by others.
- Miscoordination with equipment downstream of CB T25/12 by others. FDR12 miscoordination with transformer protection is apparent in this study and it should be revisited by others under whose scope the equipment resides.
- 58% shift applied to delta-wye transformers
- Cable impedance is typical – values from ETAP library used when available. 28kV cable values were not in the library so typical data from similar cable by Prysmian group was used.
- The utility supply of any other generation sources cannot be paralleled with the three generators.
- Minimum time for utility supply transition to generator supply transition is 5 seconds.
- Generic generator damage curve was used for modeling. Refer to item 9 in Section 3.3.
- Generator cable sizing was not available in ETAP model so 350kcmil was selected to represent the system as a worst case.
- Generators I^2T=40 typical
- CB T25/12 information was not available so typical 5 cycle clearing time was assumed.
- Contributions of large downstream motors have been reviewed by Applied Engineering Solutions Limited, and minimal impact to arc flash energies were observed.
- 1000HP dewatering pump's contribution to arc flash incident energy is calculated using typical ETAP dynamic modelling values for synchronous motors
- 250HP auxiliary dewatering pump's contribution to arc flash incident energy is calculated using typical ETAP dynamic modelling values for synchronous motors
- 1000HP dewatering motor and 250HP auxiliary dewatering motor are connected directly to the HV bus for the purposes of the arc flash study
- Generator cable connection to transformer 25/12SES-2 is through underground conduit, from which cables to 6SES-SP-0 are also connected. No panel was specified here and it is assumed that this connection is inaccessible to personnel; therefore, no arc flash considerations are required.
- 25/12SES CB-12 carries largest load on PNL 25/12 SES1 Bus1

3.3 Data Sources & Standards

ETAP version 16.1 was used for the modeling software. The following data was used to generate the ETAP model:

1. Drawing 8410 – Service Entrance Substation High Voltage Single Line Diagram
2. Drawing 8411 – Service Entrance Substation Low Voltage Single Line Diagram
3. WPE Submittal AIP2PAC-EGD-SSES-SPGS-6SES-SP-0 Rev 1 (2016-11-07): 6SES-SP-0 drawings
4. WPE Submittal AIP2PAC-EGD-SSES-SPGS-25kV Cable containing General Cable 28kV cable data sheet
5. 28kV TRXPLPE Cable typical conductor datasheet from Prysmian Group
6. Drawing O38802251-01 –6SES-SP-2 One Line Diagram
7. Drawing O38802251-01 – 2SES-SP-2 One Line Diagram
8. Project # R.057890.003 Electrical Addendum #04
9. EGD Service Entrance Substation & Pump House Substation Upgrade Short Circuit and Coordination Study (2016-11-02)
10. Email from Ross Kirschbaum of Kohler confirming that generator damage curve is applicable to all Kohler Marathon alternators. (Received 2017-05-16)
11. Kohler Power Systems 750REOZMD diesel generator set rating and data sheets
12. Kohler Power Systems TIB-102 alternator data sheet
13. Photograph of circuit breaker feeding 6SES-SP-2
14. EATON Transformer Products Electrical Test Report for 25/12SES-2 transformer
15. EATON Cooper Power Series transformer nameplate drawing
16. Load bank description by Thomson Power Systems with accompanying photograph of load bank circuit breaker residing in 6SES-SP-0 (CCT#1)
17. Email forwarded by Chris Heesterman containing time-current characteristic curves and overcurrent settings for devices 25/12SES-PR-01, and 25/12SES-PR-12. (Received 2017-05-02)
18. Southwire Canada SIMpull RW90 Copper cable specification sheet
19. DWG 8410 High Voltage Single Line Sketch
20. IEEE 1584-2002 Guide for Performing Arc Flash Hazard Calculations
21. NFPA 70E-2015 for electrical safety in the workplace standards
22. CSA Z462-15 workplace electrical safety
23. First Issue review notes made by Ian Barnes of Applied Engineering Solutions Limited

4.0 Summary of Coordination Study Results

The EGD standby power generation is supplied by 3 generators rated at 825 kW each. These generators directly supply a 3MVA step-up transformer as well as a 600V bus tap to panel 6SES-SP-0 which feeds downstream 600V panel 6SES-SP-2. Each generator is protected by a single LSIG circuit breaker which is also operated by a Schweitzer 700G relay. In order to clear a fault in 6SES-SP-0, all three generator breakers must operate. For faults downstream of 6SES-SP-0, each circuit is protected by its own LSIG circuit breaker. On the 12kV side of the transformer is a circuit breaker which is operated by transformer protection.

4.1 Fault Data & Findings

The generator model was validated by comparing simulated fault values with those provided in manufacturer-issued alternator data sheet. The results of the validation are shown in the table below:

Fault Type	Simulation	Data Sheet	Error (%)
3P	9.58kA	9.73kA	1.5
LG	8.93	9.80kA	8.9
LL	6.12kA	6.50kA	5.8

The table shows 1.5% error between the simulated 3 phase fault and the data sheet value. Small discrepancy in values is acceptable because the fault currents provided in the alternator short circuit decrement curve were slightly different than rating values provided in the alternator data sheet. Using the impedance values provided and converting to 825kVA base resulted in a decrement curve very similar to the one provided by the manufacturer. Errors in the L-G fault levels can be attributed to assumptions made for zero sequence impedance values.

The maximum fault currents on the generator bus calculated in ETAP are shown below:

Fault Type	1 Generator	2 Generators	3 Generators
3P	9.25kA	18.42kA	27.75kA
LG	8.51kA	16.91kA	25.52kA
LL	5.97kA	11.89kA	17.90kA
LLG	10.37kA	20.58 kA	31.11kA

For a fault on 6SES-SP-0, the maximum currents are shown below:

Fault Type	1 Generator	2 Generators	3 Generators
3P	9.23kA	18.34kA	27.58kA
LG	8.48kA	16.81kA	25.30kA
LL	5.96kA	11.86kA	17.82kA
LLG	10.33kA	20.42kA	28.94kA

For a fault on 6SES-SP-2

Fault Type	1 Generator	2 Generators	3 Generators
3P	8.96kA	17.27kA	25.20kA
LG	8.14kA	15.53kA	22.48kA
LL	5.83kA	11.35kA	16.69kA
LLG	9.87kA	18.68kA	26.92kA

4.2 Coordination Study Findings

Coordination time intervals used in this study are based on the recommendations in IEEE 242-2001, the “IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems,” table 15-3 “minimum CTIs.” Specifically, the minimum coordination time interval between devices is as follows:

Between relays	0.2s
Between upstream relay and downstream L-V CB	0.12s
Between L-V CBs	Clear Space

This study was performed using the alternator data sheet provided by Kohler as well as a typical stator damage curve. To adequately protect the generator, it was not possible to support the energization inrush of T25/12SES-2 with one generator online. With two generators, it may be possible to support the inrush current; however, for best reliability, all three generators should be online when energizing the transformer. Overcurrent settings for the transformer protection 25/12SES-PR-01 P and 25/12SES-PR-01 S were provided to Nextgen via time-current characteristic curves. Our model shows that current settings are adequately protecting the transformer alongside any differential current sensing. One miscoordination that cannot be ameliorated with the existing equipment is between the generator protection and transformer protection for faults downstream of the transformer. This scenario will result in tripping of all online generators. While this adequately protects the transformer and generators, any loads connected to 6SES-SP-0 will also be dropped.

Generator protection settings which were provided by others were applied to our model, and show miscoordination with downstream devices. Furthermore, the current pick-up setting of 900 primary amps will trip the generator prior to reaching full load amps as indicated in the alternator data sheet. Current use of definite-time overcurrent settings provides protection against generator damage; however, using time-overcurrent elements would improve possibility of downstream coordination. Unless system characteristics require the proposed protection scheme for the generators, it is recommended that the generator settings be revisited by others. Please refer to Appendix A for single line diagram used in ETAP model, and Appendix B for time current characteristic plots.

4.3 Protection Settings

Device	Recommended Settings
CB G1	**Phase:** Long-Time Pickup: 0.85 LT Band: 0.5 Short-Time Pickup: 2.5 ST Band: 0.2 $(I^x)t$ = out **Ground:** Ground Pickup: J Ground Band: 0.4 $(I^x)t$ = out
CB G2	**Phase:** Long-Time Pickup: 0.85 LT Band: 0.5 Short-Time Pickup: 2.5 ST Band: 0.2 $(I^x)t$ = out **Ground:** Ground Pickup: J Ground Band: 0.4 $(I^x)t$ = out
CB G3	**Phase:** Long-Time Pickup: 0.85 LT Band: 0.5 Short-Time Pickup: 2.5 ST Band: 0.2 $(I^x)t$ = out **Ground:** Ground Pickup: J Ground Band: 0.4 $(I^x)t$ = out
CB 6SES-SP-2	**Phase:** Long-Time Pickup: 0.75 LT Band: 0.5 Short-Time Pickup: 1.5 ST Band: 0 $(I^x)t$ = out Instantaneous Pickup: 2 **Ground:** Ground Pickup: E Ground Band: 0.1 $(I^x)t$ = out
CB Load Bus	**Phase:** Long-Time Pickup: 0.8 LT Band: 0.5 Short-Time Pickup: 1.5 ST Band: 0 $(I^x)t$ = out Inst Pickup: 2 **Ground:** Ground Pickup: F Ground Band: 0.1 $(I^x)t$ = out

5.0 Summary of Arc Flash Study Results

Electrical arcing is the designation of current that passes through vapour of the arc terminal which consists of metal or carbon material. Electrical arcs produce extremely high temperatures and expulsion of molten material to the surroundings, and can result in serious or fatal burns for personnel within 10 feet. Due to the number of injuries arising from electrical malfunctions, studies have been conducted to characterize the effects of arcs, whether in open air or cubic box. IEEE has made available an empirically derived model to determine incident energy in systems with voltages in the range of 208V – 15000V, three phase. Above this range, a theoretical model is available; however, the scope of this study covers equipment that falls in the empirical model range.

The objective of this study is to calculate the worst-case arc flash incident energy levels and arc flash boundaries for the Esquimalt Graving Dock Standby Generation System, and produce data for arc flash hazard warning labels to be installed on equipment. Production and installation of labels is to be done by others.

To calculate the arcing current for systems with voltage under 1000V, the following equation (1) can be used:

$$\lg II_a = K + 0.662 \lg I_{bf} + 0.0966\,V + -.000526\,G + 0.5588\,V(\lg I_{bf}) - 0.00304\,G\,(lgI_{bf})$$

Where

lg	is the $\log_{10}$
I_a	is arcing current (kA)
K	is -0.153 for open configurations and -0.097 for box configurations
I_{bf}	is bolted fault current for three-phase faults (symmetrical RMS)(kA)
V	is system voltage (kV)
G	is the gap between conductors, (mm)

For systems with voltage over 1000V, the following equation (2) can be used:

$$\lg II_a = 0.00402 + 0.983 \lg I_{bf}$$

Calculating a second arc current of 85% I_a is used to determine the duration of a second arc current.

Incident energy is calculated by first finding the $\log_{10}$ of the incident energy based on normalized data for a 0.2 second arc and 610mm distance to the person as follows in equation (3):

$$\lg E_n = K_1 + K_2 + 1.081 \lg I_a + 0.0011\,G$$

Where

E_n	is incident energy (J/cm^2) normalized for time and distance
K_1	is -0.792 for open configurations (no enclosure) and -0.555 for box configurations (enclosed)
K_2	is 0 for ungrounded and high-resistance grounded systems and -0.113 for grounded systems
G	is the gap between conductors, (mm)

Then use equation (4) to convert from log:

$$E_n = 10^{\lg E_n}$$

And finally convert from the normalized values as follows using equation (5):

$$E = C_f E_n + \left(\frac{t}{0.2}\right)\left(\frac{610^x}{D^x}\right)$$

Where

E	is incident energy (cal/cm^2)
C_f	is a factor 1.0 for voltage above 1kV and 1.5 for below
t	is arcing time (seconds)
D	is distance from the arc point to the person (mm)
x	is the distance exponent from table (1)

System Voltage (kV)	Equipment Type	Typical Gap	x Factor
0.208 - 1	Open Air	10-40	2.000
	Switchgear	32	1.473
	MCC and Panel	25	1.641
	Cable	13	2.000
>1 – 5	Open Air	102	2.000
	Switchgear	13-102	0.973
	Cable	13	2.000
>5 – 15	Open Air	13-153	2.000
	Switchgear	153	0.973
	Cable	13	2.000

To determine the flash protection, use the following equation (6):

$$D_B = \left[C_f E_n + \left(\frac{t}{0.2}\right)\left(\frac{610^x}{E_B}\right)\right]^{\frac{1}{x}}$$

Where

E_B is set at 1.2 cal/cm^2 for bare skin or at the rating for proposed PPE.
D_B is the distance of the boundary from arcing point in mm

To classify the equipment in each bus, the following table (2) which is provided by IEEE 1584-2002 was used. Standard classes of equipment and bus-to-bus gaps are used to facilitate selection of the correct equations.

Equipment Class	Typical Bus Gaps (mm)
15kV Switchgear	152
5kV Switchgear	104
Low-Voltage Switchgear	32
Low-Voltage MCCs and Panelboards	25
Cable	13
Other	Not Required

Arc flash protection is based on the amount of incident energy on a person's face and body at working distance, and not the energy on the arms and hands. The severity of injury depends on the total percentage of burned skin, and the head and torso not only comprises a large percentage of a person's skin, but also results in more severe life-threatening conditions as compared to burns in the extremities. The following table (3) is provided by IEEE for determining working distance based on equipment class.

Equipment Class	Typical Working Distance (mm)
15kV Switchgear	910
5kV Switchgear	910
Low-Voltage Switchgear	610
Low-Voltage MCCs and Panelboards	455
Cable	455
Other	Determine in Field

For the 600V equipment, a working distance of 455mm was selected in abidance with the 300mm restricted approach boundary listed in CSA Z462-15 Table 1A. Since work must take place in front of the worker's body, an allowance for partially outstretched arm/hands was added to arrive at 455mm. Although actual working distance may be greater than 455mm, this distance provides a conservative incident energy result.

ETAP version 16.1.0 was used for arc flash analysis based on the coordination study model. The IEEE 1584-2001 recommended empirical method was used in ETAP to calculate incident energy and arc flash boundary. ETAP follows NFPA 70E-2105 and CSA Z462-15 standards. Please refer to Appendix C for arc flash warning labels.

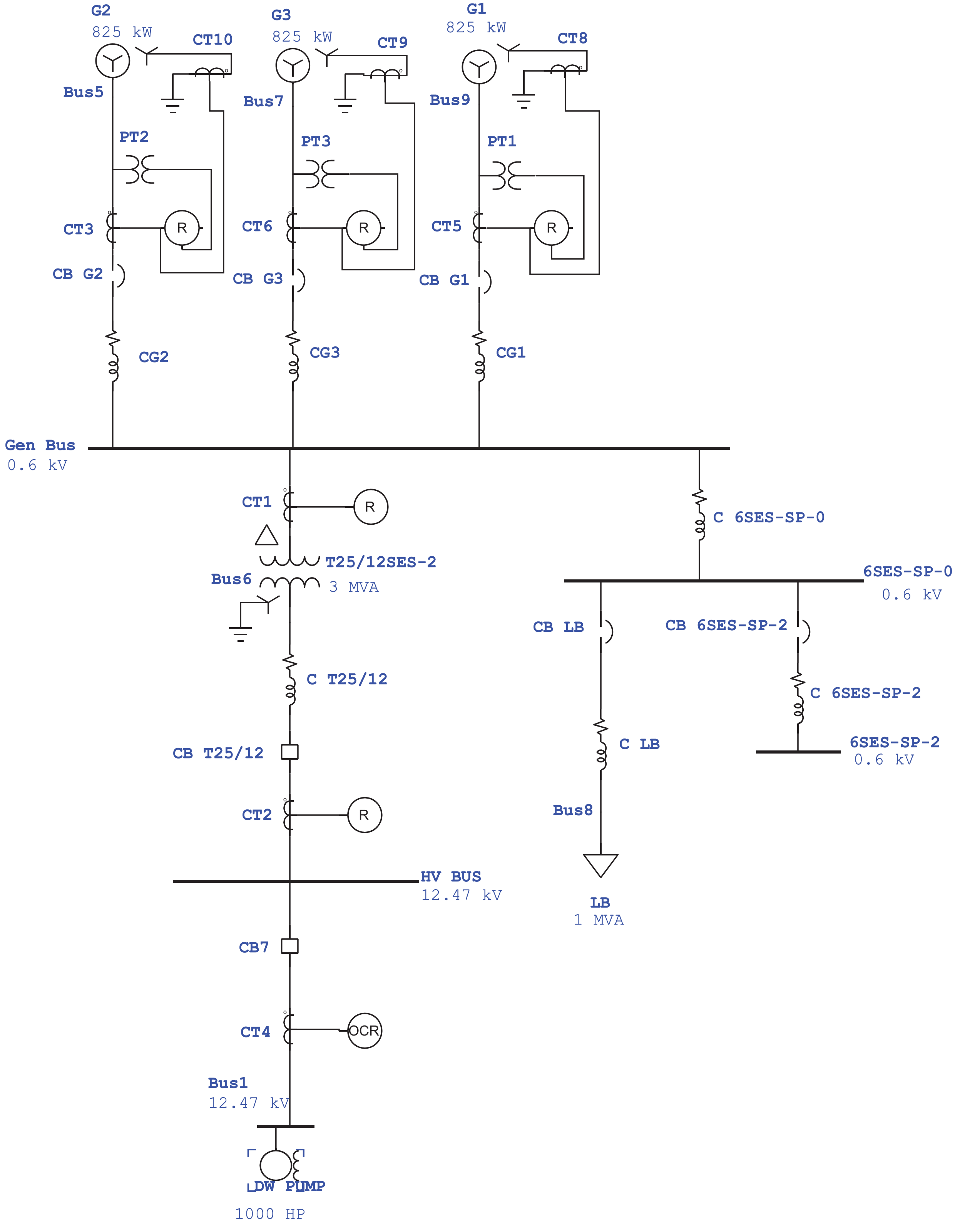
5.1 Arc Flash Study Findings

The results of the arc flash study are shown below:

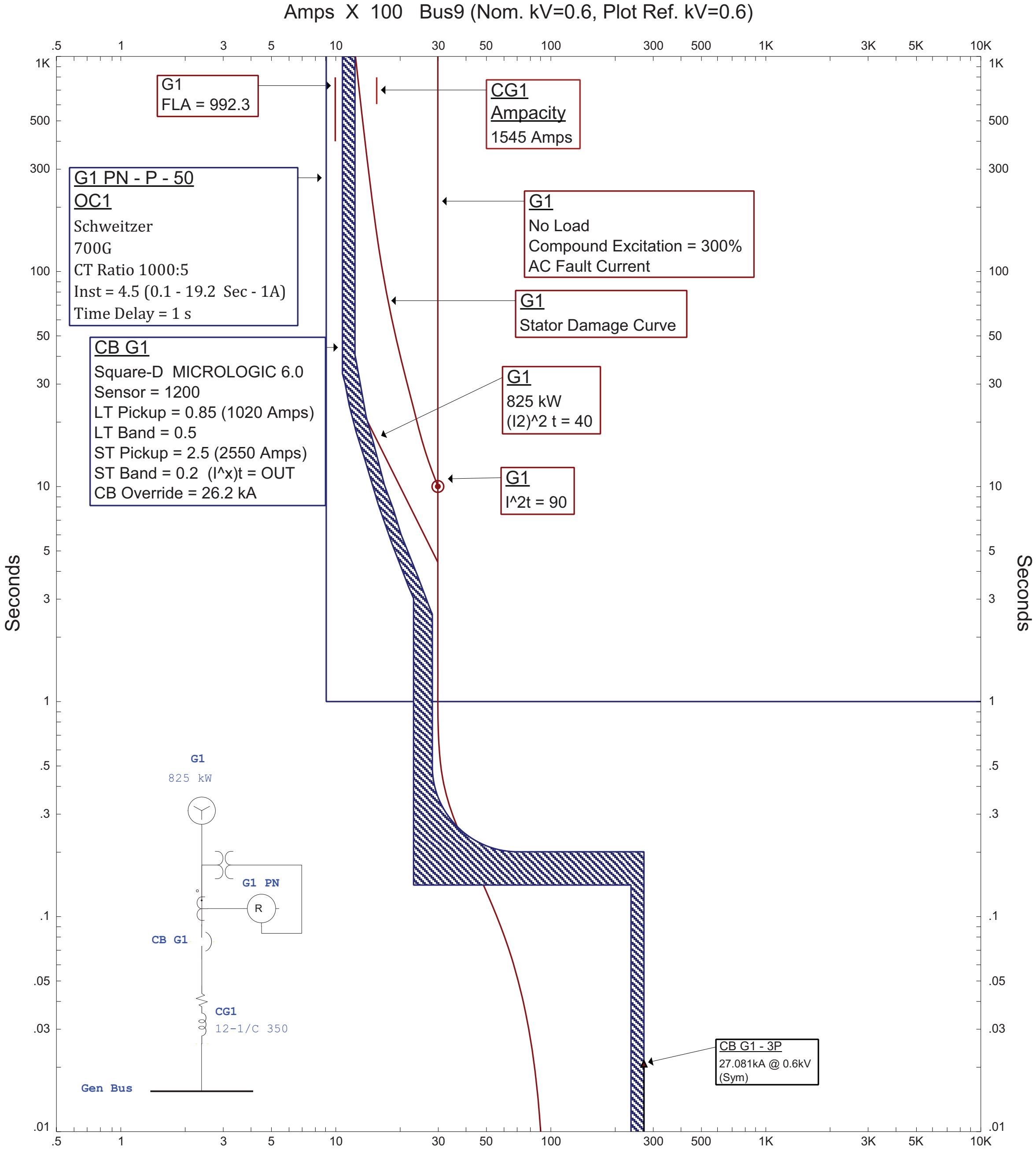
Case	**Cubicle/Panel**	**Incident Energy (cal/cm^2)**	**Arc Flash Boundary (m)**
1 Generator	6SES-SP-0	4.77	1.08
	6SES-SP-2	1.16	0.46
1 Generator & 250HP Motor	6SES-SP-0	5.40	1.14
	6SES-SP-2	1.30	0.48
2 Generators	6SES-SP-0	9.41	1.61
	6SES-SP-2	2.21	0.67
2 Generators & 1000HP Motor	6SES-SP-0	11.81	1.84
	6SES-SP-2	2.74	0.76
3 Generators	6SES-SP-0	14.08	2.04
	6SES-SP-2	3.21	0.82
3 Generators & 1000HP Motor	6SES-SP-0	16.52	2.26
	6SES-SP-2	3.71	0.91

The medium voltage bus arc flash ratings will change based on generator supply and must be revisited by others. Applied Engineering Solutions Limited conducted a review of the impact of downstream motors on the arc flash incident energies, and determined that there would not be a substantial change to the results. Simulations using typical synchronous motor dynamic characteristics show that in the worst case with all three generators and the 1000HP dewatering motor online, the arc flash incident energies at 6SES-SP-0 and 6SES-SP-2 are 16.5cal/cm^2 and 3.71cal/cm^2 respectively. With the motor out of service, the incident energies drop slightly to 14.08cal/cm^2 and 3.21cal/cm^2.

Appendix A: ETAP Single Line Diagram


G2
825 kW
CT10
G3
825 kW
CT9
G1
825 kW
CT8
Bus5
Bus7
Bus9
PT2
PT3
PT1
CT3
R
CT6
R
CT5
R
CB G2
CB G3
CB G1
CG2
CG3
CG1
Gen Bus
0.6 kV
CT1
R
C 6SES-SP-0
T25/12SES-2
Bus6
3 MVA
6SES-SP-0
0.6 kV
CB LB
CB 6SES-SP-2
C T25/12
C 6SES-SP-2
C LB
6SES-SP-2
0.6 kV
CB T25/12
CT2
R
Bus8
HV BUS
12.47 kV
LB
1 MVA
CB7
CT4
OCR
Bus1
12.47 kV
DW PUMP
1000 HP

Appendix B: Time Current Characteristic Plots

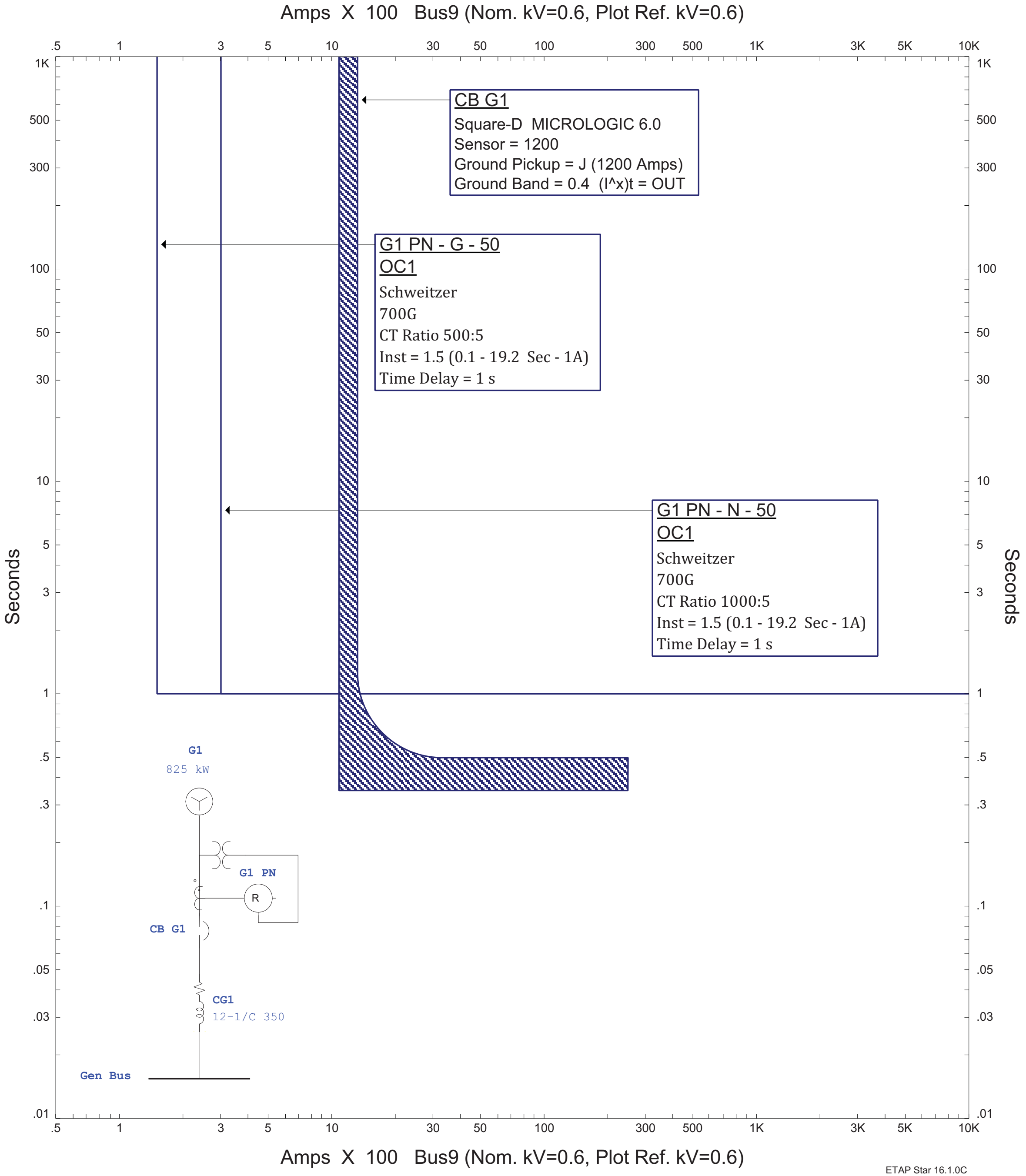


ETAP Star 16.1.0C

G1 to Gen Bus

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 05-11-2017
Fault: Phase

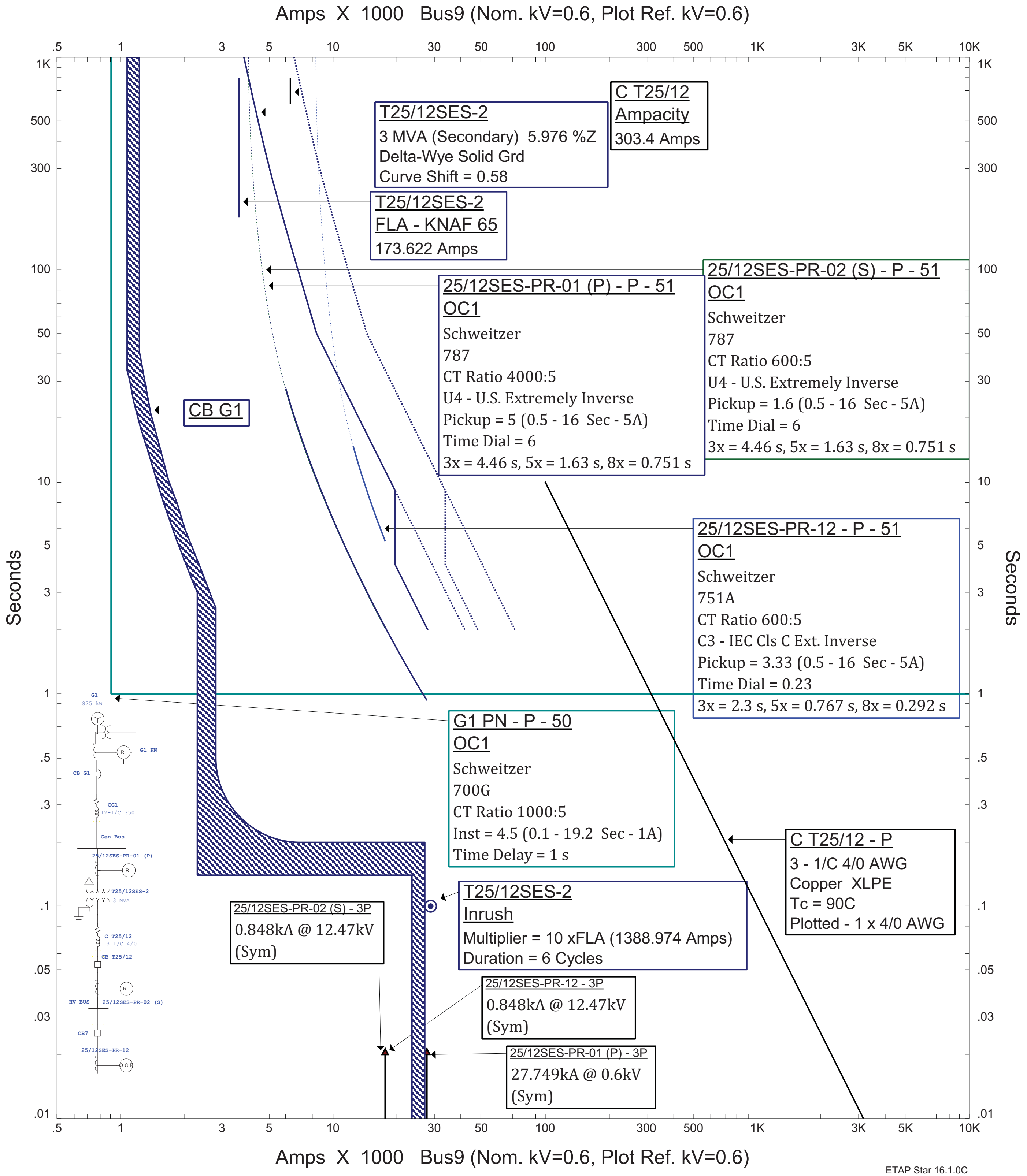


ETAP Star 16.1.0C

G1 to Gen Bus

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 05-11-2017
Fault: Ground



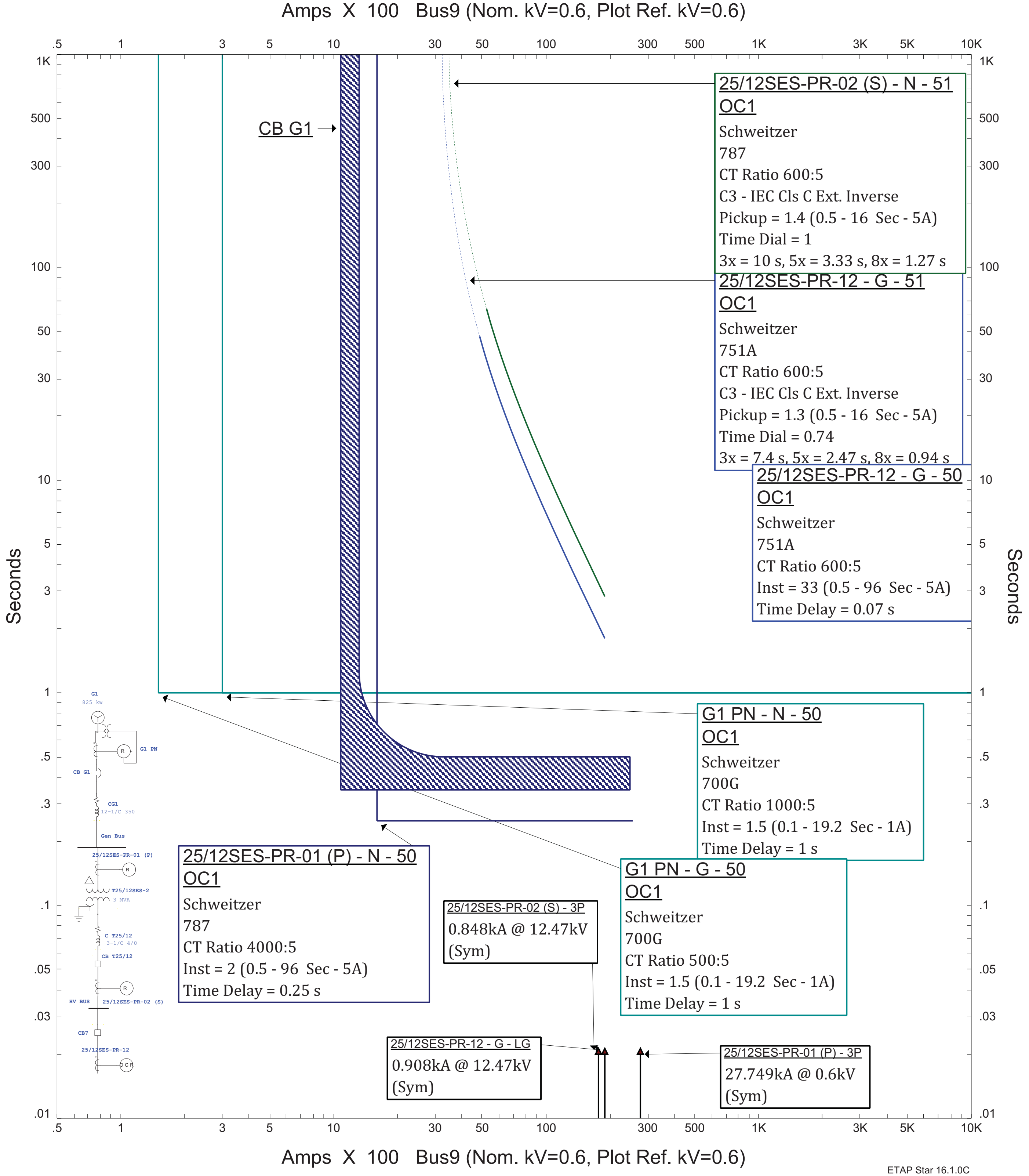
ETAP Star 16.1.0C

G1 to HV Bus

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 05-16-2017
Fault: Phase



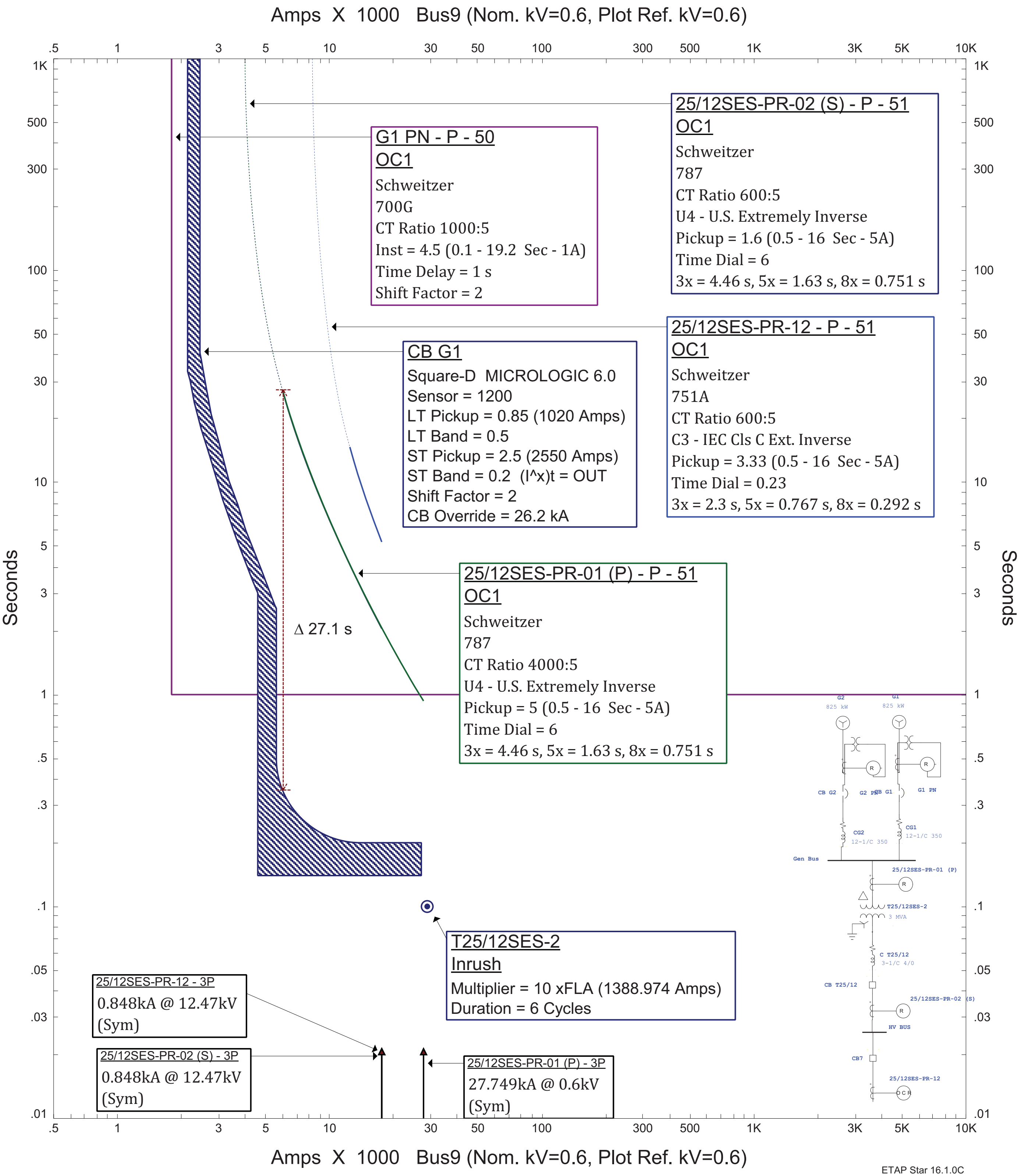
ETAP Star 16.1.0C

G1 to HV Bus

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 05-16-2017
Fault: Ground



25/12SES-PR-02 (S) - P - 51
OC1
Schweitzer
787
CT Ratio 600:5
U4 - U.S. Extremely Inverse
Pickup = 1.6 (0.5 - 16 Sec - 5A)
Time Dial = 6
3x = 4.46 s, 5x = 1.63 s, 8x = 0.751 s

G1 PN - P - 50
OC1
Schweitzer
700G
CT Ratio 1000:5
Inst = 4.5 (0.1 - 19.2 Sec - 1A)
Time Delay = 1 s
Shift Factor = 2

25/12SES-PR-12 - P - 51
OC1
Schweitzer
751A
CT Ratio 600:5
C3 - IEC Cls C Ext. Inverse
Pickup = 3.33 (0.5 - 16 Sec - 5A)
Time Dial = 0.23
3x = 2.3 s, 5x = 0.767 s, 8x = 0.292 s

CB G1
Square-D MICROLOGIC 6.0
Sensor = 1200
LT Pickup = 0.85 (1020 Amps)
LT Band = 0.5
ST Pickup = 2.5 (2550 Amps)
ST Band = 0.2 (I^x)t = OUT
Shift Factor = 2
CB Override = 26.2 kA

25/12SES-PR-01 (P) - P - 51
OC1
Schweitzer
787
CT Ratio 4000:5
U4 - U.S. Extremely Inverse
Pickup = 5 (0.5 - 16 Sec - 5A)
Time Dial = 6
3x = 4.46 s, 5x = 1.63 s, 8x = 0.751 s

T25/12SES-2
Inrush
Multiplier = 10 xFLA (1388.974 Amps)
Duration = 6 Cycles

25/12SES-PR-12 - 3P
0.848kA @ 12.47kV
(Sym)

25/12SES-PR-02 (S) - 3P
0.848kA @ 12.47kV
(Sym)

25/12SES-PR-01 (P) - 3P
27.749kA @ 0.6kV
(Sym)

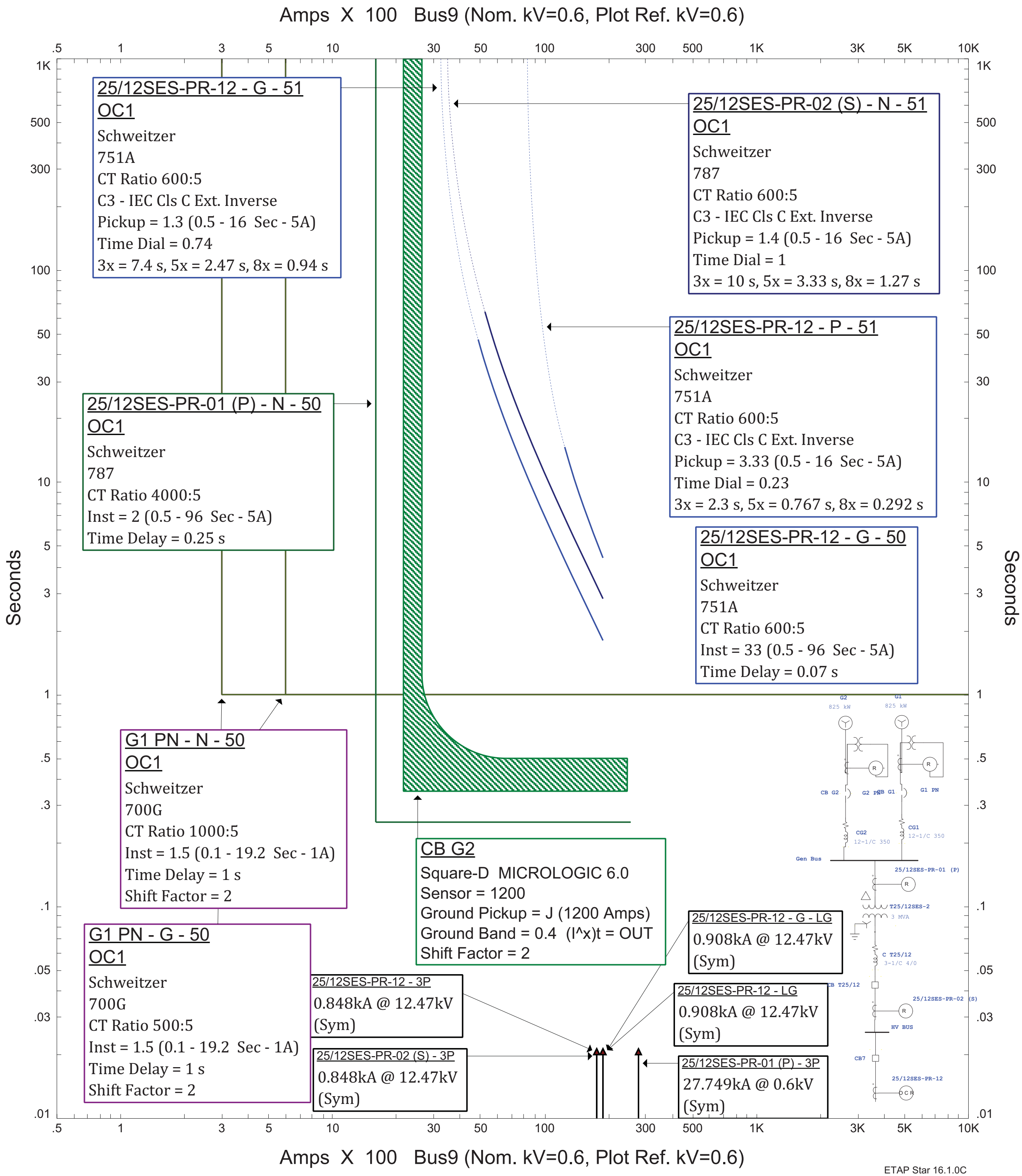
ETAP Star 16.1.0C

G1-G2 to HV Bus

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 05-16-2017
Fault: Phase



25/12SES-PR-12 - G - 51
OC1
Schweitzer
751A
CT Ratio 600:5
C3 - IEC Cls C Ext. Inverse
Pickup = 1.3 (0.5 - 16 Sec - 5A)
Time Dial = 0.74
3x = 7.4 s, 5x = 2.47 s, 8x = 0.94 s

25/12SES-PR-02 (S) - N - 51
OC1
Schweitzer
787
CT Ratio 600:5
C3 - IEC Cls C Ext. Inverse
Pickup = 1.4 (0.5 - 16 Sec - 5A)
Time Dial = 1
3x = 10 s, 5x = 3.33 s, 8x = 1.27 s

25/12SES-PR-12 - P - 51
OC1
Schweitzer
751A
CT Ratio 600:5
C3 - IEC Cls C Ext. Inverse
Pickup = 3.33 (0.5 - 16 Sec - 5A)
Time Dial = 0.23
3x = 2.3 s, 5x = 0.767 s, 8x = 0.292 s

25/12SES-PR-01 (P) - N - 50
OC1
Schweitzer
787
CT Ratio 4000:5
Inst = 2 (0.5 - 96 Sec - 5A)
Time Delay = 0.25 s

25/12SES-PR-12 - G - 50
OC1
Schweitzer
751A
CT Ratio 600:5
Inst = 33 (0.5 - 96 Sec - 5A)
Time Delay = 0.07 s

G1 PN - N - 50
OC1
Schweitzer
700G
CT Ratio 1000:5
Inst = 1.5 (0.1 - 19.2 Sec - 1A)
Time Delay = 1 s
Shift Factor = 2

CB G2
Square-D MICROLOGIC 6.0
Sensor = 1200
Ground Pickup = J (1200 Amps)
Ground Band = 0.4 (I^x)t = OUT
Shift Factor = 2

G1 PN - G - 50
OC1
Schweitzer
700G
CT Ratio 500:5
Inst = 1.5 (0.1 - 19.2 Sec - 1A)
Time Delay = 1 s
Shift Factor = 2

25/12SES-PR-12 - G - LG
0.908kA @ 12.47kV
(Sym)

25/12SES-PR-12 - 3P
0.848kA @ 12.47kV
(Sym)

25/12SES-PR-12 - LG
0.908kA @ 12.47kV
(Sym)

25/12SES-PR-02 (S) - 3P
0.848kA @ 12.47kV
(Sym)

25/12SES-PR-01 (P) - 3P
27.749kA @ 0.6kV
(Sym)

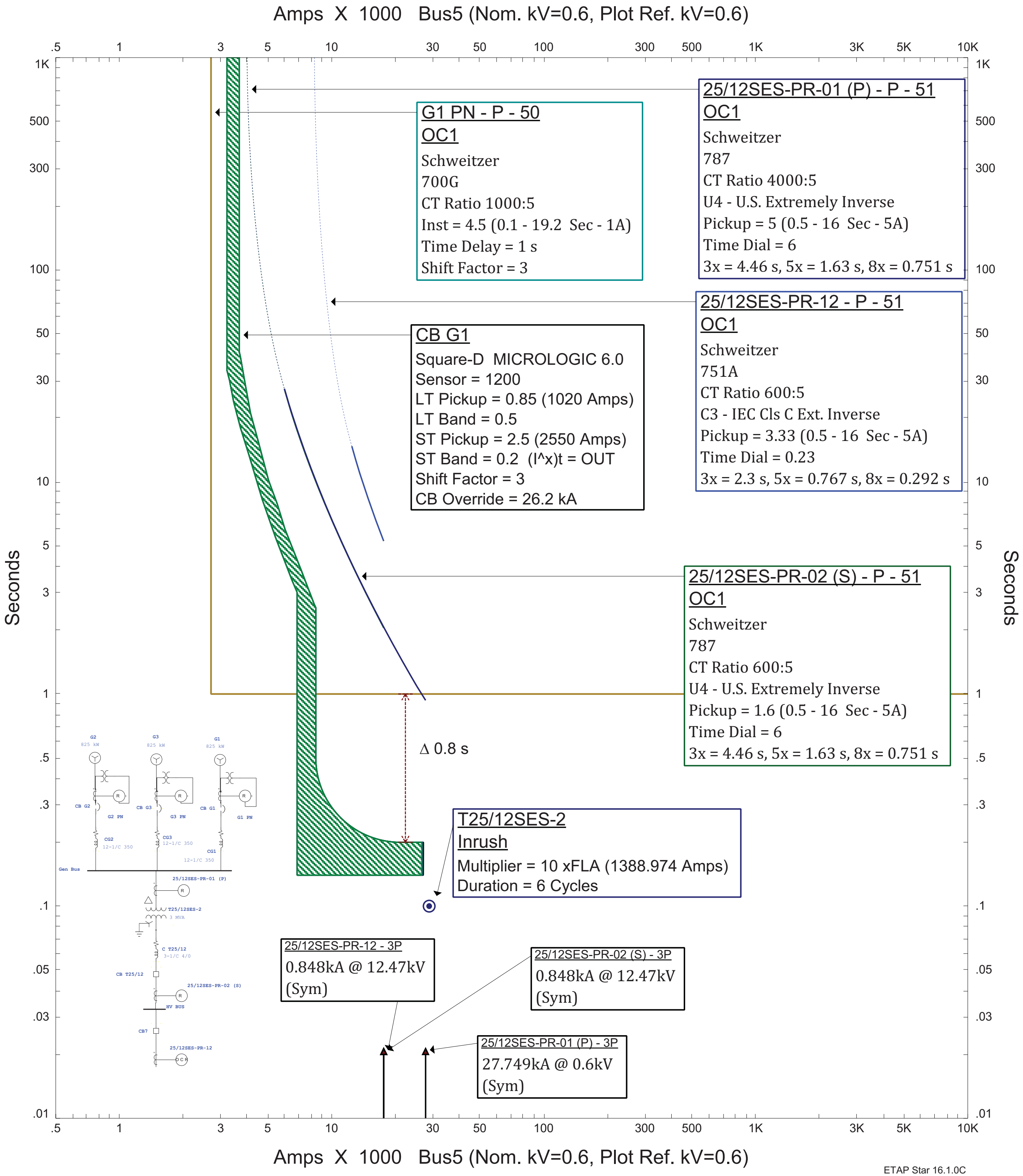
ETAP Star 16.1.0C

G1-G2 to HV Bus

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 05-16-2017
Fault: Ground



25/12SES-PR-01 (P) - P - 51
OC1
Schweitzer
787
CT Ratio 4000:5
U4 - U.S. Extremely Inverse
Pickup = 5 (0.5 - 16 Sec - 5A)
Time Dial = 6
3x = 4.46 s, 5x = 1.63 s, 8x = 0.751 s

G1 PN - P - 50
OC1
Schweitzer
700G
CT Ratio 1000:5
Inst = 4.5 (0.1 - 19.2 Sec - 1A)
Time Delay = 1 s
Shift Factor = 3

25/12SES-PR-12 - P - 51
OC1
Schweitzer
751A
CT Ratio 600:5
C3 - IEC Cls C Ext. Inverse
Pickup = 3.33 (0.5 - 16 Sec - 5A)
Time Dial = 0.23
3x = 2.3 s, 5x = 0.767 s, 8x = 0.292 s

CB G1
Square-D MICROLOGIC 6.0
Sensor = 1200
LT Pickup = 0.85 (1020 Amps)
LT Band = 0.5
ST Pickup = 2.5 (2550 Amps)
ST Band = 0.2 (I^x)t = OUT
Shift Factor = 3
CB Override = 26.2 kA

25/12SES-PR-02 (S) - P - 51
OC1
Schweitzer
787
CT Ratio 600:5
U4 - U.S. Extremely Inverse
Pickup = 1.6 (0.5 - 16 Sec - 5A)
Time Dial = 6
3x = 4.46 s, 5x = 1.63 s, 8x = 0.751 s

T25/12SES-2
Inrush
Multiplier = 10 xFLA (1388.974 Amps)
Duration = 6 Cycles

25/12SES-PR-12 - 3P
0.848kA @ 12.47kV
(Sym)

25/12SES-PR-02 (S) - 3P
0.848kA @ 12.47kV
(Sym)

25/12SES-PR-01 (P) - 3P
27.749kA @ 0.6kV
(Sym)

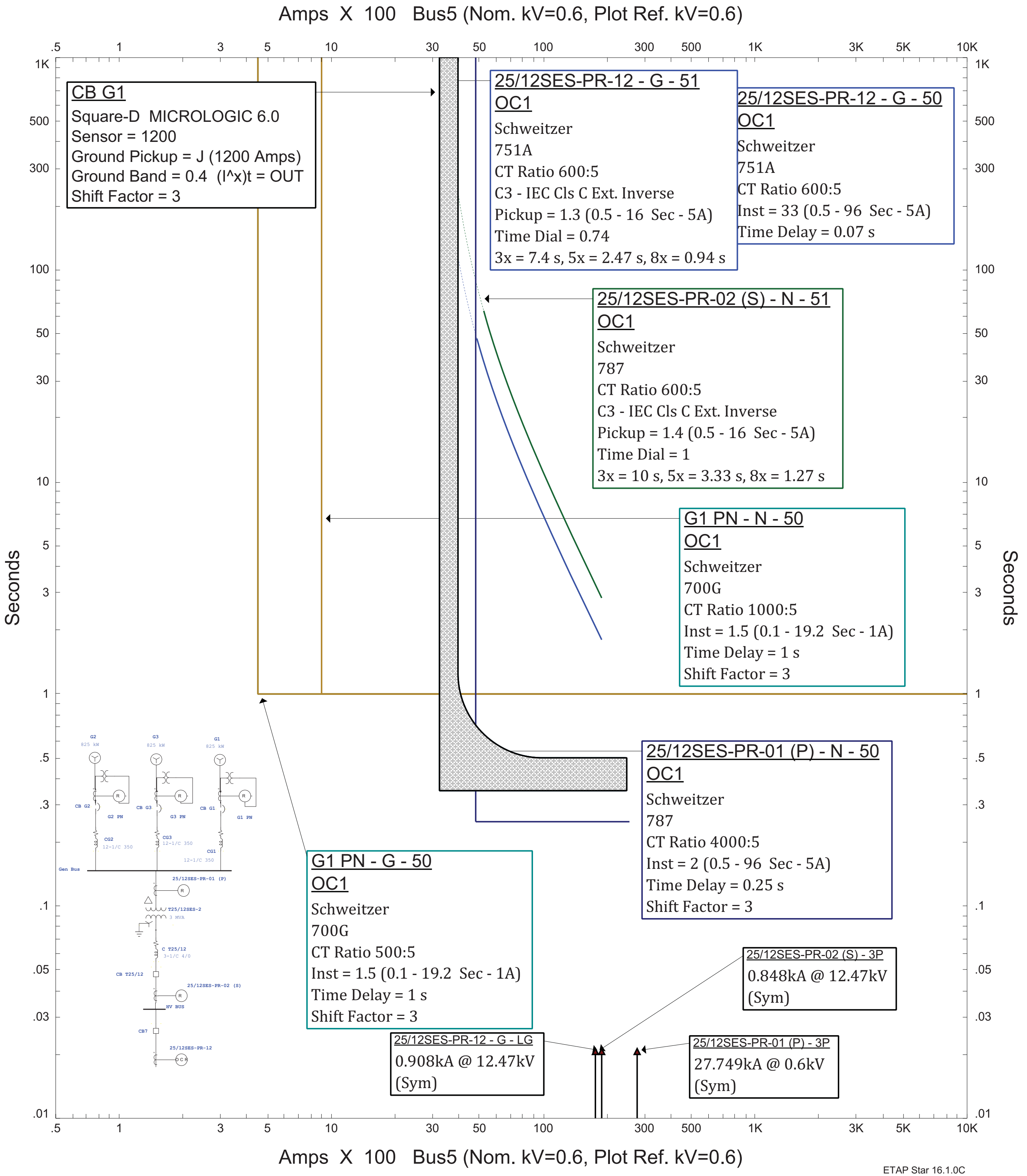
ETAP Star 16.1.0C

G1-G3 to HV Bus

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

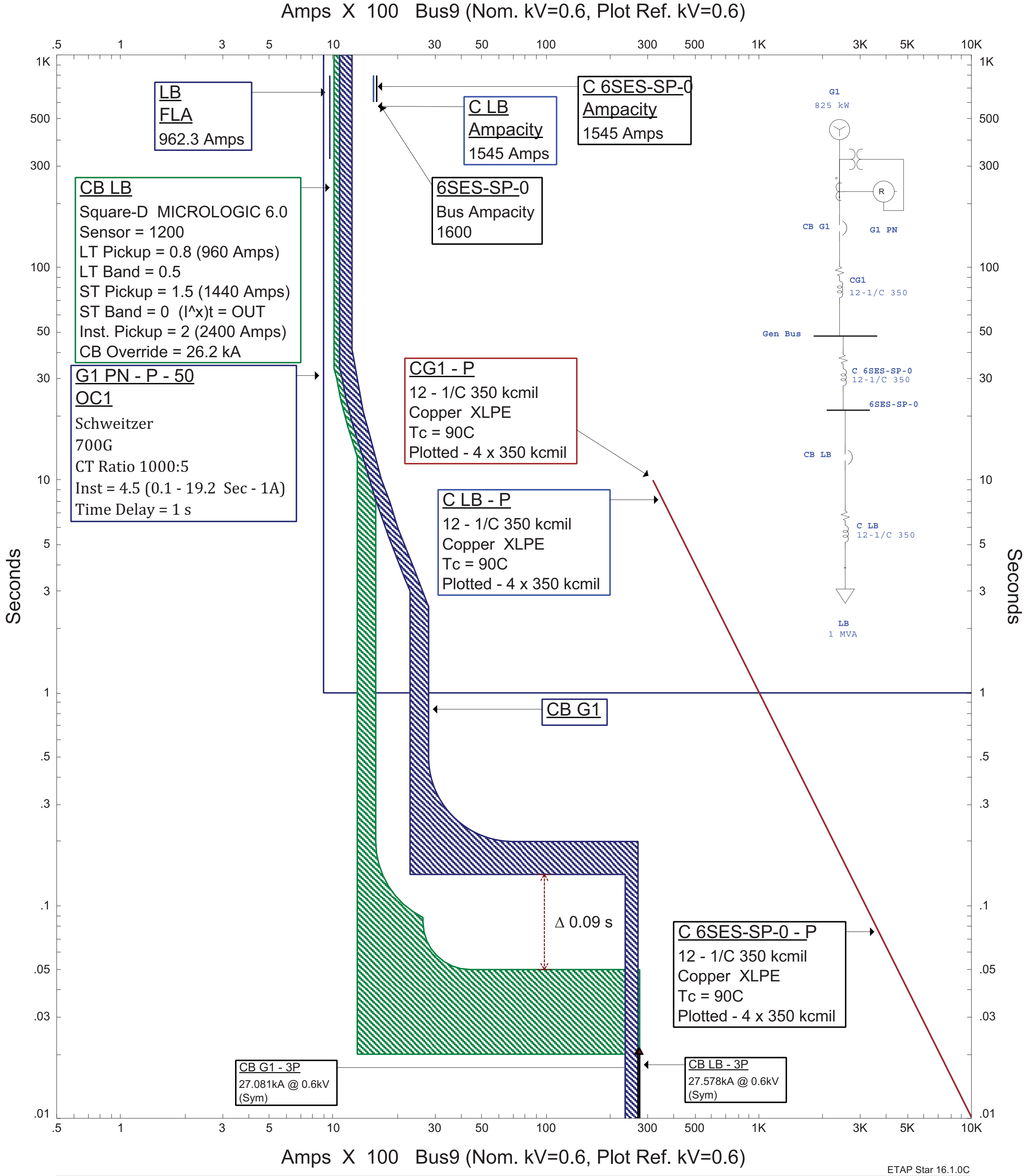
Date: 05-17-2017
Fault: Phase



G1-G3 to HV Bus

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 05-17-2017
Fault: Ground

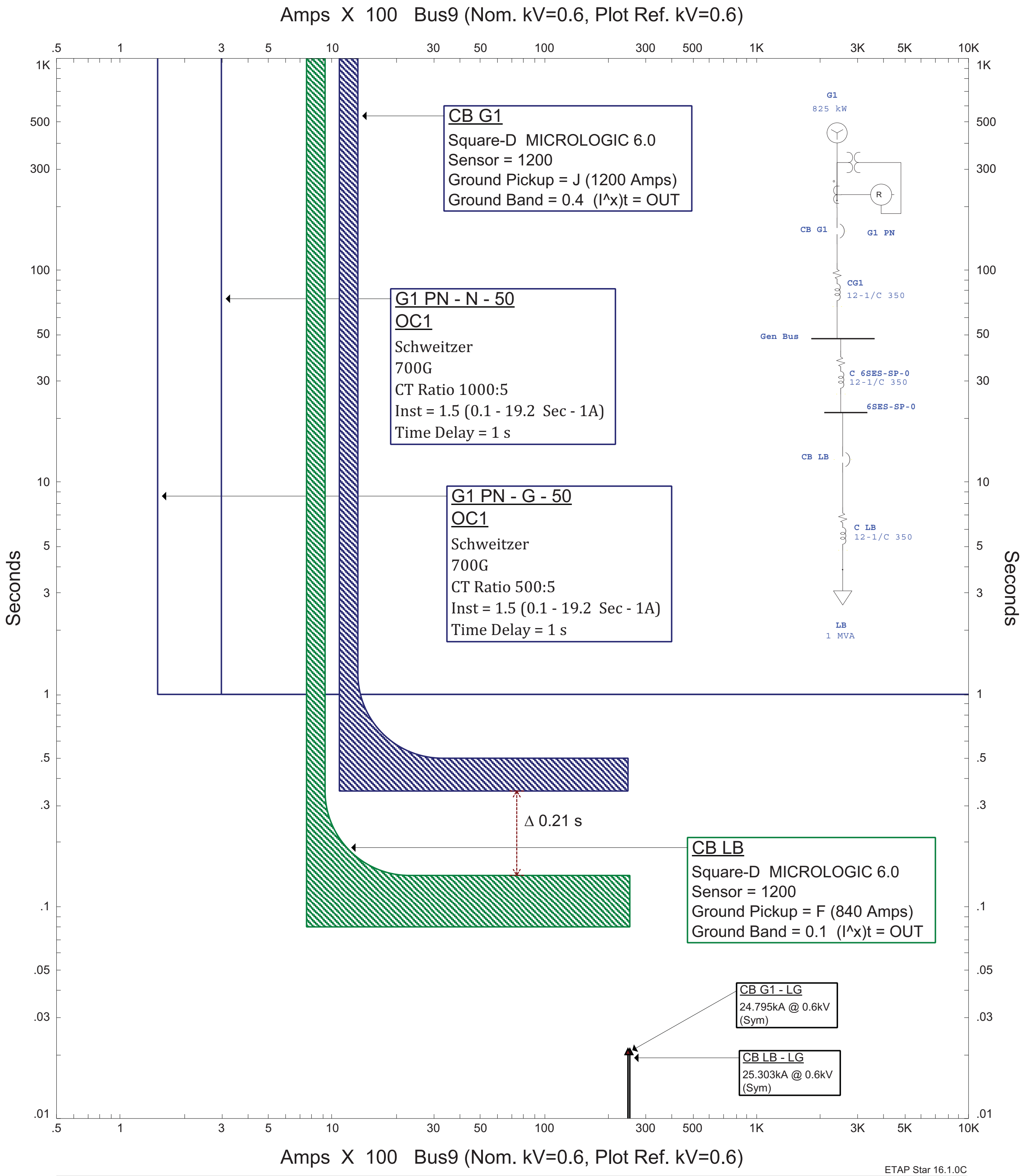


ETAP Star 16.1.0C

G1 to LB

Project: EGD Standby Power
Location: Esquimalt BC
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Phase

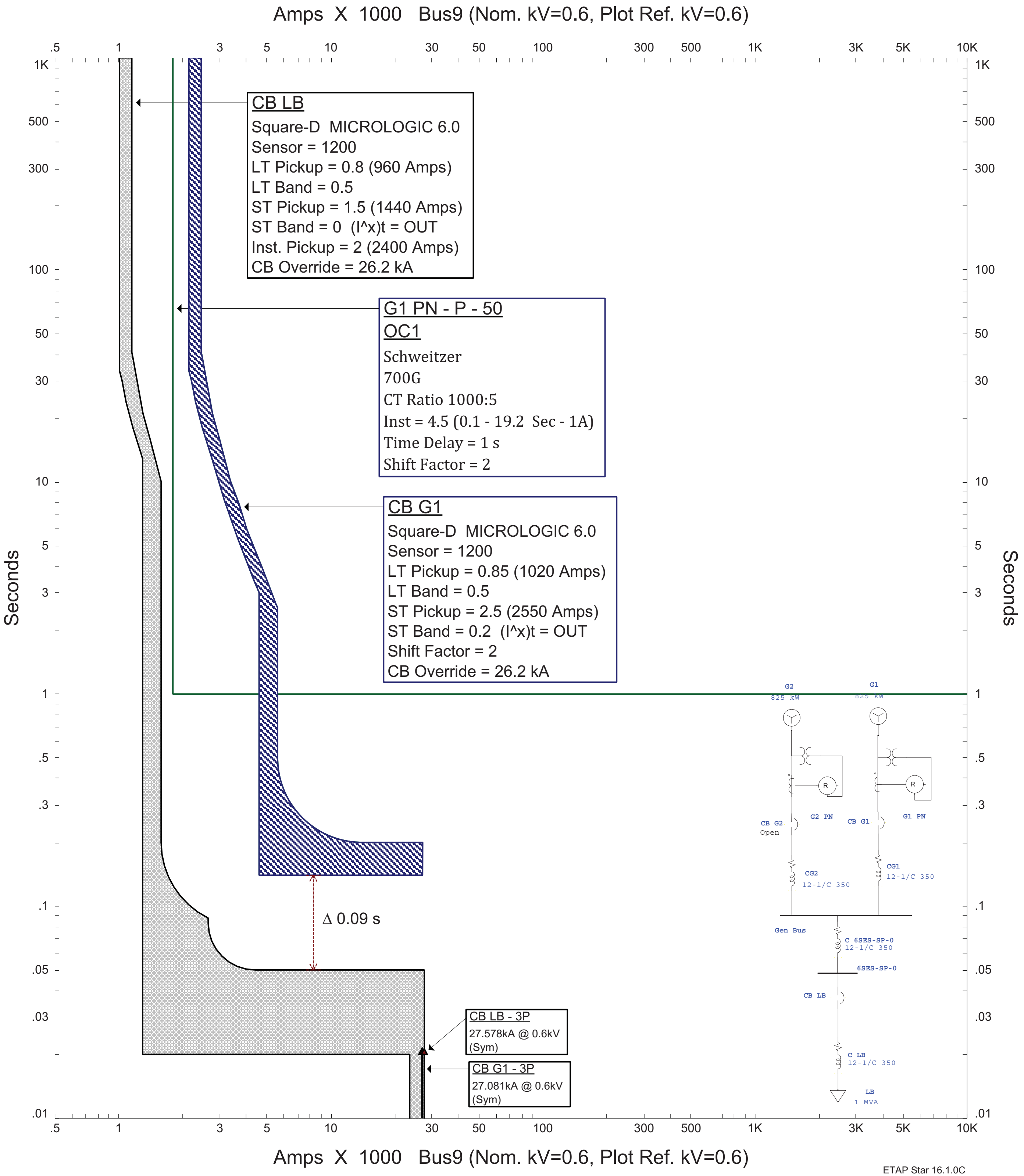


ETAP Star 16.1.0C

G1 to LB

Project: EGD Standby Power
Location: Esquimalt BC
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Ground



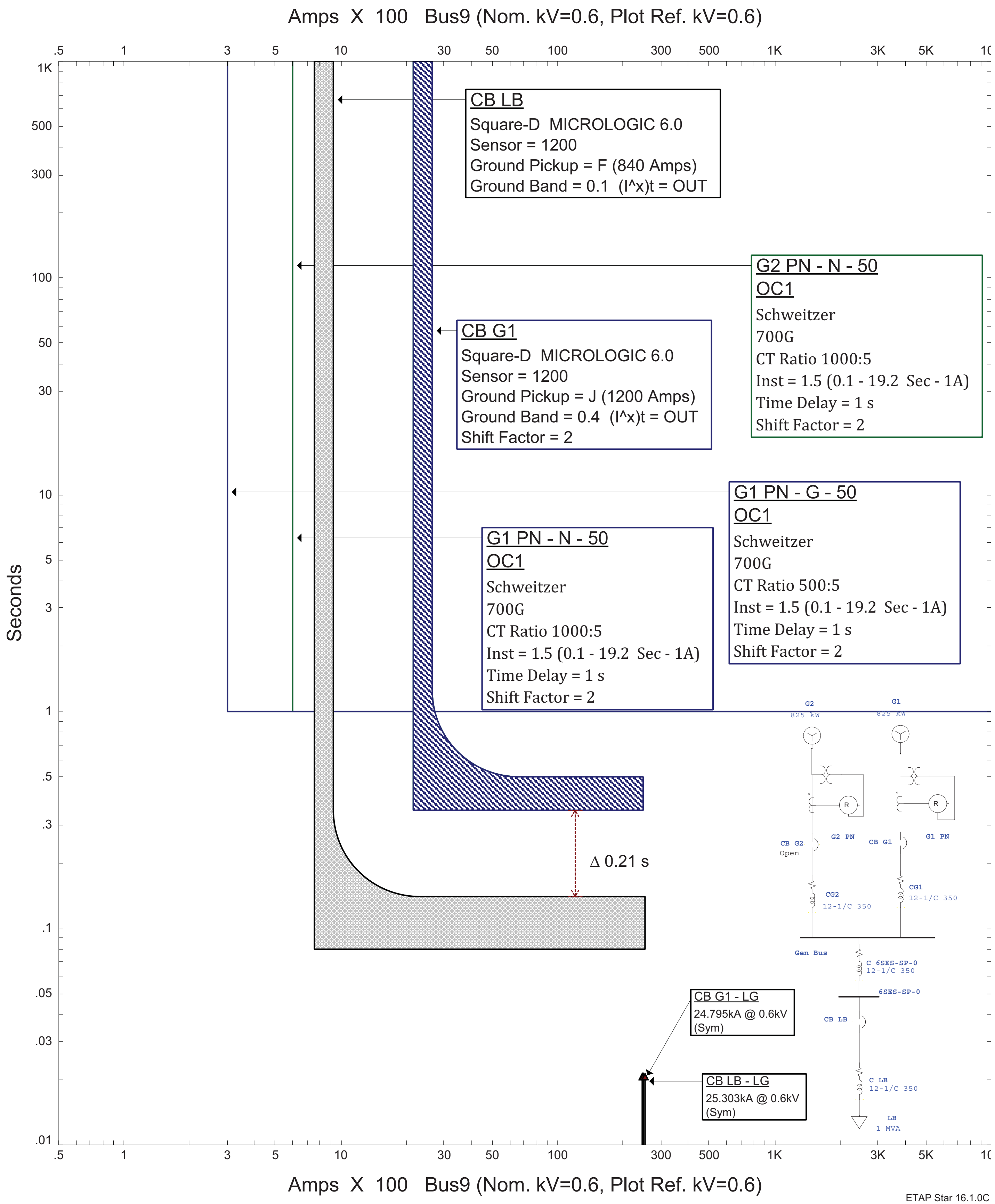
ETAP Star 16.1.0C

G1-G2 to LB

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Phase



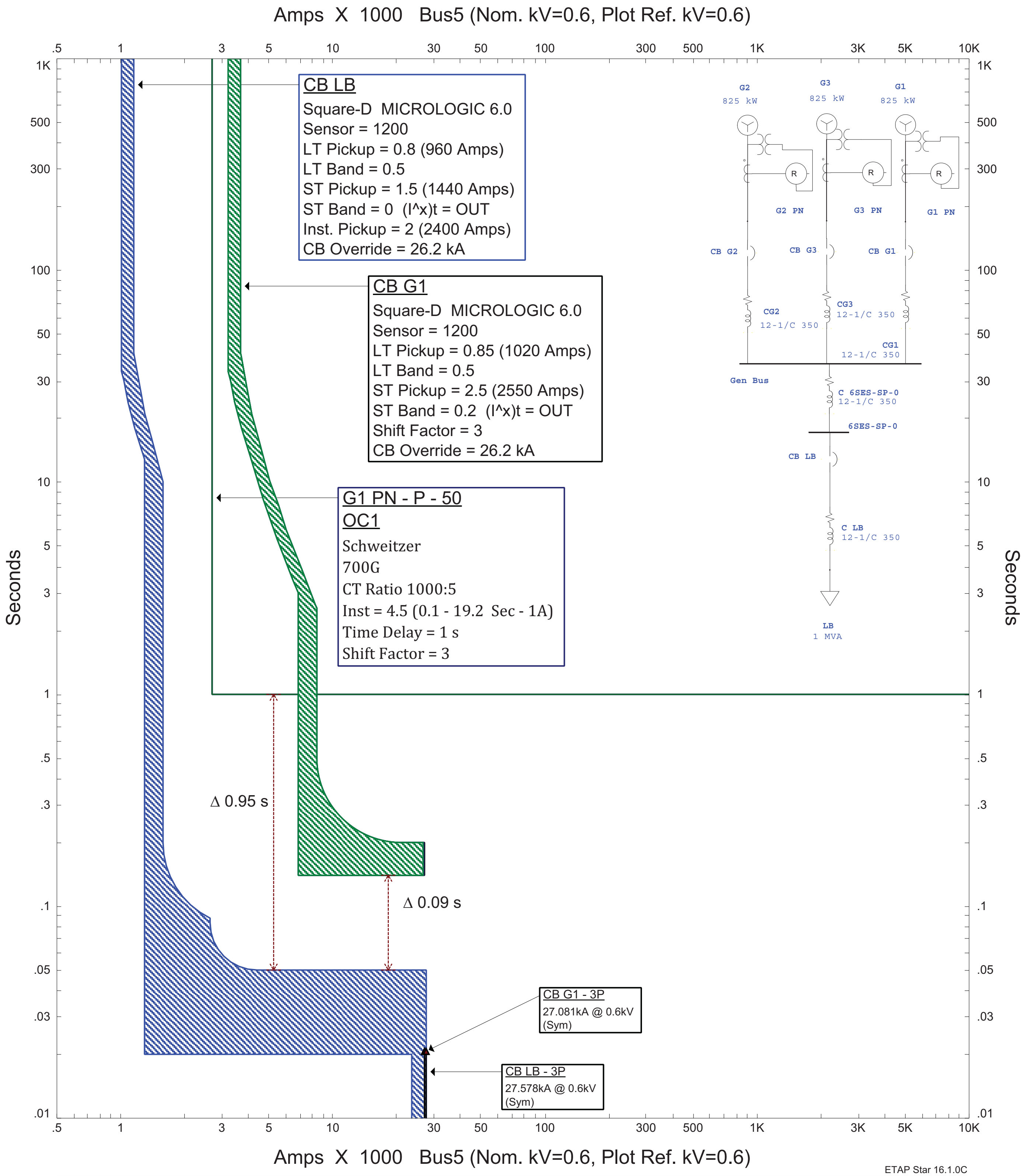
ETAP Star 16.1.0C

G1-G2 to LB

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Ground



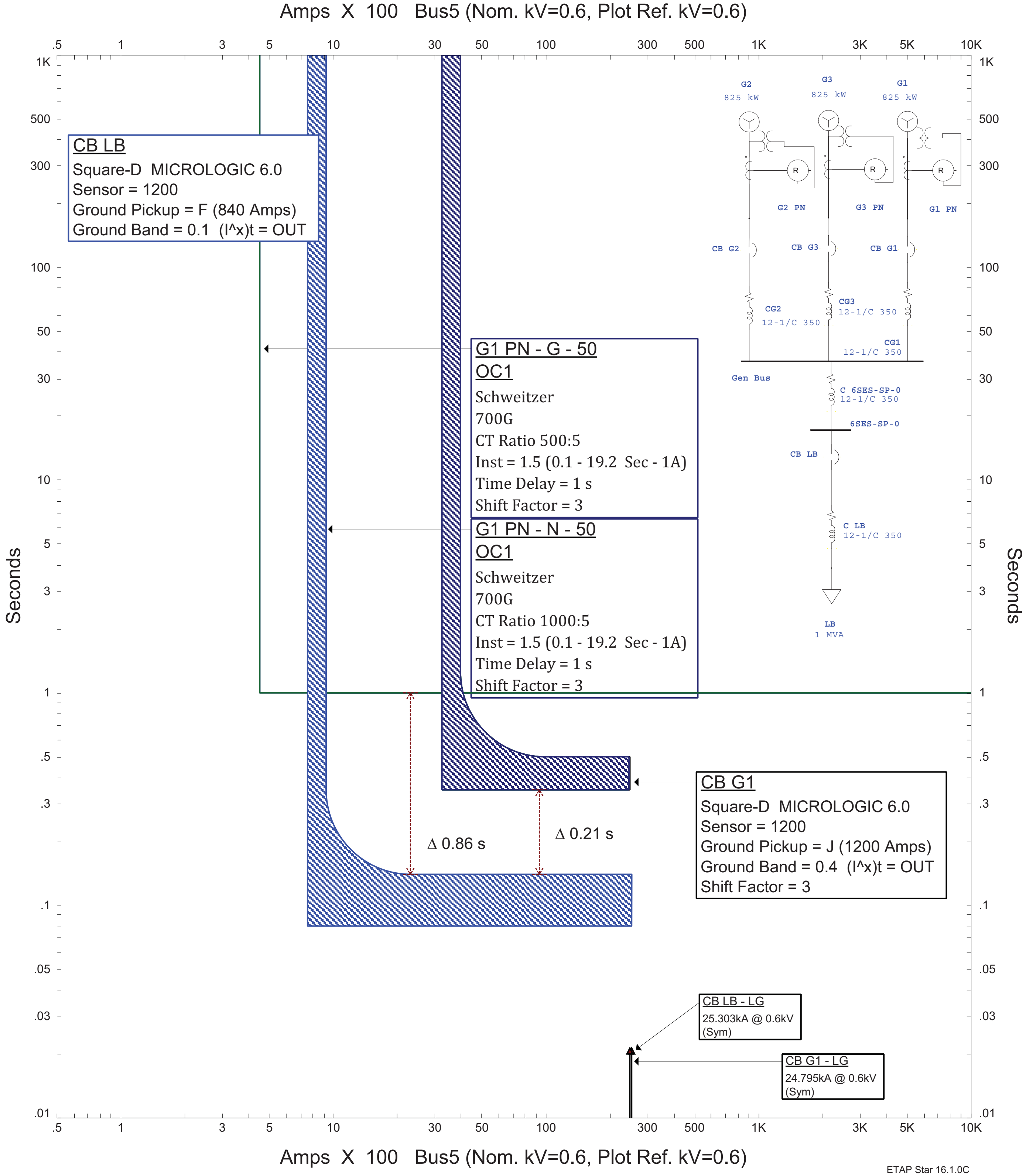
ETAP Star 16.1.0C

G1-G3 to LB

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Phase

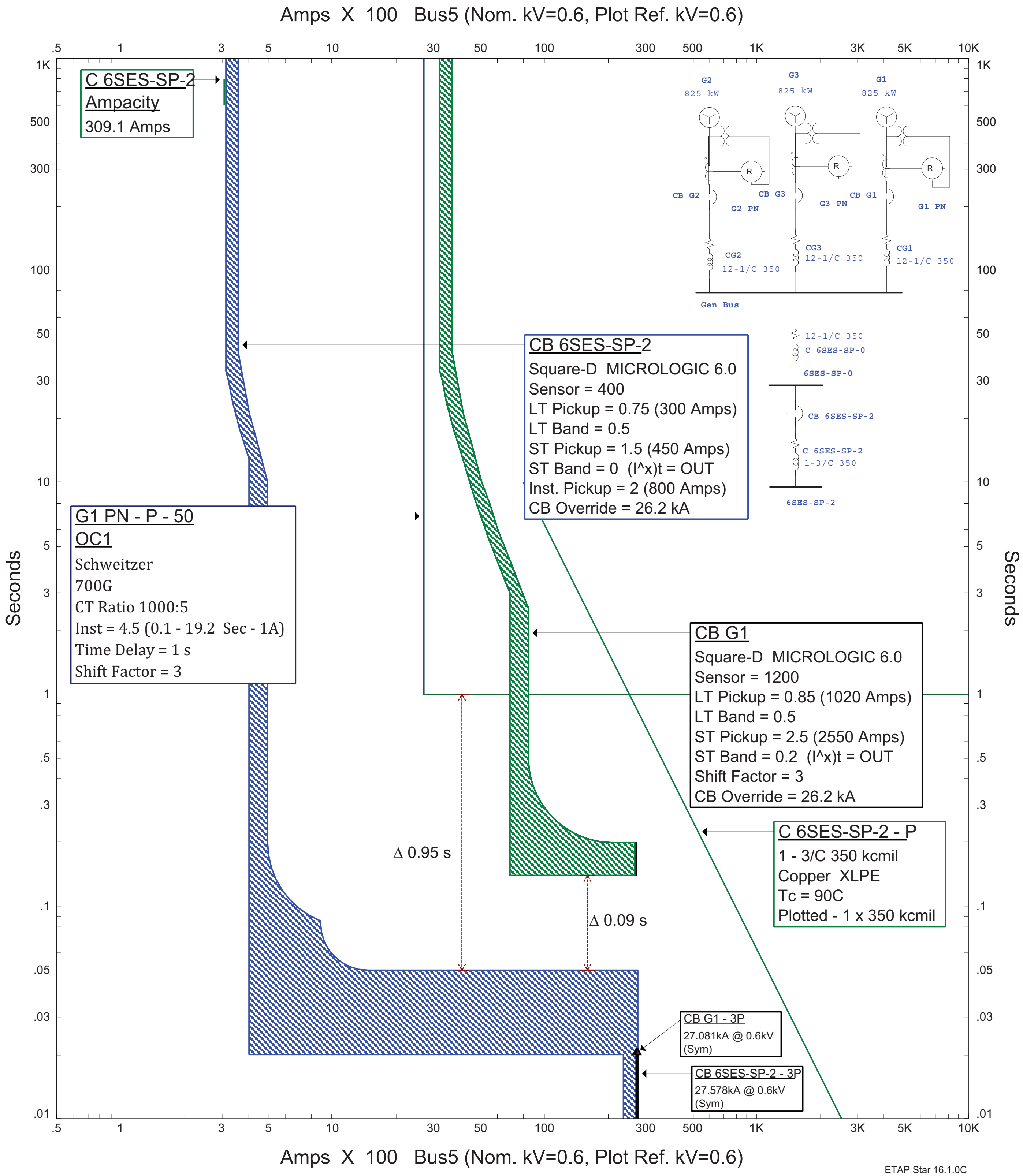


ETAP Star 16.1.0C

G1-G3 to LB

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Ground

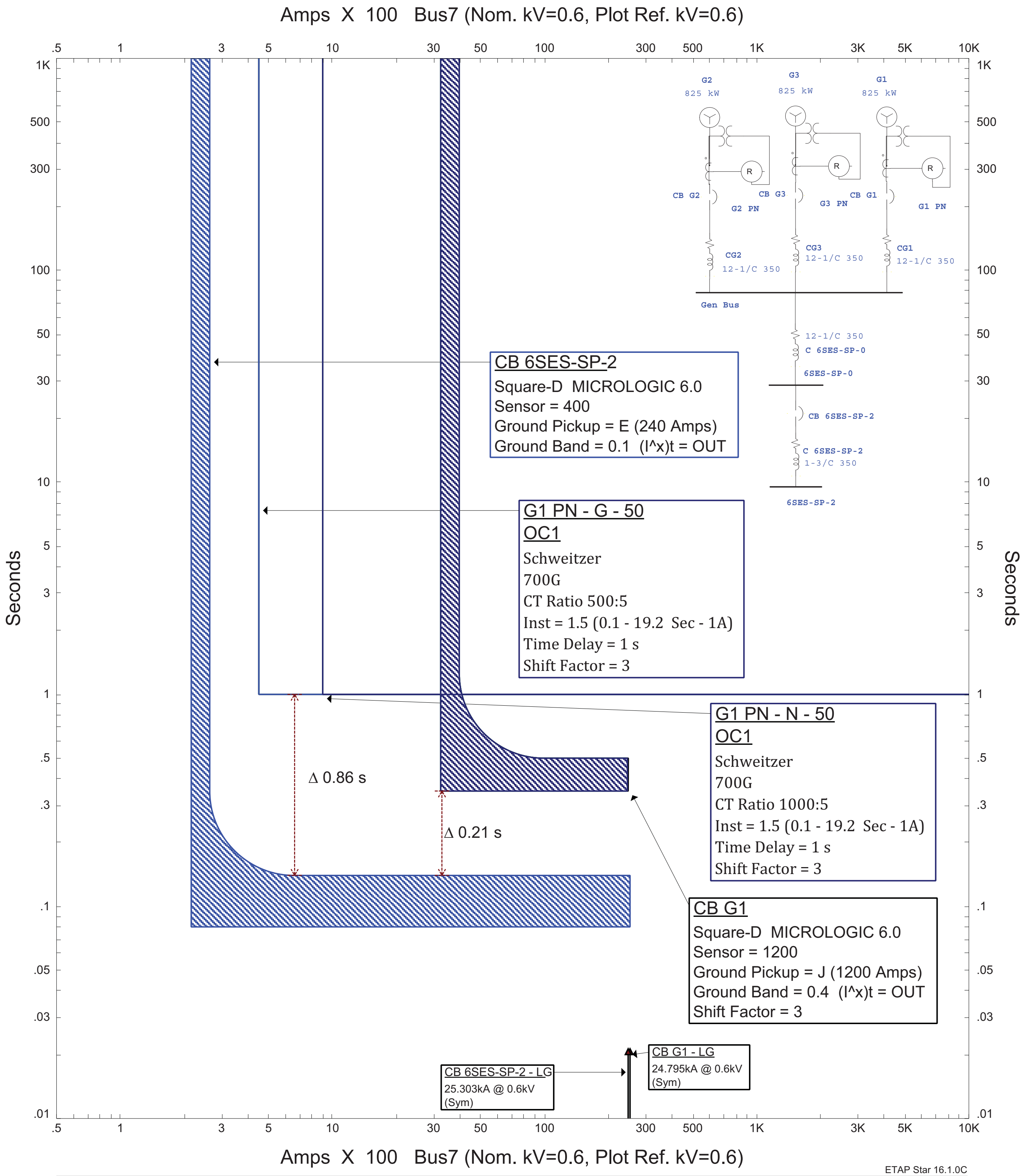


G1-G3 to 6SP2

NEXTGEN

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Phase



ETAP Star 16.1.0C

G1-G3 to 6SP2

Project: EGD Standby Power
Location: Esquimalt BC
Contract:
Engineer: Soheil Barakat

Date: 06-21-2017
Fault: Ground

Appendix C: Arc Flash Warning Labels

⚠ WARNING

Arc Flash and Shock Hazard Present

Incident Energy at 457 mm (18 in) = 16.5 cal/cm^2
Arc Flash Boundary = 2.3 m (89 in)
Nominal System Voltage = 600 VAC

Equipment ID: 6SES-SP-0

Analysis Performed on 06-21-2017

⚠ WARNING

Arc Flash and Shock Hazard Present

Incident Energy at 457 mm (18 in) = 3.7 cal/cm^2
Arc Flash Boundary = 0.9 m (36 in)
Nominal System Voltage = 600 VAC

Equipment ID: 6SES-SP-2

Analysis Performed on 06-21-2017

10 – PRE-COMMISSIONING DOCUMENTATION

UNIT 1

Pre-Commissioning / Start Up Checklist

Frontier POWER PRODUCTS

Delta, BC	1-877-946-5531
Edmonton, AB	1-877-455-2260
Calgary, AB	1-877-720-3735
Winnipeg, MB	1-877-949-1526

www.frontierpower.com

The following section is to be completed by the sales person.

WO# 68513 **Company Name** Western Pacific **Project Name** EGD

Main Contact Gord Wesbter **PH#** 778-229-1479 **Email:** 778-229-1479 (cell) Gord@wpe.ca

Unit Application

Standby Power ☑ Prime Power ☐ Farm ☐ Other (specify) ☐ ______

Generator Ratings

Serial Number: SGM32HWDD **Serial Number:** ______

Diesel ☑ Natural Gas ☐ LPG Vapor ☐ LPG Liquid ☐ Kw Size 750 Voltage 600 Phase 3

Transfer Switch

(Please include all transfer switches at site. Use "Notes" section if more than two.)

Serial # ______ **Model #** ______ **Serial #** ______ **Model #** ______

Automatic ☐ Bypass ☐ Fire Pump ☐ CTS ☐ Manual ☐ Amperage#1 ______ Amperage#2 ______

Testing Options

Start-up only ☑ Load Test ☑ Load test length 4 hours CSA 282 Type ☐ Strip Charting ☐

Specials (Attach Specs) ☐ Pump Station ☐

Note: Pump station start-ups **require** the attendance of the pump supplier technical staff. Failure to do so may cause VFD or soft starts to function incorrectly requiring additional **chargeable** visits.

The following sections are to be completed by the contractor.

Note: We require **2 - 3 weeks** advance notice booking time for start-ups. Test dates **will not** be provided without this form completed, signed and approved. A fixed amount of time has been allotted to the start up of this unit. If a return trip is required due to incomplete installation, the return trip will be **chargeable** at our regular field rate, and booked when time permits.

Requested Start-up Date APRIL 11TH/17

Site Contact CHRIS HEESTERMAN **PH#** 604-786-7558 **Email** ______

Site Address 825 ADMIRALS **City** VICTORIA **Prov.** BC **P/C** ______

End User Name PWGSC

Note: This is required for warranty registration purposes. Please provide mailing address if different from above.

Mailing Address ______ **City** ______ **Prov.** ______ **P/C** ______

The installation of this unit must adhere to supplied installation manual and applicable legislated codes.

Notes

Please see work order notes as well:

The site is providing the load bank for testing, it must be operational for testing
Thomson paralleling controls are at the site, Frontier did not provide this system and will provide basic support if Thomson is on site during our testing,
Tier 4 calibration will be provided after the initial start up and testing
Confim with Bill Matthews before test reports are released, do not release without approval.

Checklist Items

☑ Generator must be bolted to the concrete pad.
☑ Radiator must be full of coolant.
☑ Pre-wire service plug for block heater.
☑ Ensure batteries are connected properly.
☑ Radiator duct louvers must be installed and wired.
☑ Area under and around unit must be free of debris.
☑ Remote annunciator installed and wiring in place.
☑ Pre-wire service plug for battery charger.
☐ Exhaust system must be installed and insulated. (If applicable.)
☑ Control wiring should be in a conduit separate from the load conductors. Start wires need to be a minimum of #18 and labeled #3 and #4. They need to be pulled up into the generator controller and to the connection point in the transfer switch. If start wires are in the same conduit as the load conductors, they should be shielded.
☑ ATS line, load and genset connections must be made and terminated. The installing electrician **must** be on site in case wiring verification is required.
☑ Diesel fuel system must be complete and the tank filled to 80% maximum to allow for expansion.
☑ Spark ignited engine fuel system must be installed per Kohler installation manual. Gas pressure ***MUST*** be 7 - 11 inches of water column at the generator fuel inlet at all times. Supply volume must be sized for 100% rated load. Volume requirement is supplied on the generator data sheet.
☐ Confirm special site concerns. (Use "Notes" section on previous page.)
☑ Clear access for service vehicle and load bank will be confirmed. If a load test is to be performed, please indicate the distance in feet from where the load bank can be situated to the connection points.

_________ Feet USING PERMANENT LOAD BANK

Notes

- The above checklist is to help ensure that the start-up of the emergency power system goes smoothly.
- Fire alarm connections will be made at this time. Fire alarm personnel must be available or subsequent visits will be chargeable.
- Power interruptions are inevitable. They will be kept to a minimum, and announced where possible.

* If any of the above items are not complete at the time of start-up **costs will be chargeable** to the contractor.

Our technicians are on site to commission the components supplied by Frontier Power Products only. All code, safety compliance and testing of the complete power system are the responsibility of the owner (s) and their representatives.

Note: The sales person has verified that the contractor's account is in good standing. Before a commissioning date will be set the account must be up to date. ☐

Representative: CHRIS HEESTERMAN

Signature:

Sales Person: craig einarson

Signature: ____________

UNIT 2

Pre-Commissioning / Start Up Checklist

Frontier POWER PRODUCTS

Delta, BC	1-877-946-5531
Edmonton, AB	1-877-455-2260
Calgary, AB	1-877-720-3735
Winnipeg, MB	1-877-949-1526

www.frontierpower.com

The following section is to be completed by the sales person.

WO# 68513 **Company Name** Western Pacific **Project Name** EGD

Main Contact Gord Wesbter **PH#** 778-229-1479 **Email:** 778-229-1479 (cell) Gord@wpe.ca

Unit Application

Standby Power ☑ Prime Power ☐ Farm ☐ Other (specify) ☐ ______

Generator Ratings

Serial Number: SGM32HWDC **Serial Number:** ______

Diesel ☑ Natural Gas ☐ LPG Vapor ☐ LPG Liquid ☐ Kw Size 750 Voltage 600 Phase 3

Transfer Switch

(Please include all transfer switches at site. Use "Notes" section if more than two.)

Serial # ______ **Model #** ______ **Serial #** ______ **Model #** ______

Automatic ☐ Bypass ☐ Fire Pump ☐ CTS ☐ Manual ☐ Amperage#1 ______ Amperage#2 ______

Testing Options

Start-up only ☑ Load Test ☑ Load test length 4 hours CSA 282 Type ☐ Strip Charting ☐

Specials (Attach Specs) ☐ Pump Station ☐

Note: Pump station start-ups **require** the attendance of the pump supplier technical staff. Failure to do so may cause VFD or soft starts to function incorrectly requiring additional **chargeable** visits.

The following sections are to be completed by the contractor.

Note: We require **2 - 3 weeks** advance notice booking time for start-ups. Test dates **will not** be provided without this form completed, signed and approved. A fixed amount of time has been allotted to the start up of this unit. If a return trip is required due to incomplete installation, the return trip will be **chargeable** at our regular field rate, and booked when time permits.

Requested Start-up Date	APRIL 11TH/17

Site Contact CHRIS HOERTERMAN **PH#** 604-786-7558 **Email** ______

Site Address 825 ADMIRALS **City** VICTORIA **Prov.** BC **P/C** ______

End User Name PWGSC

Note: This is required for warranty registration purposes. Please provide mailing address if different from above.

Mailing Address ______ **City** ______ **Prov.** ______ **P/C** ______

The installation of this unit must adhere to supplied installation manual and applicable legislated codes.

Notes

Please see work order notes as well:

The site is providing the load bank for testing, it must be operational for testing
Thomson paralleling controls are at the site, Frontier did not provide this system and will provide basic support if Thomson is on site during our testing,
Tier 4 calibration will be provided after the initial start up and testing
Confim with Bill Matthews before test reports are released, do not release without approval.

Checklist Items

- ☑ Generator must be bolted to the concrete pad.
- ☑ Radiator must be full of coolant.
- ☑ Pre-wire service plug for block heater.
- ☑ Ensure batteries are connected properly.
- ☑ Radiator duct louvers must be installed and wired.
- ☑ Area under and around unit must be free of debris.
- ☑ Remote annunciator installed and wiring in place.
- ☑ Pre-wire service plug for battery charger.
- ☑ Exhaust system must be installed and insulated. (If applicable.)
- ☑ Control wiring should be in a conduit separate from the load conductors. Start wires need to be a minimum of #18 and labeled #3 and #4. They need to be pulled up into the generator controller and to the connection point in the transfer switch. If start wires are in the same conduit as the load conductors, they should be shielded.
- ☑ ATS line, load and genset connections must be made and terminated. The installing electrician **must** be on site in case wiring verification is required.
- ☑ Diesel fuel system must be complete and the tank filled to 80% maximum to allow for expansion.
- ☑ Spark ignited engine fuel system must be installed per Kohler installation manual. Gas pressure ***MUST*** be 7 - 11 inches of water column at the generator fuel inlet at all times. Supply volume must be sized for 100% rated load. Volume requirement is supplied on the generator data sheet.
- ☐ Confirm special site concerns. (Use "Notes" section on previous page.)
- ☑ Clear access for service vehicle and load bank will be confirmed. If a load test is to be performed, please indicate the distance in feet from where the load bank can be situated to the connection points.

__________ Feet USING PERMANENT LOAD BANK

Notes

- The above checklist is to help ensure that the start-up of the emergency power system goes smoothly.
- Fire alarm connections will be made at this time. Fire alarm personnel must be available or subsequent visits will be chargeable.
- Power interruptions are inevitable. They will be kept to a minimum, and announced where possible.

* If any of the above items are not complete at the time of start-up **costs will be chargeable** to the contractor.

Our technicians are on site to commission the components supplied by Frontier Power Products only. All code, safety compliance and testing of the complete power system are the responsibility of the owner (s) and their representatives.

Note: The sales person has verified that the contractor's account is in good standing. Before a commissioning date will be set the account must be up to date. ☐

Representative: chris HEESTERMAN

Sales Person: craig einarson

Signature: ______________________

Signature: ______________________

UNIT# 3

Pre-Commissioning / Start Up Checklist

Frontier POWER PRODUCTS

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

The following section is to be completed by the sales person.

WO# 68513 **Company Name** Western Pacific **Project Name** EGD

Main Contact Gord Wesbter **PH#** 778-229-1479 **Email:** 778-229-1479 (cell) Gord@wpe.ca

Unit Application

Standby Power ☑ Prime Power ☐ Farm ☐ Other (specify) ☐ ____

Generator Ratings

Serial Number: SGM32HWDB **Serial Number:** ____

Diesel ☑ Natural Gas ☐ LPG Vapor ☐ LPG Liquid ☐ Kw Size 750 Voltage 600 Phase 3

Transfer Switch

(Please include all transfer switches at site. Use "Notes" section if more than two.)

Serial # ____ **Model #** ____ **Serial #** ____ **Model #** ____

Automatic ☐ Bypass ☐ Fire Pump ☐ CTS ☐ Manual ☐ Amperage#1 ____ Amperage#2 ____

Testing Options

Start-up only ☑ Load Test ☑ Load test length 4 hours CSA 282 Type ☐ Strip Charting ☐

Specials (Attach Specs) ☐ Pump Station ☐

Note: Pump station start-ups **require** the attendance of the pump supplier technical staff. Failure to do so may cause VFD or soft starts to function incorrectly requiring additional **chargeable** visits.

The following sections are to be completed by the contractor.

Requested Start-up Date	

Note: We require **2 - 3 weeks** advance notice booking time for start-ups. Test dates **will not** be provided without this form completed, signed and approved. A fixed amount of time has been allotted to the start up of this unit. If a return trip is required due to incomplete installation, the return trip will be **chargeable** at our regular field rate, and booked when time permits.

Site Contact CHRIS HOERTEMAN **PH#** 604-786-7558 **Email** ____

Site Address 825 ADMIRALS **City** VICTORIA **Prov.** BC **P/C** ____

End User Name PWGSC

Note: This is required for warranty registration purposes. Please provide mailing address if different from above.

Mailing Address ____ **City** ____ **Prov.** ____ **P/C** ____

The installation of this unit must adhere to supplied installation manual and applicable legislated codes.

Notes

Please see work order notes as well:

The site is providing the load bank for testing, it must be operational for testing
Thomson paralleling controls are at the site, Frontier did not provide this system and will provide basic support if Thomson is on site during our testing,
Tier 4 calibration will be provided after the initial start up and testing
Confim with Bill Matthews before test reports are released, do not release without approval.

Checklist Items

☑ Generator must be bolted to the concrete pad.

☑ Radiator must be full of coolant.

☑ Pre-wire service plug for block heater.

☑ Ensure batteries are connected properly.

☑ Radiator duct louvers must be installed and wired.

☑ Area under and around unit must be free of debris.

☑ Remote annunciator installed and wiring in place.

☑ Pre-wire service plug for battery charger.

☑ Exhaust system must be installed and insulated. (If applicable.)

☑ Control wiring should be in a conduit separate from the load conductors. Start wires need to be a minimum of #18 and labeled #3 and #4. They need to be pulled up into the generator controller and to the connection point in the transfer switch. If start wires are in the same conduit as the load conductors, they should be shielded.

☑ ATS line, load and genset connections must be made and terminated. The installing electrician **must** be on site in case wiring verification is required.

☑ Diesel fuel system must be complete and the tank filled to 80% maximum to allow for expansion.

☑ Spark ignited engine fuel system must be installed per Kohler installation manual. Gas pressure ***MUST*** be 7 - 11 inches of water column at the generator fuel inlet at all times. Supply volume must be sized for 100% rated load. Volume requirement is supplied on the generator data sheet.

☐ Confirm special site concerns. (Use "Notes" section on previous page.)

☑ Clear access for service vehicle and load bank will be confirmed. If a load test is to be performed, please indicate the distance in feet from where the load bank can be situated to the connection points.

_________ Feet USING PERMANENT LOAD BANK

Notes

- The above checklist is to help ensure that the start-up of the emergency power system goes smoothly.
- Fire alarm connections will be made at this time. Fire alarm personnel must be available or subsequent visits will be chargeable.
- Power interruptions are inevitable. They will be kept to a minimum, and announced where possible.

* If any of the above items are not complete at the time of start-up **costs will be chargeable** to the contractor.

Our technicians are on site to commission the components supplied by Frontier Power Products only. All code, safety compliance and testing of the complete power system are the responsibility of the owner (s) and their representatives.

Note: The sales person has verified that the contractor's account is in good standing. Before a commissioning date will be set the account must be up to date. ☐

Representative: Chris [illegible]

Sales Person: craig einarson

Signature:

Signature:

Pre-Commissioning / Start Up Checklist

Frontier POWER PRODUCTS

Delta, BC 1-877-946-5531
Edmonton, AB 1-877-455-2260
Calgary, AB 1-877-720-3735
Winnipeg, MB 1-877-949-1526
www.frontierpower.com

The following section is to be completed by the sales person.

WO# 68513 **Company Name** Western Pacific enterprises Lt **Project Name** EGD - Towable Standby

Main Contact Gord Webster **PH#** 778-229-1479 **Email:** Gord@wpe.ca

Unit Application

Standby Power ☑ Prime Power ☐ Farm ☐ Other (specify) ☐ ______

Generator Ratings

Serial Number: HOP-103121 **Serial Number:** ______

Diesel ☑ Natural Gas ☐ LPG Vapor ☐ LPG Liquid ☐ Kw Size 75 Voltage 600 Phase 3

Transfer Switch

(Please include all transfer switches at site. Use "Notes" section if more than two.)

Serial # not applicable **Model #** ______ **Serial #** ______ **Model #** ______

Automatic ☐ Bypass ☐ Fire Pump ☐ CTS ☐ Manual ☐ Amperage#1 ______ Amperage#2 ______

Testing Options

Start-up only ☐ Load Test ☑ Load test length 1 CSA 282 Type ☐ Strip Charting ☐

Specials (Attach Specs) ☐ Pump Station ☐

Note: Pump station start-ups **require** the attendance of the pump supplier technical staff. Failure to do so may cause VFD or soft starts to function incorrectly requiring additional **chargeable** visits.

The following sections are to be completed by the contractor.

Requested Start-up Date	May 18, 2017

Note: We require **2 - 3 weeks** advance notice booking time for start-ups. Test dates **will not** be provided without this form completed, signed and approved. A fixed amount of time has been allotted to the start up of this unit. If a return trip is required due to incomplete installation, the return trip will be **chargeable** at our regular field rate, and booked when time permits.

Site Contact Gord Webster **PH#** 778-229-1479 **Email** gord@wpe.ca

Site Address 825 Admirals Rd **City** victoria **Prov.** BC **P/C** V9A 2P1

End User Name PWGSC

Note: This is required for warranty registration purposes. Please provide mailing address if different from above.

Mailing Address ______ **City** ______ **Prov.** ______ **P/C** ______

The installation of this unit must adhere to supplied installation manual and applicable legislated codes.

Notes

Checklist Items

☐ Generator must be bolted to the concrete pad.

☑ Radiator must be full of coolant.

☑ Pre-wire service plug for block heater.

☑ Ensure batteries are connected properly.

☐ Radiator duct louvers must be installed and wired.

☑ Area under and around unit must be free of debris.

☐ Remote annunciator/fire panel installed and wiring in place.

☐ Pre-wire service plug for battery charger.

☑ Exhaust system must be installed and insulated. (If applicable.)

☐ Control wiring should be in a conduit separate from the load conductors. Start wires need to be a minimum of #18 and labeled #3 and #4. They need to be pulled up into the generator controller and to the connection point in the transfer switch. If start wires are in the same conduit as the load conductors, they should be shielded.

☐ ATS line, load and genset connections must be made and terminated. The installing electrician **must** be on site in case wiring verification is required.

☑ Diesel fuel system must be complete and the tank filled to 80% maximum to allow for expansion.

☐ Spark ignited engine fuel system must be installed per Kohler installation manual. Gas pressure ***MUST*** be 7 - 11 inches of water column at the generator fuel inlet at all times. Supply volume must be sized for 100% rated load. Volume requirement is supplied on the generator data sheet.

☐ Confirm special site concerns. (Use "Notes" section on previous page.)

☑ Clear access for service vehicle and load bank will be confirmed. If a load test is to be performed, please indicate the distance in feet from where the load bank can be situated to the connection points.

_________Feet

Notes

- The above checklist is to help ensure that the start-up of the emergency power system goes smoothly.
- Fire alarm connections will be made at this time. Fire alarm personnel must be available or subsequent visits will be chargeable.
- Power interruptions are inevitable. They will be kept to a minimum, and announced where possible.

* If any of the above items are not complete at the time of start-up **costs will be chargeable** to the contractor.

****Our technicians are on site to commission the components supplied by Frontier Power Products only. All code, safety compliance and testing of the complete power system are the responsibility of the owner (s) and their representatives.****

Note: The sales person has verified that the contractor's account is in good standing. Before a commissioning date will be set the account must be up to date. ☐

Representative: Gord Webster

Sales Person: craig einarson

Signature:

Signature: ____________________

Thomson Power Systems

Off-Premises Work Policy

(Refer SVP002)

This is a statement of responsibilities associated with Thomson Power Systems' performance of work on equipment owned by others at a location other than on Thomson Power Systems' premises. It covers all types of work related to equipment including starting up, commissioning, repairing, testing, calibrating, etc.

In most cases the equipment upon which Thomson Power Systems is performing work will be only a part of a larger system. For example, Thomson Power Systems may be working on a diesel engine controller module which is only a part of a larger power generation system.

In all cases it is the responsibility of the equipment owner (which may be an Authorized Representative thereof) to be present during all work performance associated with the owner's equipment and related system, and to ensure that the person(s) present has expert competence and familiarity thereof. Thomson Power Systems does not assume responsibility for ensuring at any time that the owner is present, and will proceed with the work if the owner is absent, including operating the equipment and system, without assuming any additional liability.

During the course of the work performed by Thomson Power Systems, the owner shall operate the equipment and system as may be necessary. As an expert, the owner accepts all responsibility for recognizing potential dangers and for taking any necessary precautions to protect the owner's equipment, the system of which it forms a part, and any related persons, processes, data and/or equipment that may be subject to detrimental effects. Thomson Power Systems assumes responsibility only for that specific piece of equipment upon which Thomson Power Systems is performing work, and not for any contingent detrimental effect resulting from or in conjunction with that work. Unless specifically required by the owner to cease work, Thomson Power Systems will deem the owner to be in agreement with the work activities as being performed.

If there are any questions regarding the above policy, please contact Thomson Power Systems (Langley, British Columbia, Canada) by telephone at 604-888-0110 or fax at 604-888-5606.

All site start-ups and commissioning estimates are based on confirmed transportation and accommodations. A minimum of 14 days prior notice from the applicable travel date is required to allow for booking of reasonable airfares. If appropriate notice is not provided the Customer will be responsible for the difference between the reasonable accommodation and airfare and the actual airfare incurred if there is an increase.

Commissioning included in the equipment purchase price is based on a 10 hour working day, Monday to Friday, excluding weekends and holidays. The exact number of days is outlined in the Sales Quotation. Charges for a technician requested to remain on site at standby rate is based on a 10 hour working day, Monday to Friday, 8 hour working day, Saturday to Sunday. Additional charges will apply for holidays. Where consecutive commissioning days extend through weekends or holidays it will be at the Customer's expense to pay the overtime differential between the regular hourly rates and the overtime rates. Travel time or labor worked in excess of the quoted amount will be invoiced at the per diem rate specified in the Sales Quote or at our applicable published rates, available upon request. It is at the Customer's option to sign the Technician's time cards to authorize any overtime hours required in excess of the quoted amount. If customer delays prevent the completion of the commissioning as scheduled and the Technician is requested to travel back to their Thomson Power Systems home base and return to the site at a later date, all associated travel, labor and expenses will be billable to the Customer's account at the applicable rates.

Once the total number of days allowed at site have been exceeded all excess costs will be billable to the Customer's account. A purchase order or money order will then be required for completion of the site start-up / commissioning.

Thomson Power Systems' customers shall be responsible to obtain written confirmation that the following items have been completed at the site ***prior*** to Thomson Power Systems field service personnel traveling to the site. This will help ensure a timely completion of field commissioning procedures by Thomson Power Systems.

Note: The following lists of items are typical of a generator system, therefore some items may or may not be applicable.

1. **Generator Room Mechanical Installation**
   - Room ventilation system is operational (intake/exhaust louvres)
   - Engine exhaust system is installed and operational
   - Engine Fuel system is installed and operational (adequate fuel is at the site for equipment testing).
   - Generator control panel/switchgear is installed.

2. **Engine/Generator Installation**
   - Generator set skid is installed on vibration isolators (as applicable)
   - Engine cooling system is installed and radiators are filled with glycol.
   - Engine is filled with oil.
   - Engine Cranking batteries are installed, are fully charged and the battery charger(s) are on.

3. **Generator Electrical System**
   - All power cabling to/from generator and switchgear (as applicable) is installed and meggar tested.
   - Verification that utility and generator power supplies have matching phase rotation (i.e. A-B-C) as applicable.
   - All control interconnecting wiring between engine junction box, control panel and switchgear (as applicable) has been installed and has been verified correct.

- All equipment grounding bond conductors are installed as required to meet safety requirements.

4. **General**
    - System load is available to effectively test engine cooling/room ventilation systems and load sharing equipment (as applicable). Note: If system load is not available a temporary load bank must be available.
    - Generator power system is authorized to be energized and paralleled (to the utility supply as applicable) by local regulatory authorities.
    - Any Thomson Power Systems supplied equipment which has been damaged due to shipping or installation shall be immediately identified and Thomson Power Systems shall be notified to ensure timely replacement/repair (as applicable).
    - Customer Witness testing personnel are tentatively scheduled to attend the site at a mutually agreed upon date.
        - Where parallel operation to the local utility grid is included in the design, formal written approval is required.
        - All circuit breakers and utility relays to have protection settings completed and approved by authorized personnel.

If there are any questions regarding the above items, please contact Thomson Power Systems (Langley, British Columbia, Canada) by telephone at 604-888-0110 or fax at 604-888-3370.

Prior to Thomson Power Systems attending site, the following requirements must be confirmed by checking "Yes" or "No" to each item. When complete, please fax to our Service Department at 604-888-3370.

	YES	NO
A. In accordance with the Ministry of Health and Safety under the General Safety Regulation "Working Alone" we require confirmation of the following:		
1. The working area is clean and considered a safe working environment by WCB standards. If any hazards currently exist, they have been identified.	✓	
2. A contact person has been designated in event a hazardous condition occurs or first aid is required during normal business hours. Name: GORDON LEHANE Ph.: 778-266-0069	✓	
3. A contact person has been designated in event a hazardous condition occurs or First Aid is required outside of normal business hours. Name: GORDAN LEHANE Ph.: 778-266-0069 NOTE: If no names are provided for items 2) and 3) above, Thomson Power Systems will supply a second individual and will require a purchase order to cover this person's time on site.	✓	
B. An "On-Site Consultant" has been contracted and has approved completion of items 1-15 below. Name: CHRIS HEERTENMAN Ph.: 604-786-7558		
To ensure that the required work can be performed as scheduled we require:		
1. Generator installation complete	✓	
2. Switch gear and/or transfer switch installation complete	✓	
3. Exhaust system installed	✓	
4. Fuel system installed, filled and primed at the engine	✓	
5. Batteries installed and connected	✓	

marathon
Thomson Power Systems

Pre-Site Commissioning Customer Requirements

Commissioning Date: ____________________

	YES	NO
6. Battery chargers connected and powered up	✓	
7. Interconnection wiring completed between generators and control panel	✓	
8. Main conductors installed for:		
a) Utility	✓	
b) Generators	✓	
c) Load distribution	✓	
9. Generator operational with voltage regulator and governor set up	✓	
10. All engine shutdowns and alarms verified functional and correct	✓	
11. Phase rotation for all sources confirmed to be the same (ABC rotation)	✓	
12. Generators have been transferred on building load or artificial load	✓	
13. Circuit breaker and protective relay setting coordination have been approved and set points applied to appropriate equipment.(**NOTE:** Thomson Power Systems is not responsible for selection of protective relay settings.)	✓	
14. Formal approval to parallel to the local utility		✓
15. If DC station service supply is applicable and provided by other than Thomson Power Systems, such service is operational and interconnect wiring is in place.	✓	

If the answer to any of the above questions is "NO", please indicate reasons why:

WE WILL NOT BE CONNECTING GENERATORS TO UTILITY AT THIS TIME

Please complete the above form for each site. A response is required for all of the above items.

When these items have been completed, Thomson Power Systems will make final arrangements to be at the site for commissioning of the equipment.

NOTE: Time on site includes Saturdays, Sundays and holidays. Should these items not be completed upon arrival and delays are encountered, applicable labour and expense charges will apply.

NOTE: If, during the course of the above commissioning Thomson Power Systems' representative is available for work but is not working because of circumstances beyond Thomson Power Systems' control, Thomson Technology shall be reimbursed standby time, up to 10 hours per day, at the applicable rate.

UPON SIGNING OF THIS DOCUMENT YOUR COMPANY ACCEPTS ALL CONDITIONS OF THIS AGREEMENT

Work performed by: WESTERN PACIFIC ENTERPRISES Signature: chris Hoestermann

Site location: EGD - 825 ADMIRALS, VICTORIA BC

11 – COMMISSIONING AND DEMONSTRATION ACCEPTANCE

11.1 TCS & Generator Commissioning and Demonstration

WESTERN PACIFIC ENTERPRISES LTD.
PWGSC No. R.057890.003
CONTRACT No. EZ108-170397

SSES Standby Generator Operation Testing and Demonstration

Test	Description	Action by;	Completed
	The following tests form part of the overall Stand-by Power Generation System Testing and Commissioning as itemised within Section 8 of this document. The testing and SCADA results have been witnessed and demonstrated to the Owner and Consultants.		
2.02	*AUTO - Utility Failure and Retransfer DND Preferred Utility - Utility Retransfer (Open Transition / Manual Retransfer) Simulated utility failureas requested by PWGSC*	WPE	2017 09 17
2.03	*AUTO - Utility Failure and Retransfer DND Preferred Utility - Utility Retransfer (Open Transition / Auto Retransfer) Simulated utility failureas requested by PWGSC*	WPE	2017 09 17
2.04	*PLC 'Optimum Load' Control Simulated utility failureas requested by PWGSC*	WPE	2017 09 17
2.05	*Generator Load Demand - Reducing Generator Capacity*	WPE	2017 09 17
2.06	*Generator Load Demand - Increasing Generator Capacity*	WPE	2017 09 17
2.07	*Total Anticipated Load Simulated utility failureas requested by PWGSC*	WPE	2017 09 17
2.08	*N+1 Redundancy*	WPE	2017 09 17
2.09	*Supplemental live Equipment Run Reaction Test as directed by PWGSC*	WPE	2017 09 17
2.10	*Replacing Failed Generators*	WPE	2017 09 17
2.11	*Generator Low Fuel Alarm*	WPE	2017 09 17

Signature:______________________ Date: 2017/09/17

Test Preformed by : Chris Heesterman
Western Pacific Enterprises Ltd.

Signature:______________________ Date: Sept 17/17

Witnessed by: Lorne Cowley
Cowley and Associates

Signature:______________________ Date:__________

Accepted by:
on behalf of PWGSC

12 – MAINTAINANCE SCHEDULES

12.1 Electrical Power Panels
12.2 Standby 750KW Diesel Generators & Tier 4 Emissions
12.3 Towable Standby Power

Electrical Equipment and Panel Boards

Caution : Before carrying out any maintenace activity, check that the electrical equipment is locked out and no electrical power is present.

Maintenance Schedule				Yearly
Panel and Distribution Boards;	Check for enclosure for paint damage, dents, scratches, discolouration.			*
6SES-SP-0, 6SES-SP-2, 2SES-SP-2, 6C Panel Board, Main Breaker, Maunal Transfer Switch, Portable Connection Box				
	Check Bus Bars for discolouration and indication of hot spots.			*
	Check for tightness of bolted connections.			*
	Check tightness of wire connections at breakers and terminal blocks.			*
	Check breakers and moving parts for smooth operation.			*
	Inspect wiring and insulation for signs of damage by hot spots, and rodents.			*
	Clean and dust out.			*
Generator Switch Board	Check for enclosure for paint damage, dents, scratches, discolouration.			*
	Check for tightness of bolted connections.			*
	Check tightness of wire connections at terminal blocks.			*
	Inspect wiring and insulation for signs of damage by hot spots, and rodents.			*
	Clean and dust out.			*
3/4MVA Transformer	Check for enclosure for paint damage, dents, scratches, discolouration.			*
	Check for tightness of bolted connections.			*
	Check tightness of wire connections at terminal blocks.			*
	Inspect wiring and insulation for signs of damage by hot spots, and rodents.			*
	Inspect exterior and radiator fins for signs of oil leaking			*
	Inspect interior High voltge compartment for signs of oil leaks			*
	Inspect interior Low voltage compartment for signs of oil leaks			*
	Inspect Oil drain cock for signs of oil seepage			*

Frontier EGD Generator and SCR System Master Maintenance Schedule

The service schedules below are compiled from the respective Generator and SCR System service manuals. This schedule is to be used as a convenient compiled checklist of all maintenance to be performed on the entire system. Refer to the respoective manuals for further details

THE GENERATOR SET MUST BE EXERCISED ONCE EACH WEEK FOR 2 HOURS.

During the exercise period, apply a minimum of 100% load on each generator.

The operator should perform all prestart checks.

Since an SCR system has been integrated, the above exercise schedule overrides what is stated in the gen manual.

Generator Maintenance Schedule

For wear part numbers and additioan information. Refer to the generator operator manual

System — Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
Fuel System						
Day tank level	X	X				Weekly
Flexible lines and connections	X	R				Weekly
Fuel level switch	X	X				Weekly
Main tank supply level	X					Weekly
Solenoid valve operation	X	X				Weekly
Transfer pump operation	X	X				Weekly
Water in system, remove	D	D				Weekly
Filter(s)	D					Quarterly
Fuel piping	X					Yearly
Tank vents and return lines for obstructions	X					Yearly
Lubrication System						
Oil level	D	D				Weekly
Crankcase breather	D	D				Quarterly
Change oil	D					First 50 Hrs., Then Every 250 Hrs.
Replace filter(s)*	D					
Cooling System						
Air cleaner to room/enclosure	X					Weekly
Block heater operation	X					Weekly
Coolant level	D	D				Weekly
Flexible hoses and connectors	X	X				Weekly
Water pump(s)	D					Weekly
Fan and alternator belts	D	D	R			Monthly
Coolant temperature protection level	D					Six Months
Air ducts, louvers	X	X				Yearly
Coolant	D					Yearly
Heat exchanger	X					Yearly
Louver motors and controls	X	X	X			Yearly
Radiator exterior	X					Yearly
Water supply to heat exchanger	X					Yearly
Exhaust System						
Drain condensate trap	X					Weekly
Leakage	X	X				Weekly
Insulation, fire hazards	X					Quarterly

Generator Maintenance Schedule Continued

System—Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
Flexible connector(s)	X					Six Months
Excessive back pressure	X					Yearly
Hangers and supports	X					Yearly
DC Electrical System						
Battery charger operation, charge rate	X					Monthly
Battery electrolyte level	X					Monthly
Battery specific gravity, charge state	X					Monthly
Recharge after engine start	X					Monthly
Remove corrosion, clean and dry battery and rack	X	X				Monthly
Clean and tighten battery terminals	X	X				Quarterly
Tighten DC electrical connections	X					Six Months
AC Electrical System						
Controller lamp test	X	R				Weekly
General Inspection	X	Weekly				
Circuit breakers, fuses[	X	X	R	X	X	Monthly
Wire abrasions where subject to motion	X	X				Quarterly
Safety and alarm operation	X	X				Six Months
Tighten control and power wiring connections	X					Yearly
Transfer switch main contacts[	X	X				Yearly
Voltage-sensing device/relay adjustment	D	D				Yearly
Wire-cable insulation breakdown	X	X				3 Years or 500 Hrs.
Engine and Mounting						
General inspection	D					Weekly
Governor operation, lubricate moving parts	D	D				Monthly
Air cleaner service	D	D				Six Months
Choke, carburetor adjustment	D					Six Months
Governor oil (mechanical governor only)	D					Yearly
Ignition components	D	D				Yearly
Injector pump and injector flow rate, pressure, spray pattern	D	D				Yearly
Valve clearance	D					3 Years or 500 Hrs.
Bolt torque	D	D				3 Years or 500 Hrs.
Remote Control System, etc.						
Compartment condition	X	X				Weekly
Remote control	X					Monthly
Run generator set	X					Monthly
Alternator						
General inspection	X					Weekly
Rotor and stator	X	X				Yearly
Bearing condition	X	X	R			Yearly
Exciter	X	X	X			Yearly

D Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual.
If not indicated, follow this service schedule. Some items may not apply to all generator sets.
R Replace as necessary.
X Action
*Service more frequently if operated in dusty areas.

Generator Maintenance Schedule Continued

System—Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
Voltage regulator	X	X	X			Yearly
Measure and record resistance readings of windings with insulation tester (Meggerr, with SCR assembly or rectifier disconnected)	X					Yearly
Blow dust out of alternator*	X	D				2 Years or 300 Hrs.
General Condition of Equipment						
Any condition of vibration, leakage, noise, temperature, or deterioration	X	X	X			Weekly
Ensure that system is set for automatic operation	X					Weekly
Interior of equipment room or outdoor weather housing	X	X				Weekly

D Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual.
If not indicated, follow this service schedule. Some items may not apply to all generator sets.
R Replace as necessary.
X Action.
*Service more frequently if operated in dusty areas.
[Do not break manufacturer's seals or internally inspect these devices

SCR System Maintenance

For wear part numbers and additional information, refere to the SCR system maintenance schedule, found in the O&M and Supplemental Manuals

System—Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
			Injection Lance			
Injection Lance Nozzle Tip				x		6 months
Injection Lance Nozzle Tip			x			2 years
Compressed Air Check Valve			x			1 year
			Dosing Unit			
Compressed Air Compact Control Valve Filter Element			x			6 months
Compressed Air Compact Control Valve Membrane, O-Ring, Conical Nipple			x			1 year
Atomizing Air Valve		x				6 months
Atomizing Air Valve Wear Parts			x			1 year
Clean Air Check Valve		x				6 months
Clean Air Check Valve			x			1 year
Clean Air Valve		x				6 months
Clean Air Valve			x			1 year
Compressed Air Flow Switch				x*1		1 year
Urea Dosing Valve		x				1 year
Urea Dosing Valve					x *1	1 year
Urea Check Valve		x		x		6 months
Urea Check Valve			x			2 years
Urea Flow Meter				x*1		2 years
			Pump Station			
Urea Filter				x		6 months
Urea Filter Element			x			1 year
Manometer - Suction Side		x				6 months
Pressure Switch - Pressure Side		x				6 months
Overflow Valve		x				1 year
Overflow Valve Wear Parts			x			1 year
			Reactor			
Temperature Sensor		x				1 year
Differential Pressure Sensor		x				1 year
			Analyser			
Nox Sensor			x			1 year
1) And Recalibrate as Necessary						

Atlas Copco QAS 90 Towable Generator

Caution : Before carrying out any maintenace activity, check that the start switch is in 0 position and not electrical power is present on the terminals

** also refer to Maintence Manual section 5

Maintenance Schedule	**Daily**	**Every 250 hours**	**Every 500 hours**	**Every 1000 hours or yearly**
Service Pac			**1310 3004 42**	**1310 3004 43**
Check air/fuel/coolant & oil leakage	*	*	*	*
Check oil and coolent level	*	*	*	*
Check or Drain water in fuel filter/seperator	*	*	*	*
Inspect Air Cleaner / Dust Bowl	*	*	*	*
Check Vacuum Indicator	*	*	*	*
Visual walk around unit	*	*	*	*
Replace engine oil (1)			*	*
Replace engine oil filter (1)			*	*
Check/clean radiator cooler fins		*	*	*
Check tension and condition of the drive belt (4)			*	*
Grease door hinges and locks			*	*
Replace fuel filter elements			*	*
Replace fuel prefilter elements			*	*
Check electrolyte level and terminals of battery			*	*
Check engine mounts			*	*
Check cranecase ventilation system			*	*
Check condition of cooling fan assembly			*	*
Pressure test cooling system			*	*
Check engine electrical ground connection			*	*
Repalce air filter element			*	*
Replace safety cartridge			*	*
Measure alternator insulatin resistance(*)			*	*
Check glycol level in coolant			*	*
Check PH level of engine coolant			*	*
Check and adjust engine inlet and outlet valves				*
Check alternator and starter motor				*
Check electrical system for security of cables and wear				*
Test thermostats				*
Test glow plugs				*
Verify that safety circuits work				*
Inspection by Atlas Copco Service technician		generators in standby application have to be tested on a regular basis. At least once a month the engine should fun for a minimum 30 minutes at a high load (50% - 70%) so that the engine reaches its operating temperature.		

WESTERN PACIFIC ENTERPRISES GP

ELECTRICAL TECHNOLOGY AND INSTALLATIONS

13 – SPARE PARTS – TURN OVER TO OWNER

13.1 Towable Generator Spare Parts List
13.2 Generator Spare Parts List
13.3 Change Order Materials

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Loose Parts Turn Over To Owner

Specification: 26 32 10.01

Towable Generator

Item 2.2.12.6 Loose Materials				
QTY Required	**Description**	**Yes**	**No**	
1	2 5/16" ball hitch	Yes		– OK SW.
1	Spare Tire c/w rim	Yes		– OK SW
1	Jack	Yes		– OK SW.
1	Lug wrench	Yes		– OK SW
Item 2.4				
QTY	**Description**	**Yes**	**No**	
1	350 Liter Spill Kit	Yes		(1 – OK SW).

Name: STEVE WINDL.

Signature:

Date: 17/07/21

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Spare Parts Turn Over To Owner

Specification: 26 32 10

750KW Standby Generator

Item 1.11.1 Extra Materials

QTY Required	Description	Yes	No	
1	Spare control Circuit Breaker per size		N/A	NONE SUPPLIED! TO COME
12	Indicating Light Bulb per Rating		N/A	
1	control Relay c/w Socket per Rating		N/A	
1	Contactor Operating Coil		N/A	
6	Fuel Filter Elements per filter or seperator #GM 13947	Yes		✓
6	Fuel Filter Elements per filter or seperator #GM36914	Yes		✓
6	Fuel Filter Elements per filter or seperator #32562-~~58300~~ 60300	Yes		✓
6	Oil Filter Element #GM 32057	Yes		✓
6	Oil Filter Element #GM 13950	Yes		✓
6	Oil Filter Element #32540-21600	Yes		✓
6	By-Pass Element #37540-02100	Yes		✓
6	Air Cleaner Elements #274821	Yes		✓

Item 1.11.2 Tools

QTY	Description	Yes	No	
3	Battery Service Tools Hydromiter	Yes		✓
3	Plastic Squeese Bottle	Yes		✓
3	Engine Barring Device		N/A	NONE SUPPLIED - TO COME

Item 2.10.4

QTY	Description	Yes	No	
5	Spare Fuses per Battery Charger (5 only store inside each charger panel)		N/A	ONE ONLY ea.

Item 2.12

QTY	Description	Yes	No	
2	Set of spare wire markers for each external wiring connection (each generator)	Yes		✓

Item 2.17

QTY	Description	Yes	No	
3	350 Liter Spill Kit	Yes		ONE (1) REC'D. ONLY.

2 SPILL KITS FOUND FULL OF MOISTURE KITS REJECTED. AW.

Other

QTY	Description	Yes	No	
1	Fuel Tank Dip Stick	Yes		✓

Materials Received by:

Name: STEVE WINDL.

Signature:

Date: 17/07/21

From: Steve Windl <Steve.Windl@pwgsc-tpsgc.gc.ca>
Sent: November-10-17 12:37 PM
To: Chris Heesterman
Subject: RE: EGD SES Spare Parts

Thank you Chris – confirmed receipt.

Steve Windl

Project Manager, Real Property Services Branch
Public Works and Government Services Canada / Government of Canada
Steve.Windl@pwgsc-tpsgc.gc.ca / Tel: 250-363-8739 / Cell: 250-812-4092

Gestion des projets, Direction générale des services immobiliers
Travaux Publics et Services Gouvernementaux Canada / Gouvernement du Canada
Steve.Windl@pwgsc-tpsgc.gc.ca / Tél. : 250-363-8739 / Tél. Cell. : 250-812-4092

From: Chris Heesterman [mailto:cheesterman@wpe.ca]
Sent: November-10-17 12:32 PM
To: Steve Windl <Steve.Windl@pwgsc-tpsgc.gc.ca>
Cc: chris.daniel@theaimgroup.com; Gord Webster <Gord@wpe.ca>
Subject: EGD SES Spare Parts

Hi Steve.

As discussed, 15 – 7A fuses per the attached spare parts list have been dropped off with EGD security. These fuses combined with the 2 – spill kits received on Oct 27th will have satisfied EGD SES spare parts list per contract documents.

Please confirm acceptance. Thank you, enjoy the long weekend.

Chris Heesterman
General Superintendent
Western Pacific Enterprises Ltd.
604-540-1321 (main)
604-786-7558 (cell)
cheesterman@wpe.ca
www.wpe.ca

Confidential and proprietary information of MYR Group Construction Canada, Ltd. Unauthorized use, disclosure, or reproduction is strictly prohibited. Please consider the environment before printing this e-mail.

Frontier
POWER PRODUCTS

Frontier Power Products Ltd.
7983 Progress Way
Delta, BC Canada V4G 1A3
Tel: 604-946-5531
Main fax: 604-946-8524
Parts fax: 604-946-7723
www.frontierpower.com

July 21, 2017

Attention: Gord Webster

Subject: EGD Spares Request

Further to the attached spread sheet we have added comments to the pertinent items on why they w\ere not provided and the reason why.

Regards,

Craig Einarson
Sales Manager

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Spare Parts Turn Over To Owner

Specification: 26 32 10

750KW Standby Generator

Item 1.11.1 Extra Materials

QTY Required	Description	Yes	No	
1	Spare control Circuit Breaker per size		N/A	All circuit boards have integral fusing, no external fusing is used
12	Indicating Light Bulb per Rating		N/A	We do not use light bulbs on our controls only long life LED for all indicators
1	control Relay c/w Socket per Rating		N/A	All control circuit boards use only integral relay and are non-replaceable
1	Contactor Operating Coil		N/A	We have not supplied any contactor mechanisms this is typically a requst for transfer switches
6	Fuel Filter Elements per filter or seperator #GM 13947	Yes		
6	Fuel Filter Elements per filter or seperator #GM36914	Yes		
6	Fuel Filter Elements per filter or seperator #32562-58300	Yes		
6	Oil Filter Element #GM 32057	Yes		
6	Oil Filter Element #GM 13950	Yes		
6	Oil Filter Element #32540-21600	Yes		
6	By-Pass Element #37540-02100	Yes		
6	Air Cleaner Elements #274821	Yes		

Item 1.11.2 Tools

QTY	Description	Yes	No	
3	Battery Service Tools Hydromiter	Yes		
3	Plastic Squeese Bottle	Yes		
3	Engine Barring Device		N/A	Barring device is not available on this engine model

Item 2.10.4

QTY	Description	Yes	No	
5	Spare Fuses per Battery Charger (5 only store inside each charger panel)		N/A	5 Fuses where supplied, please confirm comment spares not supplied, WPE will provide

Item 2.12

QTY	Description	Yes	No
2	Set of spare wire markers for each external wiring connection (each generator)	Yes	

Item 2.17

QTY	Description	Yes	No
3	350 Liter Spill Kit	Yes	

Other

QTY	Description	Yes	No
1	Fuel Tank Dip Stick	Yes	

Materials Received by:

Name: ______________________________

Signature: ______________________________ Date: ____________

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Receiving Report for Major Electrical Equipment

Report No: 9
Date: MARCH 30/17
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation

Additional Information: DWG 8426
Reference Document: 26 32 10

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point (H)	inspected* initials/date	
1.0	Equipment tag				Tag #
2.0	Equipment description(See Remarks)	et			SPILL KITS X4
3.0	Material Request Form				Form #
4.0	P.O.	et			P.O. # C-847-001
5.0	Box/Crate #				Box #
6.0	General Information	et			350 LITER KIT
6.1	Quantity verification with packing slip	et			YES
6.2	Visual Examination (prior to possession)	et			GOOD
6.3	Visual Examination (prior to installation)	et			
6.4	Photos taken	et			Yes ✓ No
6.2	Visual Examination (prior to possession)	et			
7.0	Storage of Materials				
7.1	Materials stored as per contract specification				
7.2	If no specification, stored as per direction by customer	et			ON SITE

Accepted for Western Pacific Enterprises GP

Name: Chris Herstellman
Signature: et
Date: March 31st/17

Check sheet authorized for use by:

Lee Smith
QA Manager

Format: WPE-CHK-E071 Issue: # 3 (mm/dd/yy) Date: 10/26/12, 01/20/14, 08/26/2014, 10/20/16

LS,BB


SPILL CONTROL MATERIAL
SPILL CONTROL MATERIAL
SDH
64286

WESTERN PACIFIC ENTERPRISES GP
ELECTRICAL TECHNOLOGY AND INSTALLATIONS

Receiving Report for Major Electrical Equipment

Report No: 012
Date: MARCH 31, 2017
No. of pages

Client: PWGSC
Project No.: C847
Project Name: EGD - SSES Standby Power Generation
Additional Information: DWG 8426
Reference Document: 26 32 10

Items to Inspect		Western Pacific Enterprises GP			Remarks:
		inspected initials/date	hold point (H)	inspected* initials/date	
1.0	Equipment tag 3:	ct			Tag # SPARE PARTS
2.0	Equipment description(See Remarks)	ct			750KW GENERATOR
3.0	Material Request Form				Form #______
4.0	P.O.	ct			P.O. # C-847-01
5.0	Box/Crate #				Box # 1
6.0	General Information	ct			SPARE PARTS 1.11
6.1	Quantity verification with packing slip	ct			
6.2	Visual Examination (prior to possession)	ct			
6.3	Visual Examination (prior to installation)	ct			
6.4	Photos taken	ct			Yes ✓ No ______
6.2	Visual Examination (prior to possession)	ct			
7.0	Storage of Materials				
7.1	Materials stored as per contract specification				
7.2	If no specification, stored as per direction by customer	ct			ON SITE
	SEE INVENTORY LIST ATTACHED				

Accepted for Western Pacific Enterprises GP

Name: chris Hoesterman
Signature: ct
Date: MARCH 31ST/17

Check sheet authorized for use by:

Lee Smith
QA Manager


FRAGILE
KOHLER
274821
QTY 1
FRAGILE
KOHLER
274821
QTY 1
FRAGILE
KOHLER
274821
QTY 1


FITTING FOR
ADAPTERS ROOF
FRAGILE
DO NOT DROP-THIS SIDE UP
KEEP COOL AND DRY
FRAGILE
HANDLE WITH CARE
UP
KOHLER
GM32057
Filtre à huile
KOHLER
274821
QTY 1
MADE IN U.S.A.
KOHLER
GM13950
Qty 6
Oil Filter
Filtre à huile
Filtro de Aceite


24 KV
KOHLER
GM13950
Qty 6
Oil Filter
Filtre à huile
Filtro de Aceite
KOHLER
GM32057
Filtre à huile
Filtro de aceite
FRAGILE
DO NOT DROP-THIS SIDE UP
KEEP COOL AND DRY
KOHLER
274821
QTY 1
MADE IN U.S.A.
FRAGILE
HANDLE WITH CARE


OIL ELEMENT
オイル エレメント
32540-21600
1PC
FUEL FILTER
1PC
BY-PASS ELEMENT
バイパス エレメント
37540−02100
1 PC

WESTERN PACIFIC ENTERPRISES LTD.
ELECTRICAL TECHNOLOGY AND INSTALLATIONS
1321 KETCH COURT, COQUITLAM, B. C. V3K 6X7 TEL: 604-540-1321 FAX: 540-1390

Feb. 1, 2017

EGD Material Transfer

SSES – Standby Power Generation System
Contract EZ108-170397
Project R.057890.003

CCN-02 – Electrical Shop Upgrades Deleted from Contract

The following materials have been turned over from Western Pacific Enterprises Ltd. to the owner as part of the deleted work:

- **Square D stainless steel, weatherproof disconnect switch cat. #J50AWK c/w 100A Square D circuit breaker cat. #HJL36100**
- **Manual Transfer Switch, Marathon Thompson Power Systems, model #TS 870**
- **Generator Connection Box, West Coast Electric Cam-Lok Splitter Cabinet**
- **Panelboard 6A, Square D 600V, 225A, c/w (1) neutral assembly kit, (1) 150A 3P circuit breaker, type HJ and (1) 50A 3P circuit breaker, type EJB**

Material received by;

Name	Signature	Date
Steve Windl PWGSC		Jan 31, 2017

14 – WARRANTY LETTERS

CERTIFICATE OF WARRANTY

THIS IS TO CERTIFY THAT ALL EQUIPMENT SUPPLIED AND INSTALLED BY **WESTERN PACIFIC ENTERPRISES LTD.** #1321 KETCH COURT, COQUITLAM, BC AT:

ESQUIMALT GRAVING DOCK – SSES STANDBY POWER GENERATION SYSTEM

IS COMPLETE WITH A **12 MONTH** CONTRACTOR AND MANUFACTURER'S WARRANTY AS PER THIS PROJECT'S SUBSTANTIAL COMPLETION DATE OF **OCTOBER 31, 2017** FOR ALL EQUIPMENT AND MATERIALS SUPPLIED UNDER THIS CONTRACT.

PLEASE DIRECT ALL WARRANTY ISSUES ATTENTION RON FETTBACK.
PHONE: 604.540.1321

Gord Webster

Gord Webster
Project Manager
Our Ref #C847

1973 – 2017
44
YEARS OF EXCELLENCE
Western Pacific
Enterprises LTD.