

March 9, 2017

Vancouver Pile Driving
20 Brooksbank Avenue
North Vancouver, B.C.
V7J 2B8

Attention: Mr. Jeremy Mc Dermitt, EIT
Project Engineer

Re: Cathodic Protection (cp) System Re-Commissioning
Esquimalt Graving Dock (EGD)- South Landing Jetty
Victoria, B.C.

The initial system re-energization was undertaken on December 27th, 2016 with the follow up survey completed on January 31, 2017. Please find attached our report, including rectifier, current and potential data as well as a sketch drawing showing the dock structure and the protection system including replacement anode locations. A summary of the adjustive survey results is as follows.

1. Protection Criteria: Please see Appendix I of the report for the National Association of Corrosion Engineers (NACE) protection criteria, Standard SP0169-2013. For saltwater environments a silver-silver chloride reference electrode is generally used with an equivalent potential of 800 millivolts negative.

2. Survey Results

2.1. Rectifier Operation: The impressed current system includes two 18 volt, 200 amp rectifiers. Operational details for each are as follows.

West System: The unit was re-energized in December to an initial output of 12.1 volts producing 113.0 amps of current with a circuit resistance of 0.107ohms. During the follow-up survey the system was adjusted to 9.5 volts producing 78.5 amps with a circuit resistance of 0.121 ohms. No adjustments or repairs were required and system operation is considered satisfactory at this time.

East System: The unit was re-energized in December to an initial output of 8.8 volts producing 77.5 amps of current with a circuit resistance of 0.113 ohms. During the follow-up survey, the system was adjusted to 7.9 volts producing 66.0 amps with a circuit resistance of 0.120 ohms. No adjustments or repairs were required and system operation is considered satisfactory at this time.

2.2 Anodes: As part of the overall dock project work the existing anodes were removed and inspected and many for both systems were found to be in a deteriorated condition. As a result. a number were replaced and/or repositioned with standard Mixed Metal Oxide (MMO) seabed placed assemblies including 4 of 6 anodes for the west system and 4 of 5 anodes for the east system.

Note also that with removal of the temporary sheet pile wall, the apparent shorting condition to the pile structure was resolved. On this basis, fewer anodes were again required for the West System with placements intended to match the system configuration prior to 2015. For further details please see the attached sketch drawing.

In summary the cp systems should be left on at all times except during dock work or other unusual conditions. Monthly or quarterly checks on system output should be undertaken with a total target current level of approximately 145 amps. Changes greater than 15% in output should be referred to Corrosion Service Company for review.

2.3 Wiring & Miscellaneous Hardware: As part of the overall dock project some cp system cabling was reconfigured including new routing and bond connections. In summary visual inspections and testing confirm all negative connection wiring, bond connections and other related provisions are now in satisfactory with no further work required at this time.

2.4. Status of Protection: As the data show in Appendix IV, potential measurements meet the equivalent NACE No. 1 Protection Criterion at most test locations with protection levels more robust in the immediate area of the anodes. Over the coming months we expect to see further improvement in protection levels due to on-going polarization, however some sections of the sheet pile wall may remain only marginal protected due to increases of the seabed elevation.

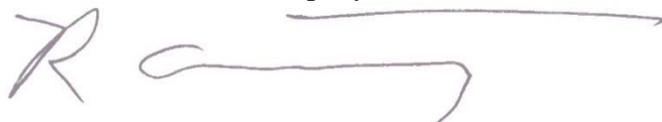
Finally, as part of the overall dock project work sacrificial anodes were installed on five Beacon piles west of the South Jetty Dock. These structures were inspected and tested and potential survey data confirm the NACE No.1 Protection Criterion is being fully on all the piles. No further work is required at this time.

Aside from regular checks on system outputs and a complete maintenance survey by year end no other work is required at this time.

We trust this information is to your satisfaction and note your final invoice for the project work including this survey and report will be mailed to you. If you have questions or require additional information, please contact the undersigned at our Annacis Island office.

Yours truly,

Corrosion Service Company Limited



Ross Armstrong
BC Regional Branch Manager
NACE Certified, No. 6520
Encl.



ICCP Systems	COMMISSIONING SURVEY
CATHODIC PROTECTION MARINE PILES	
Esquimalt Graving Dock South Landing Wharf	
VANCOUVER PILE DRIVING PO# 316215, EGD ICCP	

Prepared for: Vancouver Pile Driving Ltd.
20 Brooksbank Avenue
North Vancouver, B.C. V7J 2B8

Prepared by: _____
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Approved By: _____
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NACE Certified No. 6520

Date: February 2017

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Corrosion Service Company Limited

REPORT SUMMARY

The initial system re-energization was undertaken on December 27, 2016 with the follow up adjustive survey completed on January 31, 2017. A summary of the adjustive survey results is as follows.

Protection Criteria: Please see Appendix I of the report for the National Association of Corrosion Engineers (NACE) protection criteria, Standard SP0169-2013. For saltwater environments a silver-silver chloride reference electrode is generally used with an equivalent potential of 800 millivolts negative.

Rectifier Operation: The impressed current system includes two 18 volt, 200 amp rectifiers. Operational details for each are as follows.

West System: The unit was re-energized in December to an initial output of 12.1 volts producing 113.0 amps of current with a circuit resistance of 0.107ohms. During the follow-up survey the system was adjusted to 9.5 volts producing 78.5 amps with a circuit resistance of 0.121 ohms. No other adjustments or repairs were required and system operation is considered satisfactory at this time.

East System: The unit was re-energized in December to an initial output of 8.8 volts producing 77.5 amps of current with a circuit resistance of 0.113 ohms. During the follow-up survey, the system was subsequently re-adjusted to 7.9 volts producing 66.0 amps with a circuit resistance of 0.120 ohms. No other adjustments or repairs were required and system operation is considered satisfactory at this time.

Anodes: As part of the overall dock project work the existing anodes were removed and inspected and many for both systems were found to be in a deteriorated condition. As a result, a number were replaced and/or repositioned including 4 of 6 anodes for the west system and 4 of 5 anodes for the east system. Note also that with removal of the temporary sheet pile wall, the apparent shorting condition to the pile structure was resolved. On this basis, fewer anodes were again required for the West System with placements intended to match the system configuration prior to 2015. For further details please see the attached sketch drawing.

In summary the cp systems should be left on at all times except during dock work or other unusual conditions. Monthly or quarterly checks on system output should be undertaken with a total target current level of approximately 145 amps. Changes greater than 15% in output should be referred to Corrosion Service Company for review.

Wiring & Miscellaneous Hardware: As part of the overall dock project some cp system cabling was reconfigured including new routing and bond connections. In summary visual inspections and testing confirm all negative connection wiring, bonding and other related provisions are now in satisfactory with no further work required at this time.

Status of Protection: As the data show in Appendix IV, potential measurements meet the equivalent NACE No. 1 Protection Criterion at most test locations with protection levels more robust in the immediate area of the anodes. Over the coming months we expect to see further improvement in protection levels due to on-going polarization, however some sections of the sheet pile wall may remain only marginal protected due to increases of the seabed elevation.

Finally, as part of the overall dock project work sacrificial anodes were installed on five Beacon piles west of the South Jetty Dock. These structures were inspected and tested and potential survey data confirm the NACE No.1 Protection Criterion is being fully on all the piles. No further work is required at this time.

Aside from regular checks on system outputs and a complete maintenance survey by year end no other work is required at this time.

1.0 BACKGROUND

- 1.1 A cathodic protection system was installed at the subject site in 1986. Cathodic protection is provided to the South Landing Wharf including the piling supports and the sheet pile wall. The installation was completed by Ricketts-Sewell Electric Ltd. of Victoria.
- 1.2 Since that time the system has performed well. Rectifier outputs have been allowed to decline as structure polarization has generally maintained protection levels at reduced current levels.
- 1.3 To improve protection levels in some areas several new lead silver anodes were installed in May 1999. The anode installation has provided a more balanced current discharge and as a result system outputs have been reduced.
- 1.4 During July 2006 two new 50lb. lead silver anodes were installed for the west rectifier. Other work included replacement of failed conduit straps as well as cleaning and coating of some bond connections.
- 1.5 The last complete survey was undertaken in May 2014. At that time protection levels were found to be complete on most accessible piles and complete to near complete on the sheet pile wall.
- 1.6 Starting in 2015, at the South Jetty, seabed remediation work and removal of the wooden dock structure was undertaken. As part of the project work the anodes and much of the system cabling were temporarily removed and then subsequently replaced in late 2016.
- 1.7 This report covers the recommissioning survey of the above noted systems undertaken by Corrosion Service Company Limited.

2.0 PURPOSE

- 2.1 To determine the status of the anodes, rectifiers and associated wiring.
- 2.2 To measure rectifier outputs, bond, ground and anode lead drains. To inspect cables and other provisions for condition and operation.
- 2.3 To make adjustments and undertake minor repairs to the system to achieve optimum performance.
- 2.4 To determine the level and extent of protection being achieved throughout dock structure.

- 2.5 To report on the survey results and to make recommendations for maintaining complete protection.

3.0 PROCEDURE

- 3.1 Survey Equipment
- Fluke IP 67 Voltmeter,
 - T & R or Neilson Copper Sulphate Electrodes,
 - CCPL-3 silver-silver chloride electrode
 - Swain model Sea Clip D.C. ammeter
- 3.2 The rectifiers were inspected. Voltage and current readings were recorded and total circuit resistance was calculated. To check meter accuracy, readings were taken with an external meter.
- 3.3 For the dock facility, structure-to-water constant on potential readings were recorded for as many of the accessible piles and sheet pile wall as possible (See Appendix IV).
- 3.4 Negative and anode leads were measured for current drains.
- 3.5 All data was tabulated and analyzed in the preparation of this report.

4.0 DISCUSSION OF RESULTS

4.1 Status of Facilities

- 4.11 **Rectifiers:** The impressed current system includes two 18 volt, 200 amp rectifiers. Operational details for each are as follows

West System: The unit was re-energized in December to an initial output of 12.1 volts producing 113.0 amps of current with a circuit resistance of 0.107ohms. During the follow-up survey the system was adjusted to 9.5 volts producing 78.5 amps with a circuit resistance of 0.121 ohms. No other adjustments or repairs were required and system operation is considered satisfactory at this time.

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The systems should be left on at all times except during dock work or other unusual conditions. Monthly or quarterly checks on system output should be undertaken with a total target current level of approximately 140 amps. Changes greater than 15% in output should be reported to Corrosion Service Company Limited.

4.12 **Anodes:** As part of the overall dock project work the existing anodes were removed and inspected and many, for both systems, were found to be in a deteriorated condition. As a result, a number were replaced and/or repositioned including 4 of 6 anodes for the west system and 4 of 5 anodes for the east system. The replacements were a Mixed Metal Oxide (MMO) type anode with direct placement on the seabed. Note also that with removal of the temporary sheet pile wall, the apparent shorting condition to the pile structure was resolved. On this basis, fewer anodes were again required for the West System with placements intended to match the system configuration prior to 2015. For further details please see the attached sketch drawing.

4.13 **Wiring & Miscellaneous Hardware:** As part of the overall dock project some cp system cabling was reconfigured including new routing and bond connections. In summary visual inspections and testing confirm all negative connection wiring, bonding and other related provisions are now in satisfactory with no further work required at this time.

4.2 Status of Protection

4.21 Protection Criterion

For interpretation of potential data see Appendix I: National Association of Corrosion Engineers (NACE) Protection Criteria, standard SP0169-2013. For saltwater environments a silver-silver chloride electrode is generally used with an equivalent referenced potential of 800 millivolts negative.

Note that polarized potentials cannot be measured for the dock structure, as protective current from the rectifiers cannot be interrupted during the potential measurement. To minimize IR drop reading error, potential measurements are recorded in close proximity to pile surfaces at locations remote from the anodes. In highly conductive electrolytes, such as saltwater, voltage drops other than those across the structure to electrolyte boundary are expected to be very low and as such should not add significant error to potential measurements.

4.22 Dock Structures

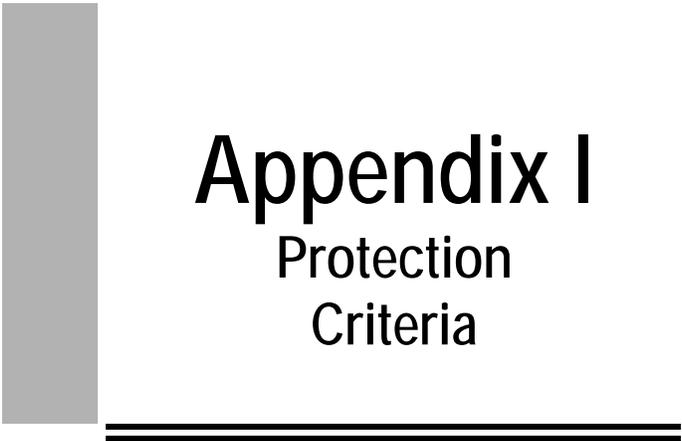
As the data show in Appendix IV, potential measurements meet the equivalent NACE No. 1 Protection Criterion at most test locations with protection levels more robust in the immediate area of the anodes. Over the coming months further improvement in protection levels can be expected due to on-going polarization. However some sections of the sheet pile wall may remain only marginal protected due to increases of the seabed elevation.

Finally, as part of the overall dock project work sacrificial anodes were installed on five Beacon piles west of the EGD South Jetty. These structures were inspected and tested and potential survey data confirm the NACE No.1 Protection Criterion is being fully on all the piles. No further work is required at this time.

Aside from regular checks on system outputs and a complete maintenance survey by year end no other work is required at this time.

5.0 RECOMMENDATIONS

- 5.1 Monthly or quarterly checks on system output should be undertaken with a target total target current level of approximately 140 amps. Changes greater than 15% in output should be referred to CSCL. for review.
- 5.2 Undertake a complete maintenance survey by year end.
- 5.3 Revise the cathodic protection system drawing to reflect the system changes noted in the attached sketch.



Appendix I

Protection Criteria

APPENDIX I

CATHODIC PROTECTION CRITERIA

From NACE Standard Practice SP0169-2013
(Annotated, Steel & Cast Iron)

- No. 1** A negative (cathodic) potential of at least 850mV with the cathodic protection applied. This potential is measured with respect to a saturated copper-copper sulphate electrode contacting the electrolyte. Voltage drops other than those across the structure to electrolyte boundary must be considered for valid interpretation of this voltage measurement.

NOTE: Consideration is understood to mean the application of sound engineering practice in determining the significance of voltage drops by methods such as:

- Measuring or calculating the voltage drop(s).
- Reviewing the historical performance of the cathodic protection system.
- Evaluating the physical and electrical characteristics of the structure and its environment.
- Determining whether or not there is physical evidence of corrosion.
- Other sound engineering practices as noted in section 6.2.1.3.1.2 of the referenced standard.

- No. 2** A negative polarized potential of at least 850mV measured with respect to a saturated copper-copper sulphate electrode contacting the electrolyte.

- No. 3** A minimum of 100mV of cathodic protection between the structure and a stable reference electrode contacting the electrolyte. The formation or decay of polarization can be measured to satisfy this criterion.

ALTERNATE REFERENCE ELECTRODES

Other standard reference electrodes may be substituted for the saturated copper/copper sulphate reference electrode. Two commonly used reference electrodes are listed below along with their voltage equivalent (at 25°C [77°F]) to – 850 mV referred to a saturated copper/copper sulphate reference electrode.

- High potential zinc reference electrode: +250 mV.
- Saturated silver/silver chloride reference electrode used in 25 ohm-cm seawater: -800 mV.



Appendix II

Rectifier Data

**APPENDIX II-1
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

RECTIFIER "A" PERFORMANCE DATA (West Rectifier, Near Bent 42)

Model No: CSOWTZ 18-200EPZ, Serial No. 86C1051

Note: AF: As Found, AL: As Left, Set: System Activated

<u>DATE</u>	<u>TIME</u>	<u>BY</u>	<u>STATUS</u>	<u>TAP</u>	<u>VOLTS</u>	<u>AMPS</u>	<u>OHMS</u>	<u>HOURS</u>
12/09/10	10:30	RJA	AF/AL	CBF4	8.0	48.0	0.167	66674
			Meter Check		8.3	41.5	0.200	
12/07/11	11:15	RJA	AF/AL	CBF4	7.5	50.0	0.150	74950
			Meter Check		8.3	37.8	0.220	
03/10/12	10:00	RJA	AF	CBF4	8.3	34.5	0.241	82145
			AL		8.1	60.0	0.135	
11/12/12	09:00	RJA	AF/AL	CBF4	8.0	60.0	0.133	n/a
			Meter Check		7.8	60.8	0.128	
12/11/13	11:30	RJA	AF/AL	CBF4	8.0	60.0	0.133	n/a
			Meter Check		7.6	57.5	0.132	
02/24/14	10:00	RJA	AF/AL	CBF4	8.0	60.0	0.133	n/a
			Meter Check		7.7	57.0	0.135	
05/05/14	09:30	JES	AF	CBF4	7.7	59.0	0.131	n/a
			AL		7.4	75.0	0.099	
12/27/16	08:00	JES	AF	CBF4	8.5	25.0	0.340	n/a
			AL	CCF3	12.0	115.0	0.104	
			Meter Check		12.1	113.0	0.107	
01/31/17	09:30	JES	AF	CCF3	12.2	105.0	0.116	n/a
			AL	CCF1	9.5	80.0	0.119	
			Meter Check		9.5	78.5	0.121	

**APPENDIX II-2
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

RECTIFIER "B" PERFORMANCE DATA (East Rectifier, Near Bent 20)

Model No: CSOWTZ 18-200EPZ, Serial No. 86C1052

Note: AF: As Found, AL: As Left, Set: System Activated

<u>DATE</u>	<u>TIME</u>	<u>BY</u>	<u>STATUS</u>	<u>TAP</u>	<u>VOLTS</u>	<u>AMPS</u>	<u>OHMS</u>	<u>HOURS</u>		
12/09/10	11:00	RJA	AF/AL	CBF3	7.5	50.0	0.146	n/a		
			Meter Check		7.6				52.0	
12/07/11	11:00	RJA	AF/AL	CBF3	7.5	50.0	0.147	n/a		
			Meter Check		7.2				49.0	
12/11/12	09:30	RJA	AF/AL	CBF3	7.5	50.0	0.140	n/a		
			Meter Check		7.4				52.5	
12/11/13	11:30	RJA	AF/AL	CBF3	7.5	50.0	0.150	n/a		
			Meter Check		7.1				50.5	
02/24/14	10:30	RJA	AF/AL	CBF3	7.0	50.0	0.140	n/a		
			Meter Check		7.3				49.5	
05/05/14	10:00	JES	AF/AL	CBF3	7.0	55.0	0.127	n/a		
			Meter Check		7.3				53.0	
12/27/16	08:00	JES	AF	CBF3	7.3	52.5	0.140	n/a		
			AL	CBF5	9.0				70.0	0.129
			Meter Check		8.8				77.5	0.113
01/31/17	09:30	JES	AF	CBF5	9.0	75.0	0.120	n/a		
			AL	CBF4	8.0				65.0	0.123
			Meter Check		7.9				66.0	0.120



Appendix III

Anode Data

**APPENDIX III-1
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

ANODE TO STRUCTURE CURRENT DATA - RECTIFIER A (West Rectifier)

SURVEY DATE	05/05/14	05/05/14	12/27/16	01/31/17	01/31/17
SURVEY BY	J.E.S.	J.E.S.	J.E.S.	J.E.S.	J.E.S.
<u>CURRENT</u>	<u>59.0</u>	<u>75.0</u>	<u>113.0</u>	<u>103.0</u>	<u>78.5</u>

Anode Cable #

1	10.7	17.2	19.6	19.0	14.1
2	5.3	4.5	20.1	18.7	13.3
3	12.2	19.0	21.1	20.4	14.9
4	10.2	17.3	21.0	12.4	14.7
5	10.1	7.9	15.6	20.1	8.6
6	6.6	11.0	16.4	16.2	12.9

Anode Total	55.1	76.9	113.8	106.8	78.5
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Negative Cable			115.2	107.6	79.5
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**APPENDIX III-2
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

ANODE TO STRUCTURE CURRENT DATA - RECTIFIER B (East Rectifier)

SURVEY DATE	05/05/14		12/27/16	12/27/16	12/27/16
SURVEY BY	J.E.S.		J.E.S.	J.E.S.	J.E.S.
<u>CURRENT</u>	<u>53.0</u>		<u>77.5</u>	<u>74.5</u>	<u>63.0</u>

Anode Cable #

1	11.9	-	15.9	14.9	12.1
2	10.9	-	15.7	18.1	13.7
3	9.9	-	18.7	15.0	12.1
4	11.9	-	14.9	15.9	13.0
5	9.8	-	14.6	14.2	12.5

Anode Total	54.4	-	79.8	78.1	63.4
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Negative Cable

(Structure Bond)

1			34.9	34.1	28.0
2			44.7	43.8	35.0

Total			79.6	77.9	63.0
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Appendix IV

Potential
Survey Data

**APPENDIX IV-1
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

PILE-TO-WATER POTENTIAL MEASUREMENTS, MILLIVOLTS NEGATIVE
Readings to Silver-Silver Chloride Reference Electrode
Except Where Noted All Measurements Recorded In Water At 1 Meter Depth

SURVEY DATE	12/11/13	12/27/16	01/31/17
SURVEY BY	R.J.A	J.S.	J.S.
<u>CURRENT</u>	<u>108 AMPS</u>	<u>STATIC</u>	<u>180 AMPS</u>
Pile Location			
W1		585	802
W2			795
W3			626
W4			575
W5		530	571
W6			614
W7			785
W8			788
W9			874
W10		605	861
W11			742
W12	820		801
W13	814		803
W14	809		667
W15		596	633
W16	880		660
W17	870		744
W18			742
W19	790		715
W20	813	608	743
W21			935
W22			1015
W23			850
W24			864
W25	930		901
W26	940		900
W27	940		807
W28	968		814
W29	1000		805
W30	980	666	847
W31	1027		818
W32	1030		793
W33	1040		710

**APPENDIX IV-2
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

PILE-TO-WATER POTENTIAL MEASUREMENTS, MILLIVOLTS NEGATIVE
Readings to Silver-Silver Chloride Reference Electrode
Except Where Noted All Measurements Recorded In Water At 1 Meter Depth

SURVEY DATE	12/11/13	12/27/16	01/31/17
SURVEY BY	R.J.A	J.S.	J.S.
<u>CURRENT</u>	<u>108 AMPS</u>	<u>STATIC</u>	<u>180 AMPS</u>
Pile Location			
A1	960		1064
A2	894	653	1067
A3			1057
B1	950		1195
B2	1102		1086
B3			1112
B4			903
B4 WEST			900
B5			928
B5 WEST			933
B6			858
B7			851
B8			935
B9			985
B10			964
B11	952		828
B12	940		884
B13	924		890
B14	890		751
B15			739
B16	940		743
B16 WEST	943		744
B17	1085		829
B17 WEST	1080		830
B18	1750		909
B19	880		804
B20	940		810
B21			983
B22			1055
B23			885
B24	1035		895
B25	1050		915
B26	1000		982
B27	1065		902

**APPENDIX IV-3
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

PILE-TO-WATER POTENTIAL MEASUREMENTS, MILLIVOLTS NEGATIVE
Readings to Silver-Silver Chloride Reference Electrode
Except Where Noted All Measurements Recorded In Water At 1 Meter Depth

SURVEY DATE	12/11/13	12/27/16	01/31/17
SURVEY BY	R.J.A	J.S.	J.S.
<u>CURRENT</u>	<u>108 AMPS</u>	<u>STATIC</u>	<u>180 AMPS</u>
Pile Location			
B28	1086		931
B28 WEST	1086		931
B29	1236		1000
B29 WEST	1240		996
B30	1080		970
B31	1124		906
B32	1100		861
B33			758
B34			740
C1	1070		1263
C2	1028		1219
C2 WEST	1000	642	1210
C3	938		965
C4			
C5			910/971
C6			934/935
C7			860/859
C8	870		907
C9	902		1123
C10	1080		1226
C11	1060		1179
C11 WEST	1075		1131
C12	1050		1168
C13	1060		1159
C14	1050		886
C14 WEST	1045		874
C15	970		851
C16	960		886
C16 WEST	960		887
C17	1130		1036
C17 WEST	1135		1053
C18	1230		1016

**APPENDIX IV-4
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

PILE-TO-WATER POTENTIAL MEASUREMENTS, MILLIVOLTS NEGATIVE
Readings to Silver-Silver Chloride Reference Electrode
Except Where Noted All Measurements Recorded In Water At 1 Meter Depth

SURVEY DATE	12/11/13	12/27/16	01/31/17
SURVEY BY	R.J.A	J.S.	J.S.
<u>CURRENT</u>	<u>108 AMPS</u>	<u>STATIC</u>	<u>180 AMPS</u>
Pile Location			
C18 WEST	1230	664	1037
C19	995		934
C20	992		950
C21	1150	671	1241
C22	1226		1490
C23	1050		969
C23 WEST	1051		973
C24	1129	648	1033
C25	1085		1083
C26	1132		1141
C26 WEST	1145		1151
C27	1114		1053
C28	1154		956
C28 WEST	1155		945
C29	1310		1123
C29 WEST	1323		1118
C30	1230	628	1081
C30 WEST	1230		1090
C31	1150		1036
C32	1140	654	918
C33	1070		835
C34	1085		784
D1	1024		1021
D2	980		1056
D2 WEST	980	646	1018
D3	1010		1139
D4	904		1116
D4 WEST	840	655	1080
D5			990
D5 WEST			976
D6			886
D6 WEST		645	890
D7			907

**APPENDIX IV-5
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

PILE-TO-WATER POTENTIAL MEASUREMENTS, MILLIVOLTS NEGATIVE
Readings to Silver-Silver Chloride Reference Electrode
Except Where Noted All Measurements Recorded In Water At 1 Meter Depth

SURVEY DATE	12/11/13	12/27/16	01/31/17
SURVEY BY	R.J.A	J.S.	J.S.
<u>CURRENT</u>	<u>108 AMPS</u>	<u>STATIC</u>	<u>180 AMPS</u>
Pile Location			
D8	860		929
D8 WEST	830		932
D9	910	655	1024
D9 WEST	916		1027
D10	1042		1141
D11	1046		1161
D11 WEST	1048		1160
D12	1114	668	1032
D13	1109		1026
D14	1142		901
D14 WEST	1138		904
D15	980		879
D16	985	671	898
D16 WEST	965		897
D17	1006		936
D17 WEST	1010		1000
D18	1042		1039
D18 WEST	1043		1036
D19	1000		980
D20	1040		938
D20 WEST	1030		961
D21	1114		1079
D21 WEST	1120		1074
D22	1249		1054
D23	1080		994
D23 WEST	1074		993
D24	1140		1105
D25	1130		1136
D26	1238		1005
D26 WEST	1233		1109
D27	1140		1011

**APPENDIX IV-6
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

PILE-TO-WATER POTENTIAL MEASUREMENTS, MILLIVOLTS NEGATIVE
Readings to Silver-Silver Chloride Reference Electrode
Except Where Noted All Measurements Recorded In Water At 1 Meter Depth

SURVEY DATE	12/11/13	05/05/14	12/27/16	01/31/17
SURVEY BY	R.J.A	J.E.S.	J.S.	J.S.
<u>CURRENT</u>	<u>108 AMPS</u>	<u>-</u>	<u>STATIC</u>	<u>180 AMPS</u>
Pile Location				
D28	1116	-	655	985
D28 WEST	1116	-		985
D29	1228	-		1109
D29 WEST	1240	-		1111
D30	1185	-		1153
D30 WEST	1202	-		1143
D31	1120	-		1132
D32	1154	-	655	1109
D32 WEST	1160	-		1108
D33	1220	-		888
D33 WEST	1210	-		850
D34	1054	-		831
E1	1011	-		1189
E2	910	-		1091
E2 WEST	869	-		1140
E3	808	-		1017
E4	815	-		1071
E4 WEST	900	-		1018
F1	890	852		928
F2	800	850		1018
F3	790	861		1072
F4	726	891		1050
F4 WEST	740	900		1041
MF1	870	810		1003
MF2	880	900		1067
MF3	810	956		1030
G1	723	784		962
G2	730	844		1010
G3	720	852		1040
G4	760	896		1015
G4 WEST	860	915		1071

**APPENDIX IV-7
PUBLIC WORKS CANADA
ESQUIMALT GRAVING DOCK
SOUTH LANDING WHARF PILING**

PILE-TO-WATER POTENTIAL MEASUREMENTS, MILLIVOLTS NEGATIVE
Readings to Silver-Silver Chloride Reference Electrode
Except Where Noted All Measurements Recorded In Water At 1 Meter Depth

SURVEY DATE	12/11/13	05/05/14	12/27/16	01/31/17
SURVEY BY	R.J.A	J.E.S.	J.S.	J.S.
<u>CURRENT</u>	<u>108 AMPS</u>	<u>-</u>	<u>STATIC</u>	<u>180 AMPS</u>
Pile Location				
H1	790	704		1007
H2	782	870		963
H3	740	874		985
H4	633	860		1014
H4 WEST	710	874		1033
MH1	732	895		962
MH2	740	962		948
MH3				936
I1	700	704	650	976
I2	764	862		1004
I3	740	-		995
I4	680	879		962
I4 WEST	645	936	653	960
		Sea Wall		674
Beacon Piles (sacrificial)				
Northwest				1042
Southwest				1024
Northeast				1023
Southeast				1016
East				943

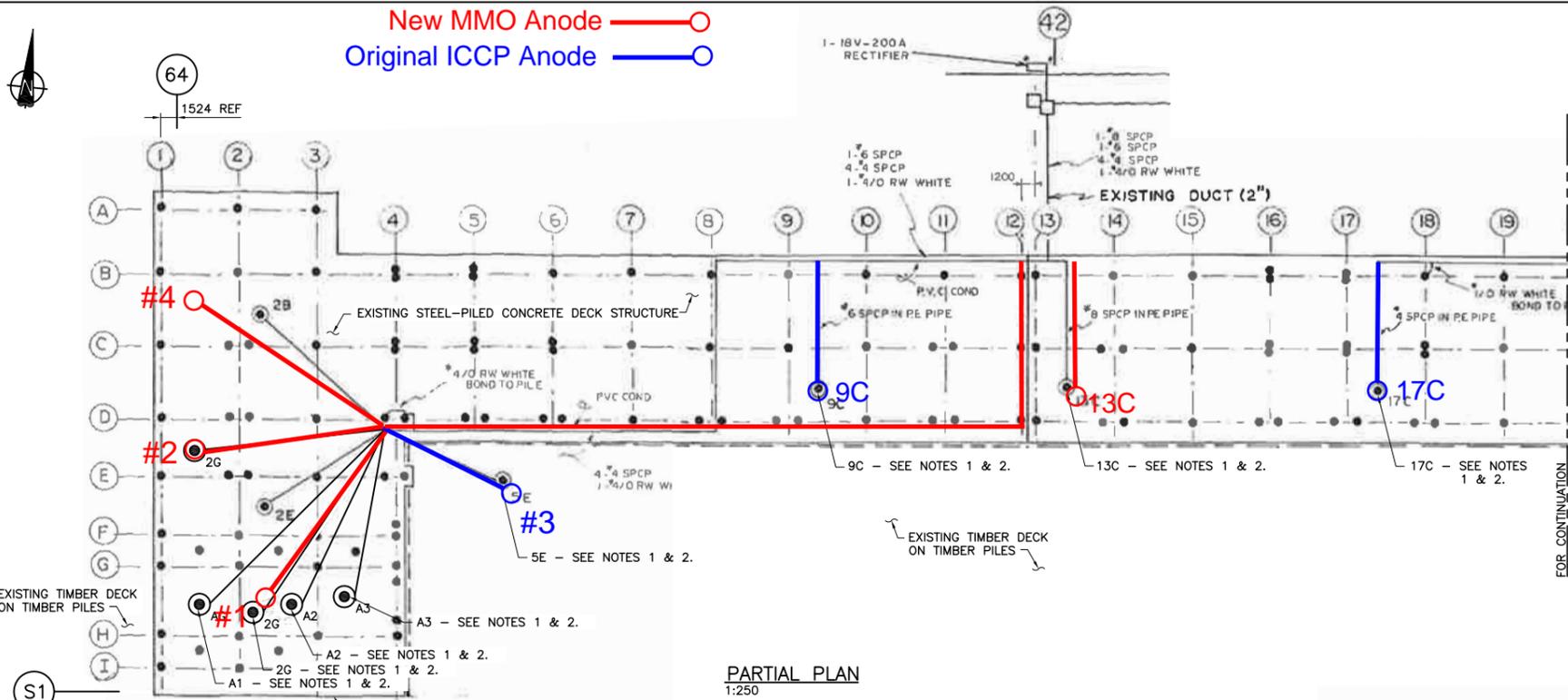


Appendix V

System
Drawing



New MMO Anode ———○
 Original ICCP Anode ———○



PARTIAL PLAN
1:250

LEGEND:

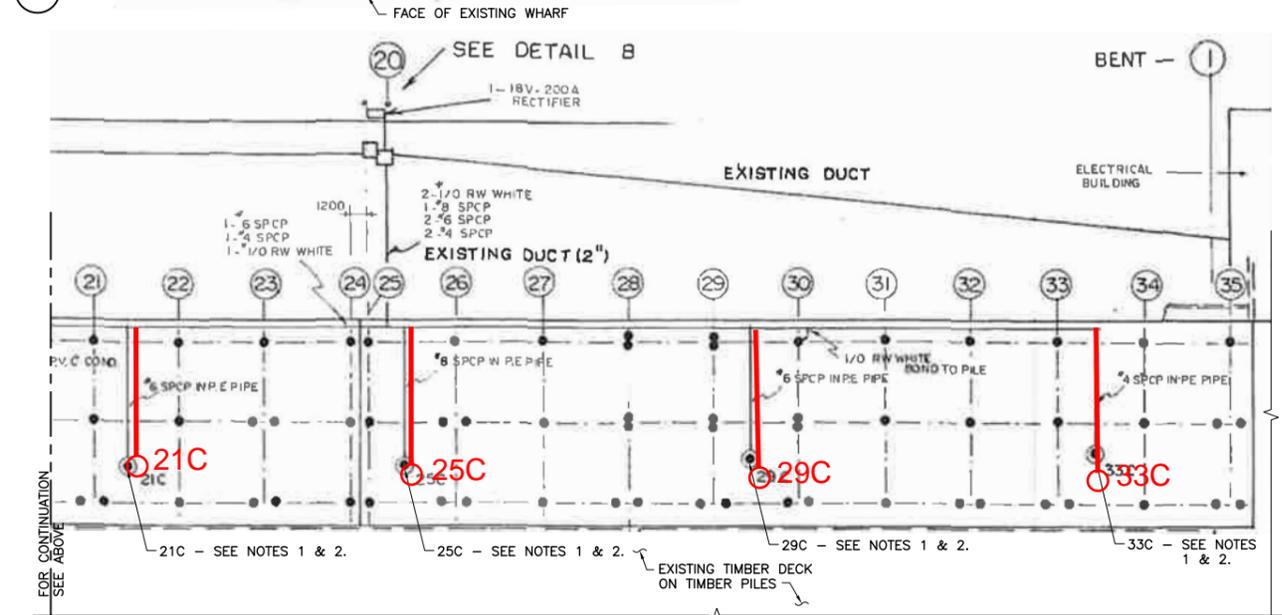
- LEAD SILVER ANODE
- EXISTING STEEL PIPE PILE

NOTES:

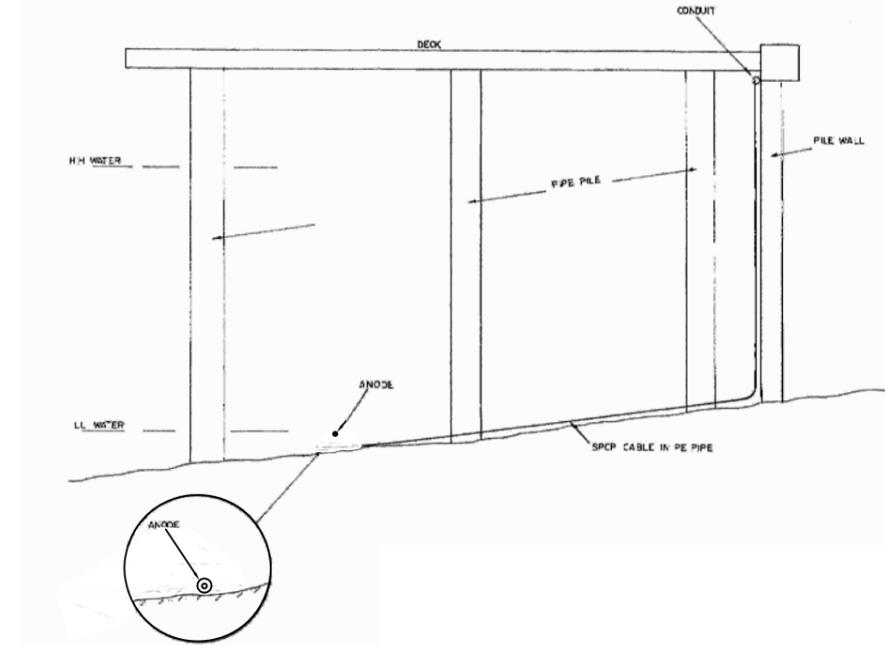
1. TEMPORARILY REMOVE, STORE AND REINSTATE ANODES TO ORIGINAL LOCATION AFTER DREDGING AND ENGINEERED CAPPING WORK ARE COMPLETED.
2. DO NOT DAMAGE THE INSULATION ON THE ANODE CABLE DURING REMOVAL AND REINSTATING.
3. DETAILS TAKEN FROM ESQUIMALT GRAVING DOCK IMPROVEMENTS, PROJECT NUMBER PR.100772 DRAWINGS 15 AND 16 OF 75, SUPPLEMENTED BY FIELD INFORMATION FROM EGD SEDIMENT REMEDIATION SOUTH JETTY UNDER-PIER EROSION PROTECTION RECORD DRAWINGS S15 (REFERENCE DRAWINGS).
4. REFER TO SPECIFICATION SECTION 02 41 13 FOR ICCP SYSTEM REQUIREMENTS.

CORROSION TESTING REQUIREMENTS:

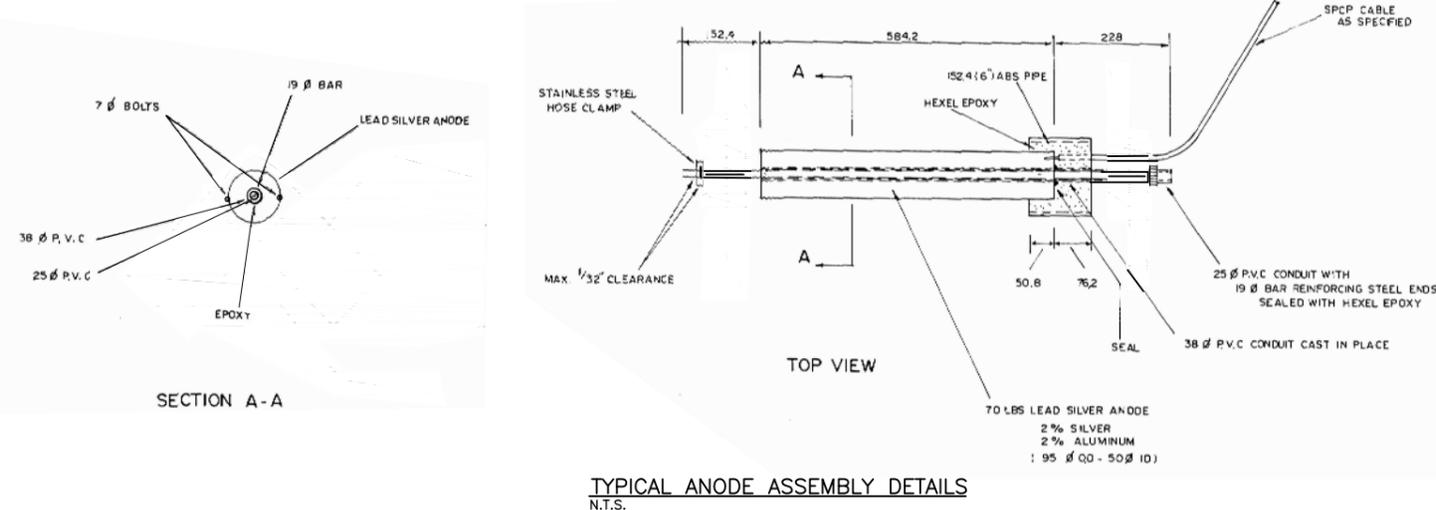
1. INSPECT AND TEST THE ICCP SYSTEM BEFORE DISCONNECTING AND AFTER REINSTATEMENT TO CONFIRM THAT THE REINSTATED ICCP SYSTEM PROVIDES THE SAME OPERATIONAL PERFORMANCE LEVEL AS PREVIOUSLY EXISTED.



PARTIAL PLAN
1:250



TYPICAL SECTION
N.T.S.



TYPICAL ANODE ASSEMBLY DETAILS
N.T.S.



Revision/	Description/Description	Date/Date
0	ISSUED FOR TENDER	2014/12/19

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet
ESQUIMALT GRAVING DOCK
 825 ADMIRALS ROAD, VICTORIA, BC

ESQUIMALT GRAVING DOCK WATERLOT PHASE 2 SOUTH JETTY UNDER-PIER SEDIMENT REMEDIATION

Consultant Signature Only
 Designed by/Concept par
 GEOFF COOPER
 Drawn by/Dessiné par
 ARNIE RIST
 PWSC Project Manager/Administrateur de Projets TPSGC
 ANDREW MYLLY
 Regional Manager, Environmental Services
 COLLIN KINGMAN

Drawing title/Titre du dessin
SOUTH JETTY MODIFICATIONS TO CATHODIC PROTECTION SYSTEM

Project No./No. du projet	Sheet/	Revision no./
R.018400.002	E11	0

