



**Fisheries and Oceans
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FISHERIES AND OCEANS CANADA

PUNTLEDGE RIVER HATCHERY

WATER SUPPLY ENERGY RECOVERY

F1700-164035/A

LIST OF TECHNICAL DOCUMENTS

PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	November 16, 2016	VERSION	2

TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

- SECTION 01 11 00 - Summary of Work
- SECTION 01 33 00 - Submittal Procedures
- SECTION 01 52 00 - Construction Facilities
- SECTION 01 61 00 - Common Product Requirements
- SECTION 01 78 00 - Closeout Submittals



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DIVISION 9 - FINISHES

- Section 09 91 23 - Interior Painting

DIVISION 23 - HVAC

- SECTION 23 00 00 - Ventilation

DIVISION 26 - ELECTRICAL

- SECTION 26 05 00 - Electrical General Requirements

DIVISION 31 - EARTHWORKS

- SECTION 31 23 33 - Excavating, Trenching and Backfilling

DIVISION 40 - PROCESS INTEGRATION

- SECTION 40 20 00 - Process Piping
- SECTION 40 20 10 - Process Piping Valves
- SECTION 40 90 00 - Instrumentation and Control for Process Systems

DIVISION 48 - ELECTRICAL POWER GENERATION

- SECTION 48 10 00 - Supply of Turbine and Generator Unit (for information only)
- SECTION 48 10 01 - Installation of Turbine and Generator Unit

APPENDICES

- APPENDIX A - Control Narrative Technical Memorandum

CONTRACT DRAWINGS (BOUND SEPARATELY)

Number	Revision	Description
G-002	C	General – Site – Key Plan and Drawing List
G-003	0	General – Site – Site Plan and Notes
M-002	0	Mechanical – Aeration Building – Piping Demolition
M-003	0	Mechanical – Aeration Building – Piping Plan, Sections & Bill of Materials
M-004	0	Mechanical – Aeration Building – Ventilation – Plan & Details
M-005	0	Mechanical – Aeration Building – Turbine & Piping Details
P-001	0	Process – Aeration Building - Schematic and Control Strategy
P-002	0	Process – Aeration Building – Process and Instrumentation Diagram
S-002	0	Structural - Aeration Building - Control Room Partition Wall
E-001	F	Electrical – Hatchery & Aeration Buildings – Single Line Diagram
E-002	D	Electrical – Hatchery & Aeration Buildings – Wall Elevations
E-003	C	Electrical – Aeration Building – Control Cabinet Layout
E-004	E	Electrical – Aeration Building – Control Cabinet Power
E-005	E	Electrical – Aeration Building – Control Cabinet I/O-1
E-006	E	Electrical – Aeration Building – Control Cabinet I/O-2
E-007	B	Electrical – Aeration Building – Control Cabinet I/O-3
E-008	D	Electrical – Aeration Building – Control Cabinet I/O-4
E-009	C	Electrical – Aeration Building – Control Cabinet I/O-5
E-010	B	Electrical – Conduit Section Details
E-011	D	Electrical – Aeration Building – Electrical Equipment Layout
E-012	B	Electrical – Aeration Building – Induction Generator Protection & Control Schematic
E-100	B	Cable Schedule

REFERENCE DRAWINGS (BOUND SEPARATELY)

Drawing Number	Description
31-6-204	Key Plan, Hydrographs, Index
31-6-206	Water Supply Mains-Plan
31-6-207	Supply Mains-Profile & Test Hole Data
31-6-208	Supply Mains-Sections & Details
31-6-210	20" Connection To Hydro Penstock
31-6-211	Aeration Bldg Site Plan Outside Piping
31-6-212	Aeration Bldg Ground Floor Plan
31-6-213	Aeration Bldg Upper Floor Plan
31-6-214	Aeration Bldg Sections
31-6-215	Aeration Bldg Details
31-6-216	Aeration Bldg Concrete
31-6-217	Aeration Bldg Concrete
31-6-218	Aeration Bldg Electrical Layout

Puntledge River Hatchery Water Supply Energy Recovery
List of Contract Documents

Drawing Number	Description
31-6-219	Aeration Bldg Electrical Schematic
31-6-220	Aeration Bldg Control Panel
31-6-236	PRH Bottom-Dwg List, Location Map, Hydrograph
31-6-237	PRH Bottom-Drainage Plan KWL
31-6-238	PRH Bottom-Drainage Profiles KWL
31-6-240	PRH Bottom-Water Distribution
31-6-243	PRH Bottom Misc Drainage & Piping Details
31-6-259	PRH Hatch Bldg Floor Plan
31-6-260	PRH Hatch Bldg Elevations
31-6-261	PRH Hatch Bldg Sections
31-6-262	PRH Hatch Bldg Sections
31-6-263	PRH Bottom Hatch Bldg Wall Sections
31-6-279	PRH Sewage Lift Station & Disposal Field
31-6-289	PRH Electric Symbols Line Dwg Elevations
31-6-290	PRH Bottom Electrical Site Layout
31-6-300	PRH Site Layout & Site Paving
31-6-302	PRH Landscaping #1 Bottom Site
31-6-303	PRH Landscaping #2 Bottom Site
31-6-326	Modifications To Existing Piping For New Aerator Pots & Support Sys.
31-6-331	Aeration Tower Modifications Key Map, Site Location, Site Plan & Dwg Index
31-6-332	Aeration Tower Modifications Metalwork & Piping General Arrangement
M-001	Aeration Building Modifications Flowmeter Replacement - Plan and Notes
S-001	Aeration Building Modifications Access Platform – Plan, Sections, and Details
E-013	BC Hydro Application Site Plan

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2	Issued for Tender	November 16, 2016	Added E-100, revised electrical drawing revisions.	Neal Whiteside

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END OF SECTION

TECHNICAL SPECIFICATON

SECTION	Division 1 General Requirements Section 01 11 00 Summary of Work		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1 GENERAL.....2

1.1 WORK COVERED BY CONTRACT DOCUMENTS.....2

1.2 PROJECT BACKGROUND2

1.3 SCOPE OF WORK.....2

1.4 CONTRACT METHOD.....3

1.5 WORK BY OTHERS.....3

1.6 WORK SEQUENCE AND CONSTRUCTION SCHEDULE4

1.7 CONTRACTOR USE OF PREMISES4

1.8 OWNER OCCUPANCY4

1.9 PRE-PURCHASED EQUIPMENT4

1.10 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING.....4

1.11 EXISTING SERVICES.....4

1.12 DOCUMENTS REQUIRED5

2 PRODUCTS.....5

3 EXECUTION5

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0	Issued for Tender	April 15, 2016	Original	Neal Whiteside

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1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- 1.1.1 Work of this Contract comprises supply and construction of a Water Supply Energy Recovery system on the water supply to the Puntledge River Hatchery ("the Hatchery") located at Courtenay, BC.
- 1.1.2 The Water Supply Energy Recovery system will be located in the existing Aeration Building, with electrical connection work in the Hatchery Building workshop and mechanical rooms.

1.2 PROJECT BACKGROUND

- 1.2.1 The Puntledge River Hatchery is located on Vancouver Island below Comox Lake in Courtenay.
- 1.2.2 Water used by the Hatchery is primarily supplied via a gravity supply from Comox Lake via a BC Hydro penstock. The facility's year round average flow is approximately 300 L/s (but with flows ranging from 0 to 700 L/s depending on hatchery uses).
- 1.2.3 The gravity water supply has considerable excess head. The available head is currently 'wasted' at pressure reducing valve(s) in the Aeration Building at the entry to the hatchery site.
- 1.2.4 Typical static gravity water supply pressure (measured in Aeration Building) – 1035 kPa (150 psi).
- 1.2.5 Typical static discharge pressure (measured in Aeration Building) – 70 kPa (10 psi).
- 1.2.6 The Water Supply Energy Recovery system will be located on the existing gravity supply line in the Aeration Building Valve Room.
- 1.2.7 The energy recovery system will utilize BC Hydro's net metering program and be connected to the BC Hydro grid through the existing electrical service at the Hatchery Building.
- 1.2.8 A pumped water supply from Puntledge River to the Aeration Building provides supply redundancy to the Hatchery.
- 1.2.9 Hatchery typical water supply requirements are as follows:

Water Use(s)	Period	Flow Range (Lpm)	Comments
Incubation	Dec. 1 to Feb. 1	8,000 - 15,000	
Rearing	Feb. 1 to May 31	12,000 – 32,000	Flows increase through period
Spring Clean-up	Jun. 1 to Jun. 15	0 – 2,000	Flows variable
Summer Chinook Capture	Jun. 16 to Jul. 31	32,000	
Summer Shutdown	Aug. 1 to Sep. 15	0 – 2,000	Minimal Usage corresponds to yearly shutdown
Fall Capture	Sep. 16 to Nov. 30	25,000 – 35,000	Flows increase through period

1.3 SCOPE OF WORK

- 1.3.1 The project scope includes but is not limited to the following:
- Removal of existing gravity supply control valves and selective removal of associated piping.
 - Removal of an interior masonry wall and construction of a new masonry partition wall for the Aeration Building control room.

- Supply, installation, and commissioning of a turbine-generator unit.
- Supply, installation and commissioning of control valves including the turbine control valve.
- Supply, installation and testing of process piping.
- Upgrading of the Aeration building ventilation system.
- Disconnecting the existing Aeration Building electrical service (from the Pumphouse),
- Installation, testing and connection of a new electrical service to the Aeration Building from the Hatchery Building.
- Supply, installation, testing, and commissioning of new electrical panels in the Aeration Building Electrical / Storage room.
- Supply, installation, testing, and commissioning of a new water supply control system including the energy recovery turbine controls and integrating existing instrumentation for the water supply. Controls to be located in the Aeration Building Control Room.

1.4 CONTRACT METHOD

1.4.1 Construct Work under stipulated price contract.

1.5 WORK BY OTHERS

- 1.5.1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from DFO Representative.
- 1.5.2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to DFO Representative, in writing, any defects which may interfere with proper execution of Work.
- 1.5.3 Work of Project executed prior to start of Work of this Contract, and which is specifically excluded from this Contract:
- Supply, installation of flow meters as shown on Reference drawing M-001.
 - Supply, installation of access platform as shown on Reference drawing S-001.

1.6 WORK SEQUENCE AND CONSTRUCTION SCHEDULE

- 1.6.1 Construct Work in stages to accommodate Owner's continued use of premises and water supply during construction.
- 1.6.2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.
- 1.6.3 Maintain access to the hatchery site at all times.
- 1.6.4 The work includes disruptions to the water supplies to the hatchery. Water supply must be maintained for all periods except for **Shutdown Period from August 1 to August 31**.
- 1.6.5 During Shutdown Period maintain Washdown and Fire Protection water supply except for designated full shutdowns not to exceed one working day.
- 1.6.6 Schedule all process piping removals and installation, valve installation and turbine installation work to occur within Shutdown Period.
- 1.6.7 Work outside of the shutdown period will be limited to preparation or clean-up work that does not affect the Hatchery Water Supply.
- 1.6.8 An approved Construction Schedule is required prior to any work being completed on-site.
- 1.6.9 Construction Schedule to demonstrate that the Work will meet above requirements.
- 1.6.10 Submit Construction Schedule as per Section 01 33 00.

1.7 CONTRACTOR USE OF PREMISES

- 1.7.1 Limited use of premises for Work as described in Section and as per approved Construction Schedule.
- 1.7.2 Limited use of premises for storage as shown on Contract Drawings.
- 1.7.3 Co-ordinate use of premises under direction of DFO Representative.
- 1.7.4 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.8 OWNER OCCUPANCY

- 1.8.1 Owner will occupy premises during entire construction period for execution of normal operations.
- 1.8.2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.9 PRE-PURCHASED EQUIPMENT

- 1.9.1 The Turbine – Generating Unit has been pre-purchased. Refer to Section 48 10 00 .
- 1.9.2 Purpose for pre-purchasing this equipment is to ensure delivery to site within required project completion schedule. Obtain necessary shop drawings from DFO Representative and proceed to co-ordinate details for installation, expedite, receive, unload, install, connect and test specified equipment.
- 1.9.3 Equipment specification (Section 48 10 00) for pre-purchased items are included for information.
- 1.9.4 Install Turbine – Generating Unit as per Section 48 10 01.

1.10 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- 1.10.1 Execute work with least possible interference or disturbance to hatchery operations. Arrange with DFO Representative to facilitate execution of work.

1.11 EXISTING SERVICES

- 1.11.1 Notify DFO Representative of any intended interruption of services including reason and expected duration and obtain required permission.
- 1.11.2 Where Work involves breaking into or connecting to existing services, give DFO Representative 72 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to hatchery operations.
- 1.11.3 Provide alternative routes for pedestrian and vehicular traffic.
- 1.11.4 Establish location and extent of service lines in area of work before starting Work. Notify DFO Representative of findings.
- 1.11.5 Submit schedule to and obtain approval from DFO Representative for any shut-down or closure of active service or facility including water supply, power, and communications services. Adhere to approved schedule and provide notice to affected parties.
- 1.11.6 Provide temporary services when directed by DFO Representative to maintain critical building and tenant systems.
- 1.11.7 Where unknown services are encountered, immediately advise DFO Representative and confirm findings in writing.
- 1.11.8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- 1.11.9 Record locations of maintained, re-routed and abandoned service lines.

1.12 DOCUMENTS REQUIRED

- 1.12.1 Maintain at job site, one copy each document as follows:
 - Contract Drawings – red-lined with changes.
 - Specifications.
 - Addenda.
 - Reviewed Shop Drawings.
 - Change Orders.
 - Other Modifications to Contract.
 - Field Test Reports.
 - Copy of Approved Work Schedule.
 - Health and Safety Plan and Other Safety Related Documents.
 - Other documents as specified.

2 PRODUCTS

- 2.1.1 Not used.

3 EXECUTION

- 3.1.1 Not used

END OF SECTION

TECHNICAL SPECIFICATON

SECTION	Division 1 General Requirements Section 01 33 00 Submittal Procedures		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1 GENERAL.....2

1.1 SCOPE.....2

1.2 ADMINISTRATIVE.....2

1.3 SHOP DRAWINGS AND PRODUCT DATA.....2

1.4 INSURANCE SUBMITTALS.....4

2 PRODUCTS.....4

3 EXECUTION.....4

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1 GENERAL

1.1 SCOPE

- 1.1.1 This section identifies general submittal requirements and procedures for the project.
- 1.1.2 Individual sections list which submittals are required.

1.2 ADMINISTRATIVE

- 1.2.1 Submit to DFO Representative a list of required submittals for review.
- 1.2.2 Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- 1.2.3 Do not proceed with Work affected by submittal until review is complete.
- 1.2.4 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- 1.2.5 Contractor to review submittals prior to submission to DFO Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- 1.2.6 Notify DFO Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- 1.2.7 Verify field measurements and affected adjacent Work are co-ordinated.
- 1.2.8 Contractor's responsibility for errors and omissions in submission is not relieved by DFO Representative's review of submittals.
- 1.2.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by DFO Representative review.
- 1.2.10 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- 1.3.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- 1.3.2 Where "sealed shop drawings" are required by Contract Documents submit drawings stamped and signed by professional engineer registered or licensed in British Columbia.
- 1.3.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- 1.3.4 Allow seven days for DFO Representative's review of each submission.
- 1.3.5 Adjustments made on shop drawings by the DFO Representative are not intended to change the Contract Price. If adjustments affect value of Work, state such in writing to the DFO Representative, prior to proceeding with Work.

- 1.3.6 Make changes in shop drawings as the DFO Representative may require, consistent with Contract Documents. When resubmitting, notify the DFO Representative in writing of revisions other than those requested.
- 1.3.7 Submissions shall include:
- Date and revision dates.
 - Project title and number.
 - Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - Details of appropriate portions of Work as applicable:
 - Fabrication.
 - Layout, showing dimensions, including identified field dimensions, and clearances.
 - Setting or erection details.
 - Capacities.
 - Performance characteristics.
 - Standards.
 - Operating weight.
 - Wiring diagrams.
 - Single line and schematic diagrams.
 - Relationship to adjacent work.
- 1.3.8 After DFO Representative's review, distribute copies.
- 1.3.9 Submit electronic copy (in PDF format) of shop drawings for each requirement requested in specification Sections and as the DFO Representative may reasonably request.
- 1.3.10 Submit electronic copies (in PDF format) of product data sheets or brochures for requirements requested in specification Sections and as requested by DFO Representative where shop drawings will not be prepared due to standardized manufacture of product.
- 1.3.11 Submit electronic copies (in PDF format) of test reports, certificates, manufacturer's instructions, and field reports as requested in specification Sections and as requested by DFO Representative.
- 1.3.12 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- 1.3.13 Submit electronic copies (in PDF format) of Operation and Maintenance Data for requirements requested in specification Sections and as requested by DFO Representative.
- 1.3.14 Delete information not applicable to project.
- 1.3.15 Supplement standard information to provide details applicable to project.
- 1.3.16 If upon review by the DFO Representative, no errors or omissions are discovered or if only minor corrections are made, electronic copies will be returned and fabrication and installation of Work may proceed. If submittals are rejected, noted copy will be returned and resubmission of corrected submittals, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- 1.3.17 The review of submittals by the DFO Representative is for the sole purpose of ascertaining conformance with the general concept.
- This review shall not mean approval of the detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

- Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.4 INSURANCE SUBMITTALS

- 1.4.1 Immediately after award of Contract, submit WorksafeBC Clearance Letter.
- 1.4.2 Submit certificate of insurance immediately after award of Contract.

2 PRODUCTS

- 2.1.1 Not Used.

3 EXECUTION

- 3.1.1 Not Used.

END OF SECTION

TECHNICAL SPECIFICATON

SECTION	Division 1 General Requirements Section 01 52 00 Construction Facilities		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1 GENERAL.....2

1.1 SITE STORAGE/LOADING.....2

1.2 CONSTRUCTION PARKING.....2

1.3 EQUIPMENT, TOOL AND MATERIALS STORAGE.....2

1.4 SANITARY FACILITIES.....2

1.5 WATER.....2

1.6 ELECTRICITY.....2

1.7 CLEAN-UP.....2

2 PRODUCTS.....2

3 EXECUTION.....2

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0	Issued for Tender	April 15, 2016	Original	Neal Whiteside

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1 GENERAL

1.1 SITE STORAGE/LOADING

- 1.1.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- 1.1.2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.2 CONSTRUCTION PARKING

- 1.2.1 Parking will be permitted on site only in locations shown on Drawings.

1.3 EQUIPMENT, TOOL AND MATERIALS STORAGE

- 1.3.1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- 1.3.2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.4 SANITARY FACILITIES

- 1.4.1 Contractor may use existing Hatchery sanitary facilities for work force.

1.5 WATER

- 1.5.1 Contractor may use existing Hatchery water taps subject to approval of DFO Representative of location of taps, and adequate backflow protection to protected potable and hatchery water supply as appropriate.

1.6 ELECTRICITY

- 1.6.1 Contractor may use existing Hatchery electrical power on an as-available basis.
- 1.6.2 Contractor is advised of limitations of using extension cords outside the Aeration Building due to current electrical grounding system.

1.7 CLEAN-UP

- 1.7.1 Remove construction debris, waste materials, packaging material from work site daily.
- 1.7.2 Clean dirt or mud tracked onto paved or surfaced roadways.
- 1.7.3 Store materials resulting from demolition activities that are salvageable.

2 PRODUCTS

- 2.1.1 Not Used.

3 EXECUTION

- 3.1.1 Not Used

END OF SECTION

TECHNICAL SPECIFICATON

SECTION	Division 1 General Requirements Section 01 61 00 Common Product Requirements		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1 GENERAL.....2

1.1 REFERENCES.....2

1.2 QUALITY2

1.3 STORAGE, HANDLING AND PROTECTION.....2

1.4 MANUFACTURER'S INSTRUCTIONS.....3

1.5 QUALITY OF WORK3

1.6 CO-ORDINATION3

1.7 REMEDIAL WORK.....3

1.8 LOCATION OF FIXTURES.....3

1.9 FASTENINGS3

1.10 FASTENINGS - EQUIPMENT4

1.11 PROTECTION OF WORK IN PROGRESS.....4

1.12 EXISTING UTILITIES.....4

2 PRODUCTS.....4

3 EXECUTION4

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1 GENERAL

1.1 REFERENCES

- 1.1.1 Within text of each specifications section, reference may be made to reference standards.
- 1.1.2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- 1.1.3 If there is question as to whether products or systems are in conformance with applicable standards, the DFO Representative reserves right to have such products or systems tested to prove or disprove conformance.
- 1.1.4 Cost for such testing will be born by the DFO Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- 1.2.1 Refer to General Conditions Clause 3.5.
- 1.2.2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- 1.2.3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- 1.2.4 Should disputes arise as to quality or fitness of products, decision rests strictly with the DFO Representative based upon requirements of Contract Documents.
- 1.2.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

1.3 STORAGE, HANDLING AND PROTECTION

- 1.3.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- 1.3.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- 1.3.3 Store products subject to damage from weather in weatherproof enclosures.
- 1.3.4 Store cementitious products clear of earth or concrete floors, and away from walls.
- 1.3.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- 1.3.6 Store sheet materials, and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- 1.3.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- 1.3.8 Remove and replace damaged products at own expense and to satisfaction of the DFO Representative.
- 1.3.9 Touch-up damaged factory finished surfaces to the DFO Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.4 MANUFACTURER'S INSTRUCTIONS

- 1.4.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- 1.4.2 Notify the DFO Representative in writing, of conflicts between specifications and manufacturer's instructions, so that DFO Representative will establish course of action.
- 1.4.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the DFO Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.5 QUALITY OF WORK

- 1.5.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the DFO Representative if required Work is such as to make it impractical to produce required results.
- 1.5.2 Do not employ anyone unskilled in their required duties. the DFO Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- 1.5.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the DFO Representative, whose decision is final.

1.6 CO-ORDINATION

- 1.6.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- 1.6.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.7 REMEDIAL WORK

- 1.7.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- 1.7.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.8 LOCATION OF FIXTURES

- 1.8.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- 1.8.2 Inform the DFO Representative of conflicting installation. Install as directed.

1.9 FASTENINGS

- 1.9.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- 1.9.2 Prevent electrolytic action between dissimilar metals and materials.
- 1.9.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- 1.9.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- 1.9.5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- 1.9.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.10 FASTENINGS - EQUIPMENT

- 1.10.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- 1.10.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- 1.10.3 Bolts may not project more than one diameter beyond nuts.
- 1.10.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.11 PROTECTION OF WORK IN PROGRESS

- 1.11.1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of the DFO Representative.

1.12 EXISTING UTILITIES

- 1.12.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by DFO Representative.
- 1.12.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

2 PRODUCTS

- 2.1.1 Not Used.

3 EXECUTION

- 3.1.1 Not Used.

END OF SECTION

TECHNICAL SPECIFICATON			
SECTION	Division 1 General Requirements Section 01 78 00 Closeout Submittals		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1	GENERAL	2
1.1	CLOSEOUT SUBMITTALS PROCEDURE.....	2
1.2	OPERATIONS AND MAINTENANCE MANUAL FORMAT.....	2
1.3	OPERATIONS AND MAINTENANCE MANUAL CONTENTS	2
1.4	AS-BUILT DOCUMENTS	3
1.5	RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS.....	3
1.6	EQUIPMENT AND SYSTEMS.....	4
1.7	MATERIALS AND FINISHES	4
1.8	SPARE PARTS AND SPECIAL TOOLS.....	4
1.9	WARRANTY INFORMATION	5
2	PRODUCTS	5
3	EXECUTION	5

Revision History

Version #	Status	Date	Description of Revisions	Author
0	Issued for Tender	April 13, 2016	Original	Neal Whiteside

Macintosh HD:Users:nealwhiteside:Documents:WEL:001-Projects:025 - Puntledge Des:600-specs:01 78 00 Closeout Submittals.docx

1 GENERAL

1.1 CLOSEOUT SUBMITTALS PROCEDURE

- 1.1.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- 1.1.2 Two weeks prior to Substantial Performance of the Work, submit to the DFO Representative, a draft digital copy (in PDF format) of the Operating and Maintenance manual in English.
- 1.1.3 If approved by the DFO Representative, provide four final paper copies of the Operating and Maintenance manuals.
- 1.1.4 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

1.2 OPERATIONS AND MAINTENANCE MANUAL FORMAT

- 1.2.1 Organize data as instructional manual.
- 1.2.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf [219 x 279] mm with spine and face pockets.
- 1.2.3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
- 1.2.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- 1.2.5 Arrange content by system under Section numbers and sequence of Table of Contents.
- 1.2.6 Provide tabbed coversheet for each separate product and system, with typed description of product and major component parts of equipment.
- 1.2.7 Text: manufacturer's printed data, or typewritten data.
- 1.2.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- 1.2.9 Provide [1:1] scaled CAD files in dwg format.

1.3 OPERATIONS AND MAINTENANCE MANUAL CONTENTS

- 1.3.1 Table of Contents for Each Volume: provide title of project;
 - Date of submission; names.
 - Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - Schedule of products and systems, indexed to content of volume.
 - For each product or system: List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

- 1.3.2 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- 1.3.3 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- 1.3.4 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.4 AS -BUILT DOCUMENTS

- 1.4.1 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- 1.4.2 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- 1.4.3 Keep record documents available for inspection by the DFO Representative.

1.5 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- 1.5.1 Record information on set of Construction drawings.
- 1.5.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- 1.5.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- 1.5.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - Measured depths of elements of foundation in relation to finish first floor datum.
 - Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - Field changes of dimension and detail.
 - Changes made by change orders.
 - Details not on original Contract Drawings.
 - References to related shop drawings and modifications.
- 1.5.5 Specifications: mark each item to record actual construction, including:
 - Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - Changes made by Addenda and change orders.

- 1.5.6 Other Documents: maintain manufacturer's certifications, inspection certifications and field test records, required by individual specifications sections.

1.6 EQUIPMENT AND SYSTEMS

- 1.6.1 For each item of equipment and each system include description of unit or system, and component parts. Give function, normal operation characteristics and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- 1.6.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- 1.6.3 Include installed colour coded wiring diagrams.
- 1.6.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions.
- 1.6.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- 1.6.6 Provide servicing and lubrication schedule, and list of lubricants required.
- 1.6.7 Include manufacturer's printed operation and maintenance instructions.
- 1.6.8 Include sequence of operation by controls manufacturer.
- 1.6.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- 1.6.10 Provide installed control diagrams by controls manufacturer.
- 1.6.11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- 1.6.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- 1.6.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- 1.6.14 Include test and balancing reports.
- 1.6.15 Additional requirements: as specified in individual specification sections.

1.7 MATERIALS AND FINISHES

- 1.7.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- 1.7.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- 1.7.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- 1.7.4 Additional requirements: as specified in individual specifications sections.

1.8 SPARE PARTS AND SPECIAL TOOLS

- 1.8.1 Provide spare parts and special tools, in quantities specified in individual specification sections.
- 1.8.2 Provide items of same manufacture and quality as items in Work.
- 1.8.3 Deliver to site, stored in Aeration Building storage room.

- 1.8.4 Receive and catalogue items.
- 1.8.5 Submit inventory listing to the DFO Representative.
- 1.8.6 Include approved listings in Maintenance Manual.
- 1.8.7 Obtain receipt for delivered products and submit prior to final payment.
- 1.8.8 Delivery, Storage And Handling
 - Store spare parts, and special tools in manner to prevent damage or deterioration.
 - Store in original and undamaged condition with manufacturer's seal and labels intact.
 - Store components subject to damage from weather in weatherproof enclosures.
 - Remove and replace damaged products at own expense and for review by the DFO Representative.

1.9 WARRANTY INFORMATION

- 1.9.1 Assemble warranties as required by each specification at end of Operations and Maintenance Manual. Submit upon acceptance of work and organize as follows:
 - Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within [ten] days after completion of applicable item of work.
 - Verify that documents are in proper form, contain full information, and are notarized.
 - Co-execute submittals when required.
 - Retain warranties until time specified for submittal.
- 1.9.2 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- 1.9.3 Respond in timely manner to oral or written notification of required construction warranty repair work. Written verification to follow oral instructions. Failure to respond will be cause for the the DFO Representative to proceed with action against Contractor.

2 PRODUCTS

- 2.1.1 Not Used.

3 EXECUTION

- 3.1.1 Not Used.

END OF SECTION

TECHNICAL SPECIFICATION

SECTION	Division 9 Finishes Section 09 91 23 Interior Painting		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 18, 2016	VERSION	0

Table of Contents

1 GENERAL.....2

1.1 SUMMARY2

1.2 REFERENCES.....2

1.3 SITE CONDITIONS2

2 PRODUCTS.....3

2.1 MATERIALS3

2.2 COLOURS.....3

2.3 GLOSS/SHEEN RATINGS.....3

2.4 INTERIOR PAINTING SYSTEMS.....3

2.5 SPECIAL FINISHES3

3 EXECUTION3

3.1 MANUFACTURER'S INSTRUCTIONS.....3

3.2 GENERAL3

3.3 EXAMINATION.....4

3.4 PROTECTION4

3.5 SURFACE PREPARATION4

3.6 APPLICATION.....5

3.7 SITE TOLERANCES.....5

3.8 RESTORATION5

Revision History

Version #	Status	Date	Description of Revisions	Author
0	Issued for Tender	March 11, 2016	Original	Neal Whiteside

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1 GENERAL

1.1 SUMMARY

- 1.1.1 Section Includes: Material and installation of site applied paint finishes to new interior surfaces, including site painting of shop primed surfaces.
- Following items to be painted:
 - New Control Room masonry walls (both sides)
 - Existing unpainted Control Room masonry wall sections (unpainted sections exposed due to relocated equipment). New interior control room door and frame, and control room window frame.

1.2 REFERENCES

- 1.2.1 Master Painters Institute (MPI): MPI Architectural Painting Specifications Manual, 2004.

1.3 SITE CONDITIONS

- 1.3.1 Coordinate use of existing ventilation system with DFO Representative and ensure its operation during and after application of paint as required.
- 1.3.2 Provide Manufacturer's recommended minimum lighting level on surfaces to be painted.
- 1.3.3 Unless pre-approved written approval by DFO Representative and product manufacturer, perform no painting when:
- Ambient air and substrate temperatures are below °C.
 - Substrate temperature is above 32 °C unless paint is specifically formulated for application at high temperatures.
 - Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - The relative humidity is under 85 % or when the dew point is more than 3 degrees C variance between the air/surface temperatures. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature.
- 1.3.4 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
- 1.3.5 Allow new concrete and masonry to cure minimum of 28 days.
- 1.3.6 Surface and Environmental Conditions:
- Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - Apply paint when previous coat of paint is dry or adequately cured.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- 2.1.2 Provide paint materials for paint systems from single manufacturer.
- 2.1.3 Conform to latest MPI requirements for interior painting work including preparation and priming.
- 2.1.4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.
- 2.1.5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- 2.1.6 Provide paint products meeting MPI "Environmentally Friendly" E2 or E3 ratings based on VOC (EPA Method 24) content levels.
- 2.1.7 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- 2.1.8 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.

2.2 COLOURS

- 2.2.1 To match existing.

2.3 GLOSS/SHEEN RATINGS

- 2.3.1 To match existing.

2.4 INTERIOR PAINTING SYSTEMS

- 2.4.1 Paint interior surfaces in accordance with the following MPI Architectural Painting Specification Manual requirements.
- 2.4.2 Un-painted concrete masonry units: smooth and split face block and brick: INT 4.2A - Latex.
- 2.4.3 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts: INT 5.3A - Latex semi-gloss finish.

2.5 SPECIAL FINISHES

- 2.5.1 Process Piping and appurtenances: Field touch-up of shop coatings only, See Section 40 20 00.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- 3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

- 3.2.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- 3.2.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- 3.3.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to [Departmental Representative] [DCC Representative] [Consultant] damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- 3.3.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- 3.3.3 Maximum moisture content as follows:
- 3.3.4 Concrete / Masonry: 12 %.

3.4 PROTECTION

- 3.4.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by DFO Representative.
- 3.4.2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- 3.4.3 Protect factory finished products and equipment.
- 3.4.4 Protect Hatchery and Contractor's staff in and about the building.

3.5 SURFACE PREPARATION

- 3.5.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
- 3.5.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
- 3.5.3 Place "WET PAINT" signs in occupied areas as painting operations progress.
- 3.5.4 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
- 3.5.5 Remove dust, dirt, and other surface debris by wiping with dry, clean cloths.
- 3.5.6 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
- 3.5.7 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- 3.5.8 Allow surfaces to drain completely and allow to dry thoroughly.
- 3.5.9 Prepare surfaces for water-based painting; water-based cleaners should be used in place of organic solvents.
- 3.5.10 Use trigger operated spray nozzles for water hoses.
- 3.5.11 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- 3.5.12 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- 3.5.13 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes.

3.5.14 Touch up of shop primers with primer as specified.

3.6 APPLICATION

3.6.1 Apply paint by brush and roller. Conform to manufacturer's application instructions unless specified otherwise.

3.6.2 Brush and Roller Application:

3.6.3 Apply paint in uniform layer using brush and/or roller type suitable for application.

3.6.4 Work paint into cracks, crevices and corners.

3.6.5 Remove runs, sags and brush marks from finished work and repaint.

3.6.6 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

3.6.7 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

3.6.8 Sand and dust between coats to remove visible defects.

3.7 SITE TOLERANCES

3.7.1 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 RESTORATION

3.8.1 Clean and re-install hardware items removed before undertaken painting operations.

3.8.2 Remove protective coverings and warning signs as soon as practical after operations cease.

3.8.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

3.8.4 Protect freshly completed surfaces from paint droppings and dust. Avoid scuffing newly applied paint.

3.8.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition.

END OF SECTION

TECHNICAL SPECIFICATON

SECTION	Division 23 HVAC Section 23 00 00 Ventilation		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 14, 2016	VERSION	0

Table of Contents

1 GENERAL.....2

1.1 SCOPE.....2

1.2 REFERENCE STANDARDS2

1.3 SUBMITTALS2

2 PRODUCTS.....3

2.1 GENERAL3

2.2 FANS.....3

2.3 DAMPERS3

2.4 WEATHER HOODS.....3

3 EXECUTION4

3.1 INSTALLATION4

Revision History

Version #	Status	Date	Description of Revisions	Author
0	Issued for Tender	April 13, 2016	Original	Neal Whiteside

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1 GENERAL

1.1 SCOPE

- 1.1.1 This section includes all work associated with the supply, installation, and testing of all ductwork, fans, louvers, dampers, and actuators and associated ventilation equipment.

1.2 REFERENCE STANDARDS

- 1.2.1 The following standards apply to this section:
- Air Movement and Control Association Inc. - AMCA Publication 210, 211, 300, 301, and 511.

1.3 SUBMITTALS

- 1.3.1 Provide submittals as per Section 01 33 00 for the following items prior to ordering:
- All fans, louvers, and dampers – manufacturer's specification sheet showing dimensions, performance characteristics and materials of construction.
- 1.3.2 Provide submittals as per Section 01 33 00 for the following items prior to testing of equipment of this section:
- All fans, louvers, and dampers – manufacturer's operations and maintenance manual.

- 1.3.3 Models listed in this section are meant to illustrate a style of design and standard of quality desired. The Contractor may submit alternate products for approval. The DFO Representative will review alternates proposed and will approve alternates subject to the proposed equipment meeting design requirements listed and standard of quality.

2 PRODUCTS

2.1 GENERAL

- 2.1.1 Provide fans, dampers, and weather hoods as per schedule on drawings.

2.2 FANS

- 2.2.1 Provide fans rigidly mounted on a heavy gauge frame.
- 2.2.2 Fan motors shall be permanently lubricated, heavy-duty type, premium-efficiency matched to the fan load with a 1.15 service factor.
- 2.2.3 Fan to be statically and dynamically balanced.
- 2.2.4 Where mounting is in an exposed location, provide rear and/or front guards on fans to meet meeting WorksafeBC requirements.
- 2.2.5 Fan(s) shall comply with AMCA Publication 211 and be licensed to bear the AMCA Certified Rating Program seal. The fans shall be tested for air performance — flow rate, fan pressure, power, air density, speed of rotation and fan efficiency — according to ANSI/AMCA Standard 210/ASHRAE Standard 51. Fan sound ratings shall be certified in compliance with AMCA Publication 311 and shall comply with ANSI/AMCA Standard 301. The fans shall be tested according to ANSI/AMCA Standard 300.
- 2.2.6 Fan F-1 : Standard of Acceptance Pennbarry Model BX-20T
- 2.2.7 Fan F-2 : Standard of Acceptance Pennbarry Model P10VA

2.3 DAMPERS

- 2.3.1 Damper frame to be extruded aluminum
- 2.3.2 Damper frame to be 70 mm deep when closed and 143 mm deep when open.
- 2.3.3 Damper blades to be extruded aluminum with vinyl edge seals integral to the blade
- 2.3.4 Dampers shall be licensed to bear the AMCA Certified Ratings Program seal for air performance, air leakage and efficiency in accordance with AMCA Publication 511.
- 2.3.5 Provide adjustable gravity counter-weight suitable for installation.
- 2.3.6 Ratings for vent losses at design air flow as per damper schedule on drawings or better.
- 2.3.7 Ratings for air leakage better than $0.2 \text{ m}^3/\text{s}/(\text{m}^2 \text{ face area})$ with 250 Pa across the closed damper (40 cfm/ft² @ 1"WC).
- 2.3.8 Damper D-1: Standard of Acceptance Pennbarry Type WSR Wall Shutter
- 2.3.9 Damper D-2: Standard of Acceptance Ventex Model 1205

2.4 WEATHER HOODS

- 2.4.1 Provide galvanized steel, welded construction, weather hoods with epoxy powder coat finish.

- 2.4.2 For inlet hoods, size weather hood so air velocities through hood are less than 3.5 m/s to prevent rain ingress.
- 2.4.3 Provide insect and bird screens integral to hood.
- 2.4.4 Colour selection by Owner from available standard colours.
- 2.4.5 Standard of Acceptance : Ventex Weatherhood WHD-90

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Mount fans, dampers and hoods in accordance with manufacturer's instructions and as suitable for mounting material.
- 3.1.2 Commissioning
- 3.1.3 Test operation of fans with thermostats during commissioning.
- 3.1.4 Adjust damper counterweights.

END OF SECTION

TECHNICAL SPECIFICATON

SECTION	Division 26 Electrical Section 26 05 00 - Electrical General Requirements		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	Nov 16, 2016	CONTRACT #	File/Contract #####
VERSION	D	STATUS	Tender

Table of Contents

1 GENERAL.....2

1.1 SCOPE2

1.2 REFERENCE STANDARDS2

1.3 SUBMITTALS3

1.4 ALTERNATES3

2 PRODUCTS.....3

2.1 GENERAL.....3

2.2 MATERIALS3

2.3 WIRE AND CABLE.....4

2.4 TRANSFORMERS.....5

3 EXECUTION.....6

3.1 INSTALLATION6

3.2 SITE TESTING AND COMMISSIONING.....7

Revision History

Version #	Status	Date	Description of Revisions	Author
D	Tender	Nov. 16, 2016	Revised for Tender	Rajan Gandhi

1 GENERAL

1.1 SCOPE

- 1.1.1 This section includes work associated with the supply, installation, and testing of all electrical equipment in the Work Shop, Mechanical Room and Aeration Building.
- 1.1.2 The scope of work includes the supply and installation of a new 250A circuit breaker in the hatchery building electrical room. This circuit breaker will be used as a new feeder to the Aeration building.
- 1.1.3 The scope of work includes the supply and installation of the 600V feeder cable between the Hatchery electrical room and the 600V isolation transformer in the Aeration building. This cable must be installed in a new cable tray between the electrical room and the junction box to be installed in the workshop. The junction box will be used to convert from Teck90 cable to RW90 cable suitable for pulling in the underground conduit and then enter the Aeration building and terminate at a junction box and converted to Teck90 cable to feed the isolation transformer.
- 1.1.4 The scope of work includes the supply and installation of all of the 600V equipment in the aeration building electrical room as shown on the electrical drawings.
- 1.1.5 The scope of work includes disconnecting and removal of the incoming cable for the existing service to the aeration building. Contractor is also responsible for disconnecting the 'supply' end of the cable that currently feeds the aeration building located in the BC Hydro Pump house. This cable is direct buried between the sites so the abandoned buried portion of the cable must comply with CEC requirements.
- 1.1.6 The scope of work also includes the supply and installation of a new control panel in the Aeration building control room.

1.2 REFERENCE STANDARDS

- 1.2.1 Electrical equipment, controls equipment and instrumentation supplied under this Contract and installed under the Installation Contract shall comply with the latest revision, including amendments, of the following and/or other relevant standards, codes and regulations of the following organisations:
 - Canadian Electrical Code (CEC).
 - Canadian Standards Association (CSA). All electrical equipment shall bear a CSA or Underwriters Laboratories of Canada (ULC) approval label.
 - Workers' Compensation Board (WorkSafeBC), Occupational Health and Safety Regulations (WCB).
 - Institute of Electrical and Electronic Engineers (IEEE).
 - National Electrical Manufacturers Association (NEMA).
 - Electrical and Electronic Manufacturers of Canada (EEMAC).
 - Canadian Electrical Manufacturers Association (CEMA).
 - International Electrotechnical Commission (IEC).
 - International Electrical Testing Association (NETA).
 - BC Building Code (BCBC). Installation must include provision for structural capacity of electrical components including anchorage and seismic restraint where required.

1.3 SUBMITTALS

1.3.1 Provide submittals as per Section 01 33 00 for the following items prior to ordering:

- All electrical equipment including but not limited to control panel, transformers, protection relays, circuit breakers, contactors, soft starts, capacitors, cable tray and enclosures – manufacturer's specification sheet showing dimensions, performance characteristics and materials of construction.

1.3.2 Provide submittals as per Section 01 33 00 for the following items prior to testing of equipment of this section:

- All electrical equipment – manufacturer's operations and maintenance manual.

1.4 ALTERNATES

1.4.1 Approved equals will be considered but must be submitted to the owner for approval.

2 PRODUCTS

2.1 GENERAL

2.1.1 Provide electrical equipment as per schedule on drawings.

2.1.2 All equipment to be new and CSA or ULc certified or equivalent (all panel assemblies must bear a CSA or equivalent inspection label).

2.1.3 Any deviation from these specifications must be pre-approved by the owner or engineering consultant.

2.2 MATERIALS

2.2.1 Prohibited Hazardous Materials

2.2.1.1 The follow materials may not be used without the express written permission of the Owner:

- Lead, including coatings and lubricants with a lead content higher than 600 PPM.
- Asbestos.
- Mercury
- Chromium, including Zinc Chromate plating.
- Any substance listed by Worksafe BC whereby normal installation, maintenance or disposal procedures would result in exposure levels exceeding the 8(hour TWA (time weighted average) limit and cannot be easily mitigated with a standard respirator using appropriate filters.

- Refer to the following document for details:
http://www2.worksafebc.com/PDFs/regulation/exposure_limits.pdf

2.2.2 Fasteners

- 2.2.2.1 All fasteners wetted by water or oil shall be stainless steel, except where Seller has determined that alternative materials will provide superior long term performance or are required to prevent galvanic corrosion.
- 2.2.2.2 All fasteners exposed to air shall be Electroless Nickel Plated (ENP) carbon steel or better.
- 2.2.2.3 Anti-corrosive / anti-seize compound shall be applied to any threaded connections that are at risk of seizing or corroding.
- 2.2.2.4 Suppliers drawings shall clearly identify the nominal torque specifications and the required anti-seize compounds used for all maintainable fastened connections.

2.3 WIRE AND CABLE

2.3.1 Provide XLPE RW90/TECK90, stranded copper cables rated as follows:

- 1000-volt for 600V circuits
- 600-volt for 120/240V circuits
- 300V for 24V circuits

2.3.2 Install a minimum #12 AWG wire for all branch circuits and protect with 15amp circuit breakers. Note that #14 AWG is acceptable for control circuits where identified per the cable schedule.

2.3.3 Identify all wires by phase colours according to the following:

- A: Red
- B: Black
- C: Blue
- Neutral; White

2.3.4 Armoured Power Cables

Where armoured cables are specified, supply and install metal-clad cables (Teck90) suitable for use in wet and dry locations at temperatures not exceeding 90C with the following additional requirements:

- An overall black, fire retardant PVC jacket having a thickness of not less than 0.06 inches

- Cross-linked polyethylene XLPE conductor insulation, 90C rated
- Interlocked Aluminum armour
- Copper conductors rated to operate at a maximum continuous temperature of 90C
- Include code-size, bare ground conductors
- 1000V conductor insulation

2.3.5 Armoured Instrument Cables

All instrument cables must be armoured unless indicated otherwise, supply and install metal-clad cables (Teck90) suitable for use in wet and dry locations at temperatures not exceeding 90C with the following additional requirements:

- An overall black, fire retardant PVC jacket having a thickness of not less than 0.06 inches
- Interlocked Aluminum armour
- Include code-size, bare ground conductors
- Twisted pairs and triads with individual and overall aluminum polyester tape shield, conductors as specified on drawings, 300V conductor insulation.

2.4 TRANSFORMERS

2.4.1 Supply and install 600V:600/347V isolation transformer with the following ratings:

- 2.4.1.1 Dry type transformer to be rated for 150kVA based on 30°C ambient temperature and 115°C winding temperature rise.
- 2.4.1.2 Impedance of not more than 5%.
- 2.4.1.3 Transformer to be constructed with copper windings encapsulated with electrical grade silica and resin compounds.
- 2.4.1.4 NEMA 2 enclosure suitable for mounting on concrete floor.

2.5 CONTROL CABINET

2.5.1 Supply and install one control cabinet as per layout and bill of materials detailed in drawing E-003.

- 2.5.1.1 Supplier to provide approval drawings for layout and wiring prior to manufacture. Schematic diagrams clearly identifying all field cable connections and interface points. Wire tag names included for all internal wiring and wires must be labelled at both ends.
- 2.5.1.2 All I/O including spares to be wired to terminal blocks.

2.5.1.3 Include CSA approval label or special inspection label.

2.6 UNINTERRUPTIBLE POWER SUPPLY (UPS)

2.6.1 Supply and install one UPS in the control room as shown on drawing E-011 and Bill of Material on E-001.

2.6.1.1 Contractor to provide shop drawings for approval.

2.6.1.2 UPS to be rated 3000VA (2000W), 120/240V Input (terminal connections), 120V/240V Output (terminal connections), 60Hz, .

2.6.1.3 Manufacturer: Alpha Technologies. Model: CFR 3000.

2.6.1.4 Contractor to supply stand or shelf suitable for mounting UPS a minimum of 150mm above floor.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Contractor is responsible for supply, delivery, off-loading and placement of equipment at site.

3.1.2 Contractor is responsible for supply and installation of all cables terminations, lugs, cable fittings, fastening devices, cable connectors, splices, taps and any other necessary hardware to complete the installation. Contractor to provide documentation demonstrating hardware is mounted correctly and all maintainable bolts are torqued appropriately.

3.1.3 All cable is Teck 90 unless otherwise indicated. Any deviation must be pre-approved by the owner prior to installation. [The 600V cable installed in conduit between the junction box at the aeration building and the junction box at the Workshop is not required to be Teck90].

3.1.4 Contractor is responsible for onsite testing and energization of the equipment and must provide documentation demonstrating that each component has been inspected and tested.

3.1.5 Contractor is responsible for grounding and bonding of all equipment. All LV grounding and bonding is to be installed in compliance with the requirements of the Canadian Electrical Code (CEC 22.1-15).

3.1.6 Contractor to supply and install anchor bolts and associated hardware as required for installation of the equipment. All outdoor equipment must be fastened to concrete using suitable anchor bolts.

3.1.7 Underground conduit to be buried as per drawing E-009 Detail C, and applicable codes.

3.1.8 Conduit entrances to buildings are to be sealed to prevent the ingress of water into the building and enclosure.

3.2 SITE TESTING AND COMMISSIONING

- 3.2.1 Perform all site testing and commissioning services for supplied equipment as per NETA acceptance and maintenance testing specifications.
- 3.2.2 Tests described in these specifications outline the minimum testing and commissioning expected. Supplier to perform all testing as required to provide a turn-key product for the Owner.
- 3.2.3 Contractor to provide the following on-site field testing after installation of equipment:
 - 3.2.3.1 Visual inspection of finished installation
 - 3.2.3.2 Cable insulation resistance
 - Check resistance to ground before energizing
 - Megger all circuits, feeders and equipment and maintain a list of test results

TECHNICAL SPECIFICATON			
SECTION	Division 31 Earthworks Section 31 23 33 Excavating, Trenching, and Backfilling		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1	GENERAL	2
1.1	MEASUREMENT PROCEDURES	2
1.2	REFERENCES	2
1.3	DEFINITIONS	2
1.4	EXISTING CONDITIONS	2
2	PRODUCTS	3
2.1	TRENCH FILL MATERIALS	3
3	EXECUTION	3
3.1	SITE PREPARATION	3
3.2	PREPARATION/PROTECTION	3
3.3	STRIPPING OF TOPSOIL	3
3.4	STOCKPILING	3
3.5	SHORING, BRACING AND UNDERPINNING	4
3.6	DEWATERING AND HEAVE PREVENTION	4
3.7	FILL TYPES AND COMPACTION	4
3.8	BEDDING AND SURROUND OF UNDERGROUND SERVICES	4
3.9	BACKFILLING	4
3.10	RESTORATION	4

Reference Standard Detail Drawings: MMCD G4 and G5

Revision History

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1 GENERAL

1.1 MEASUREMENT PROCEDURES

- 1.1.1 Payment per lump sum prices unless Rock or unexpected ground conditions are encountered.

1.2 REFERENCES

- 1.2.1 Master Municipal Construction Documents (MMCD), platinum edition. 2009.

1.3 DEFINITIONS

- 1.3.1 **Excavation classes:** two classes of excavation will be recognized; common excavation and rock excavation.
- 1.3.2 **Rock:** solid material in excess of 1.00 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 m³ bucket. Frozen material not classified as rock.
- 1.3.3 **Common excavation:** excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- 1.3.4 **Topsoil:**
- 1.3.5 **Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.**
- 1.3.6 **Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than [25 millimeters] [1 inch] in any dimension.**
- 1.3.7 **Waste material:** excavated material unsuitable for use in Work or surplus to requirements.
- 1.3.8 **Borrow material:** material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- 1.3.9 **Recycled fill material:** material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- 1.3.10 **Unsuitable materials:**
- 1.3.11 **Weak, chemically unstable, and compressible materials.**

1.4 EXISTING CONDITIONS

- 1.4.1 **Before commencing work establish location of buried services on and adjacent to site.**
- 1.4.2 **Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.**
- 1.4.3 **Remove obsolete buried services within 2 m of foundations: cap cut-offs.**
- 1.4.4 **Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.**
- 1.4.5 **Prior to beginning excavation Work, notify DFO Representative establish location and state of use of buried utilities and structures. Contractor to clearly mark such locations to prevent disturbance during Work.**
- 1.4.6 **Confirm location and depth of buried utilities in vicinity of trench(s) by hand excavations or soil hydrovac methods.**

- 1.4.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
- 1.4.8 Where utility lines or structures exist in area of excavation, obtain direction of DFO Representative. Record location of maintained, re-routed and abandoned underground lines.
- 1.4.9 Confirm locations of recent excavations adjacent to area of excavation.
- 1.4.10 Existing buildings and surface features:
- 1.4.11 Conduct, with DFO Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
- 1.4.12 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by DFO Representative.

2 PRODUCTS

2.1 TRENCH FILL MATERIALS

- 2.1.1 To requirements of MMCD Section 31 05 17 for "Native Material", "Granular Pipe Bedding", "Imported Granular Backfill", "Granular Subbase", and "Granular Base".
- 2.1.2 Provide per attached drawing MMCD G4 and G5.

3 EXECUTION

3.1 SITE PREPARATION

- 3.1.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- 3.1.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 PREPARATION/PROTECTION

- 3.2.1 Protect existing features in accordance with Drawings.
- 3.2.2 Keep excavations clean, free of standing water, and loose soil.
- 3.2.3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- 3.2.4 Protect buried services that are required to remain undisturbed.

3.3 STRIPPING OF TOPSOIL

- 3.3.1 Strip topsoil to depths as directed by DFO Representative. Do not mix topsoil with subsoil.
- 3.3.2 Stockpiling of topsoil should be in locations as directed by DFO Representative. Stockpile height not to exceed 2 m and should be protected from erosion.
- 3.3.3 Dispose of unused topsoil.

3.4 STOCKPILING

- 3.4.1 Stockpile select native fill materials in areas designated by DFO Representative.
- 3.4.2 Stockpile granular materials in manner to prevent segregation.
- 3.4.3 Protect fill materials from contamination.

3.4.4 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.5 SHORING, BRACING AND UNDERPINNING

3.5.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Worksafe BC regulations.

3.6 DEWATERING AND HEAVE PREVENTION

3.6.1 Keep excavations free of water while Work is in progress.

3.6.2 Protect open excavations against flooding and damage due to surface run-off.

3.6.3 Excavation

3.6.4 Excavation must not interfere with bearing capacity of adjacent foundations.

3.6.5 Do not disturb soil within branch spread of trees or shrubs that are to remain.

3.6.6 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

3.6.7 Keep excavated and stockpiled materials safe distance away from edge of trench.

3.6.8 Restrict vehicle operations directly adjacent to open trenches.

3.6.9 Dispose of surplus and unsuitable excavated material off site.

3.6.10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

3.6.11 Obtain DFO Representative approval of completed excavation.

3.6.12 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by DFO Representative

3.7 FILL TYPES AND COMPACTION

3.7.1 Use types of fill and compaction as per MMCD drawing G4 and G5.

3.8 BEDDING AND SURROUND OF UNDERGROUND SERVICES

3.8.1 Place and compact granular material for bedding and surround of underground services as indicated.

3.8.2 Place bedding and surround material in unfrozen condition.

3.9 BACKFILLING

3.9.1 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

3.9.2 Do not use backfill material, which is frozen or contains ice, snow or debris.

3.9.3 Place backfill material in uniform layers not exceeding 200 mm-compacted thickness. Compact each layer before placing succeeding layer.

3.10 RESTORATION

3.10.1 Upon completion of Work, remove waste materials and debris off-site.

3.10.2 Replace topsoil in landscaped areas.

3.10.3 Reinstate lawns to elevation, which existed before excavation.

3.10.4 Reinstate pavements disturbed by excavation to thickness, structure and elevation, which existed before excavation.

- 3.10.5 Restore pavement structure as per MMCD drawing G4 and G5.
- 3.10.6 Clean and reinstate areas affected by Work.
- 3.10.7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

TECHNICAL SPECIFICATON			
SECTION	Division 40 Process Integration Section 40 20 00 Process Piping		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1	GENERAL	2
1.1	SCOPE	2
1.2	REFERENCE STANDARDS	2
1.3	SUBMITTALS	2
1.4	QUALITY ASSURANCE	2
1.5	SHIPPING, PROTECTION AND STORAGE	2
2	PRODUCTS	3
2.1	CARBON STEEL PROCESS PIPING	3
2.2	STAINLESS STEEL PIPING	4
2.3	COPPER PIPING	4
2.4	PROCESS PIPING - STEEL	5
2.5	PIPE EXPANSION, HANGERS AND SUPPORTS	6
3	EXECUTION	7
3.1	GENERAL PIPING SYSTEM INSTALLATION REQUIREMENTS	7
3.2	UNIONS (< 75 MM DIA.)	7
3.3	PRESSURE AND LEAKAGE TESTING OF PIPING	7

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1 GENERAL

1.1 SCOPE

- 1.1.1 Provide all labour, materials and incidentals for complete and operable mechanical piping systems as shown on the drawings and herein described.
- 1.1.2 This section includes all piping and associated systems and materials within the facility including mechanical installation of products supplied under Section 40 20 10 (Valves) and Section 40 90 00 (Instrumentation).

1.2 REFERENCE STANDARDS

- Section 40 20 10 Process Piping Valves
- Section 40 90 00 Instrumentation

1.3 SUBMITTALS

- 1.3.1 Provide submittals as per Section 01 33 00 for the following items prior to ordering:
- Large dia. piping (> 150 mm dia.) – provide dimensioned shop drawing identifying dimensions of all piping to be fabricated.
 - Welding – submit welding certification.

1.4 QUALITY ASSURANCE

- 1.4.1 Welding Certification - All welders to be certified under the B.C. Power Engineers and Boiler and Pressure Vessels Safety Act and Regulations. As a minimum, welders will hold a Level B Journeyman Welders Certificate.

1.5 SHIPPING, PROTECTION AND STORAGE

- 1.5.1 Piping to be stored under cover.
- 1.5.2 Piping to be unloaded with appropriate slings and lifting equipment. No use of chains to lift pipe. Pipe to be lowered, not dropped, during unloading.
- 1.5.3 Provide temporary plastic end caps on piping during shipping and storage.

2 PRODUCTS

2.1 CARBON STEEL PROCESS PIPING

2.1.1 Design Pressure 285 psig

2.1.2 Provide pipe, fittings and appurtenances as per following table.

Item	Sizes	General Description
Pipe	65 mm and larger	Standard schedule (Schedule 40), bevelled ends, ASTM A53 Grade A or B carbon steel.
Fittings	65 mm and larger	Standard schedule (Schedule 40), tube turn, butt weld, ASTM A234 Grade WPB carbon steel to ANSI B16.9. Coat to suit the adjoining pipe.
Welding Outlets	All	Weldolets, sockolets and thredolets to ANSI B16.9, ANSI B16.11 and ANSI B31.1. Coat with adjoining pipe.
Joints	50 mm and smaller	Threaded ANSI B16.3
Joints	65 mm and larger	Full penetration butt weld
Grooved Joints	65 mm and larger	Square cut grooves to grooved fitting manufacturer's location, depth, width, and specification and meeting requirements of AWWA C606.
Flanges	65 mm and larger	ANSI Class 150 mild steel ASTM A105 Grade B, raised face, slip-on or weld-neck to ANSI B16.5. Use flat-faced flanges against flat-faced valves and equipment. Coat to suit the adjoining pipe.
Flange Adapter		Restrained, gasketed flange adapter for connecting groove end pipe to flanges. Ductile Iron body with EPDM gasket. Standard of acceptance - Victaulic Style 741 or Gruvlok Fig. 7012. Provide flange adapter insert where recommended by flange adapter manufacturer.
Flexible Couplings		Restrained, flexible, gasketed coupling for installation on cut-groove joints. Ductile Iron body with EPDM gasket. Standard of acceptance - Victaulic Style 77 or Gruvlok Fig. 7001.
Bolts and Nuts	-	ASTM A193, Grade 8M stainless steel hex head machine bolts with heavy hex nuts.
Gaskets	All	3 mm full-face premium grade neoprene
Coating and Lining	All	<p>For pipe and fittings - shop-applied fusion-bonded Epoxy Coating and lining to AWWA C213.</p> <p>For ancillary components supplied with primer coat only and for touch-up of minor damage to coatings – field apply liquid epoxy coating to AWWA C210.</p> <p>Do not coat stainless steel bolts and nuts.</p> <p>Exterior colour – Blue (matching existing). Lining – White.</p>

2.2 STAINLESS STEEL PIPING

2.2.1 Design Pressure 225 psig

2.2.2 Provide pipe, fittings and appurtenances as per following table.

ITEM	SIZES	GENERAL DESCRIPTION
Pipe	50mm and smaller	Sch. 40S SMLS threaded and coupled, ASTM A312 stainless steel, Alloy 304.
Fittings and Unions	50mm and smaller	ANSI Class 150, screwed stainless steel to ASTM A-182, alloy 304 L
Joints	50 mm and smaller	Threaded ANSI B16.3
Dielectric Unions	50mm and smaller	For all connections to other piping materials (steel, stainless steel) use dielectric unions – standard of acceptance – Hart Model D-3136 Series
Bolts, Nuts and Gaskets	50mm and smaller	ASTN A193, Grade 8M stainless steel hex head machine bolts with heavy hex nuts.

2.3 COPPER PIPING

2.3.1 Design Pressure 225 psig

2.3.2 Provide pipe, fittings and appurtenances as per following table.

ITEM	SIZES	GENERAL DESCRIPTION
Tubing	50mm and smaller	Copper tubing to ASTM B88, Type "L" hard temper.
Fittings and Unions	50mm and smaller	Wrought copper, solder joint to ANSI B16.22, or cast brass to ANSI B16.18. Lead free solder.
Dielectric Unions	50mm and smaller	For all connections to other piping materials (steel, stainless steel) use dielectric unions – standard of acceptance – Hart Model D-3136 Series

2.4 PROCESS PIPING - STEEL

- 2.4.1 Flanges shall be true and perpendicular to the axis of the pipe or fitting. Plain ends of pipe or fittings shall be true and perpendicular to the axis, with edges deburred.
- 2.4.2 Pipe shall be free from rust, dents and unsightly defects.
- 2.4.3 Welding in fabricator's shop and in the field shall be performed by qualified welders using approved procedures.
- 2.4.4 Field welding of pipe joints shall not be allowed.
- 2.4.5 Completed pipe lines shall be washed with steam or hot water to remove any dirt picked up during transport on construction site.
- 2.4.6 Pipe Welding – Standards - General
 - ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
 - ANSI/ASME B31.1 Power Piping
 - ANSI/ASME B31.3 Chemical Piping
 - ANSI B32.1 Metal Products
 - CSA CAN3-S16.1-M Steel Structures for Buildings (Limit State Design)
 - CSA W59-M Welded Steel Construction (Metal Arc Welding)
 - CSA W47.1 Certification of Companies for Fusion Welding of Steel Structures

2.4.7 Pipe Welding – Procedures - Complete welding in accordance with Part 3.

2.5 PIPE EXPANSION, HANGERS AND SUPPORTS

- 2.5.1 All piping shall be so installed that it will in no way be strained or distorted by expansion and contraction. Anchors shall be provided wherever necessary to protect equipment and control direction of pipe movement. Pipe guides shall be provided at each side of each expansion joint.
- 2.5.2 Supports for major piping (100 mm diameter and larger) have been detailed on the drawings.
- 2.5.3 Provide all hangers, anchors, brackets and miscellaneous supports as required for the installation of the piping and equipment. Supports, hangers, and brackets shall be attached to walls, ceilings and floors in an approved substantial manner. All hanger supports for equipment shall be set in structural members of the building to the Engineer's approval. Pipe hangers shall be as detailed on the drawings. Perforated band iron wire or chain hangers will not be approved.
- 2.5.4 All hangers shall be capable of vertical adjustment after pipe is erected. Pipe shall not be hung from or attached to other pipe.
- 2.5.5 Hanger rods shall be continuously threaded stainless steel.
- 2.5.6 Where pipe is hung provide lateral support (sway bracing) designed to Building Code. Lateral support systems to be shown on shop drawings and be sealed by Professional Engineer.
- 2.5.7 Sway bracing to be connected to same structural assembly as hanger (to prevent differential motion and /or settlement problems).
- 2.5.8 Pipe supports shall be provided as shown on the drawings, but at least in accordance with the following:

Size (mm)	Hanger Rod Diameter (mm)	MAXIMUM SUPPORT CENTRES	
		Copper Pipe (mm)	Steel Pipe (mm)
12 to 50	10	2,500	2,500
65 to 90	12	-	2,500
100	16	-	2,500
150	19	-	3,750
200	22	-	3,750
250	22	-	3,750
300	22	-	3,750

- 2.5.9 Vertical piping shall be supported with riser clamps as shown, and also in accordance with the above table.

3 EXECUTION

3.1 GENERAL PIPING SYSTEM INSTALLATION REQUIREMENTS

- 3.1.1 Carefully place and support all pipe at proper lines and grades; where possible slope to permit complete drainage.
- 3.1.2 Blow all piping clean after assembly and before connecting to equipment; test underground piping both before and after backfilling.
- 3.1.3 Handle pipes with care at all times and use equipment designed so that no damage occurs; replace any pipe damaged in handling or laying.
- 3.1.4 Repair factory coatings at field cuts or where otherwise damaged.
- 3.1.5 The pipe shall be cleaned of dirt and other foreign materials. The pipe shall be flushed at water velocities of 1.0 m/s or as high a velocity as can be obtained from the available water sources.

3.2 UNIONS (< 75 MM DIA.)

- 3.2.1 Provide unions in all piping connections to all items of equipment to permit the removal of each and every device without dismantling the pipe.
- 3.2.2 Provide dielectric unions between piping of different materials (i.e. between steel and stainless steel or between steel and copper)

3.3 PRESSURE AND LEAKAGE TESTING OF PIPING

- 3.3.1 Supply all equipment, materials, and install all necessary fittings to complete pressure testing (in accordance with AWWA C600) to the satisfaction of the Engineer.
- 3.3.2 Provide all temporary caps, flanges, valves, and thrust blocks required for testing.
- 3.3.3 Tests shall be completed before field painting of all piping.
- 3.3.4 The Contractor shall notify and obtain the approval of the Engineer prior to proceeding with initial testing of the piping. Upon successful completion of the initial tests, the Engineer is to be contacted to witness a final test.
- 3.3.5 The purpose of the test is to detect any damaged material that may have been installed, and to ensure that all fittings are properly braced. Pipe, fittings, valves and joints should be inspected thoroughly while under pressure.
- 3.3.6 If leaks develop or excessive pipe movement is noted, make all necessary corrections and new tests until all defects or deficiencies have been remedied. Corrections necessary for the proper functioning of the installation shall be made to the satisfaction of the Owner before final acceptance of the facility.

- 3.3.7 Provide a written report to the Owner summarizing the results of the pressure and leakage testing for each section. The report will include the type of test, duration, allowable leakage rate, and actual leakage. The report will be prepared by the Contractor and shall be signed by both the Engineer and the Contractor.
- 3.3.8 Test to 1550 kPa (225 psig).
- 3.3.9 Check all drains for obstructions.

END OF SECTION

TECHNICAL SPECIFICATION

SECTION	Division 40 Process Integration Section 40 20 10 Process Piping Valves		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1 GENERAL.....2

1.1 SCOPE.....2

1.2 REFERENCE STANDARDS2

1.3 SUBMITTALS2

2 PRODUCTS.....3

2.1 SMALL DIAMETER (< 75 MM) STAINLESS STEEL BALL VALVES3

2.2 SMALL DIAMETER (< 75 MM) BRONZE BALL VALVES3

2.3 ISOLATION GATE VALVES (100 - 300 MM)3

2.4 CONTROL VALVES4

3 EXECUTION7

3.1 GENERAL VALVE INSTALLATION REQUIREMENTS.....8

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1 GENERAL

1.1 SCOPE

1.1.1 Provide valves as shown on the drawings and herein described.

1.2 REFERENCE STANDARDS

1.2.1 Section 40 20 00 Process Piping

1.3 SUBMITTALS

1.3.1 Provide submittals as per Section 01 33 00 for the following items prior to ordering:

- All valves – full product data including weight, dimensions, pressure rating, hydraulic losses (i.e. C_v),
- Control valves – above plus specific information on hydraulic losses through range of valve positions,
- Hydraulic control valves – above plus specific information on pilot system
- Actuators – power supply and electrical outputs, technical information to demonstrate compliance with specifications.

1.3.2 Provide submittals as per Section 01 33 00 for operations and maintenance manual:

- All submittals above plus,
- Provide warranty for valves and actuators,
- Provide manufacturer's test report for control valves,
- Operating and maintenance manuals for control valves and actuators.

2 PRODUCTS

2.1 SMALL DIAMETER (< 75 MM) STAINLESS STEEL BALL VALVES

- 2.1.1 2-piece or 3-piece 316 SS body, to allow valve to be removed from line without dismantling piping, screwed ends to ANSI B2.1. Provide two-piece for drain piping and where shown on the drawings. Provide 3-piece for instrumentation piping.
- 2.1.2 Adjustable packing nut, blowout proof 316SS stem
- 2.1.3 Locking lever handle
- 2.1.4 316 SS floating ball
- 2.1.5 Teflon stem packing and teflon seats
- 2.1.6 M.A. Stewart Model G2 and G3 or approved equal.

2.2 SMALL DIAMETER (< 75 MM) CARBON STEEL BALL VALVES

- 2.2.1 Two-piece Carbon Steel (A216 WCB), screwed ends to ANSI B2.1.
- 2.2.2 Locking lever handle
- 2.2.3 316 SS floating ball
- 2.2.4 PTFE stem packing and teflon seats
- 2.2.5 M.A. Stewart Model CSCR-2 or approved equal.

2.3 SMALL DIAMETER (< 75 MM) BRASS BALL VALVES

- 2.3.1 2-piece forged brass body, to allow valve to be removed from line without dismantling piping, screwed ends to ANSI B2.1.
- 2.3.2 Class 150 (150 WSP, 600 WOG)
- 2.3.3 Adjustable packing nut, blowout proof stem
- 2.3.4 Chrome plated ball
- 2.3.5 Teflon stem packing and teflon seats
- 2.3.6 M.A. Stewart Model B3, Crane Fig. 9102-B, or approved equal to the above requirements.

2.4 ISOLATION GATE VALVES (100 – 300 MM)

- 2.4.1 Construction to AWWA C509 (resilient seated gate valves for water supply service, rated for 250 psig service and hydrostatic tested to 500 psig).
- 2.4.2 Ductile iron body, ductile iron wedge with bonded rubber coating, O-ring seals, resilient seat,
- 2.4.3 Flanged joints as noted on the drawings.
- 2.4.4 Rising stem (OS&Y) with manual 450 mm dia. handwheel
- 2.4.5 Fusion-bonded epoxy coating and lining to AWWA C550
- 2.4.6 Each valve shall have the manufacturer's name, the pressure rating, and the year in which it was manufactured cast on the body. Each valve shall be hydrostatically pressure tested according to the requirements of AWWA C509.
- 2.4.7
- 2.4.8 Standard of Acceptance: Clow Resilient Wedge Valve – Model 2639

2.4.9 Alternate Manufacturer's: Mueller, AVK Series 25 (as available from Emco Ltd. Waterworks), or Approved equal

2.4.10 Valves to open counter clockwise.

2.5 CONTROL VALVES

2.5.1 As per following valve specification sheets.

Puntledge River Hatchery Water Supply Energy Recovery
 Division 40 Process Integration
 Section 40 20 10 Process Piping Valves

Control Valve Tag	CV1A	CV3A
General		
Operating Description	High-Flow Tank Control Valve	Low-Flow Tank Control Valve
Type of Valve	Full-port Globe Valve	
Nominal Diameter	300 mm	200 mm
End Connections	Flanged (ANSI B16.42 Class 150#)	
Features / Ancillary Components	Actuated with solenoid control valves, remote pilot connection, anti-cavitation trim, with PRV back-up hydraulic pilots	
Operating Conditions & Pressures		
Valve Pressure Rating	250 psig	
Upstream Static Pressure	160 psig	
Upstream Operating Pressure	130 to 155 psig typical range	
Downstream Operating Pressure	10 to 20 psig typical range	
Downstream Static Pressure	10 psig	
Temperature Range of Fluid	4 to 20 °C	
Service Fluid	Clean Water	
Cv full open	900 USgpm/psi ^{0.5}	360 USgpm/psi ^{0.5}
Description	Solenoid valves actuated to add or remove water from the bonnet, closing or opening the valve as required to maintain level set-point in tank as per signal from level transmitter. Valve normally controlled by PLC. On power failure, parallel hydraulic pilot system to control valve position.	
Valve Materials		
Body	ASTM A536 Ductile Iron	
Disc Retainer & Diaphragm Washer	Cast Iron	
Diaphragm	Nylon Reinforced Buna-N Rubber	
Trim (Disc Guide, Seat & Cover Bearing)	Stainless Steel	
Stem, Nut and Spring	Stainless Steel	
Fasteners	Stainless Steel	
Acceptable Products		
Standard of Acceptance	Cla-Val Model 100-01KO Main Valve with piloting to suit.	
Approved Alternate Manufacturers	Singer	
Ancillary Components	Valve position transmitter (X117 Series Position Transmitter or approved Equal)	
Notes	Provide Pilot Controls as per Clause 2.6	

Puntledge River Hatchery Water Supply Energy Recovery
 Division 40 Process Integration
 Section 40 20 10 Process Piping Valves

Control Valve Tag	TCV
General	
Operating Description	Turbine Control Valve
Type of Valve	Triple Offset Butterfly Valve with Motorized Actuator
Nominal Diameter	200 mm
End Connections	Lug style for ANSI B16.42 Class 150# flanges
Features / Ancillary Components	Actuated with fail-closed motorized actuator, valve position transmitter.
Operating Conditions & Pressures	
Valve Pressure Rating	250 psig
Upstream Static Pressure	160 psig
Upstream Operating Pressure	20 to 50 psig typical range
Downstream Operating Pressure	10 to 20 psig typical range
Downstream Static Pressure	10 psig
Temperature Range of Fluid	4 to 20 °C
Service Fluid	Clean Water
Cv full open	1500 USgpm/psi ^{0.5}
Description	Valve operated in conjunction with turbine control. Valve to fail-closed on power failure.
Valve Materials	
Body	ASTM A 105 WCB Carbon Steel
Seat / Bearing Material	ASTM CoCr alloy Gr.21
Disc	Same as body – nickel plated
Shaft	S/S 410
Acceptable Products	
Standard of Acceptance	Velan Torqseal triple offset butterfly valve to above requirements.
Approved Alternate Manufacturers	Zwick triple offset butterfly valve to above requirements.
Ancillary Components	Actuator see Clause 2.9
Notes	

2.6 CONTROL VALVE PILOTING (CV1A AND CV3A)

- 2.6.1 Level is normally controlled by the electronic controller that operates two solenoids to modulate the valve to maintain the process variable.
- 2.6.2 Should a power failure occur, a parallel hydraulically operated pressure reducing pilot system takes control of the valve maintaining a pre-set outlet pressure. When power is restored, the valve automatically reverts back to the electronic mode.
- 2.6.3 Standard of Acceptance: Piloting per Cla-Val Model 131-18 (Electronic Control Valve equipped with Hydraulic Pressure Reducing Solenoid).
- 2.6.4 Solenoids: Solenoid valve coil voltage shall be 24 V DC. Solenoid valve shall be supplied with a IP 66 rated enclosure. Solenoid valve body material shall be brass with NPT connections.
- 2.6.5 The pilot fittings shall be supplied AISI 316 stainless steel.
- 2.6.6 The pilot tubing shall be supplied AISI 316 stainless steel with PTFE lined flexible braided stainless steel connection to remote duplex strainer assembly.
- 2.6.7 Opening and closing needle valve speed controls shall be supplied. Needle valves shall be constructed of 316 stainless steel with manual operator.
- 2.6.8 Pilot isolation ball valves shall be supplied. Pilot isolation ball valve(s) shall be constructed of 316 stainless steel with stainless steel handle operator.
- 2.6.9 Supply to pilot system shall be remote, as per Clause 2.7.

2.7 REMOTE DUPLEX STRAINER (COMBINED FOR CV1A AND CV3A)

- 2.7.1 Provide wall-mount duplex y-strainer system.
- 2.7.2 Strainers and piping sized to adequately close both valves from full open in 10 s.
- 2.7.3 Y-strainer: Cla-Val X43 Strainer or approved equal.
- 2.7.4 Provide brass isolation ball valves on either side of each y-strainer.
- 2.7.5 Provide copper tubing to remote connection point and to each valve.
- 2.7.6 Provide Uni-strut channel to protect
- 2.7.7 Provide air-release valve at high-point(s).

2.8 VALVE POSITION INDICATOR (CV1A AND CV3A)

- 2.8.1 24VDC external power supply
- 2.8.2 Provide precise 4-20mA calibrated output signal, with adjustable zero and span, proportional over 0-100% of valve stroke position.
- 2.8.3 The valve position transmitter assembly shall be mounted directly to the valve stem.
- 2.8.4 Standard of Acceptance: Cla-Val Model X117C Valve Position Transmitter.
- 2.8.5 Alternate: Singer Model X156 Linear Inductive Valve Position Transmitter.

2.9 TURBINE CONTROL VALVE ACTUATOR

- 2.9.1 Continuous-duty, quarter turn actuator. Duty with non-periodic load and speed variations, capable of continuous unrestricted modulation.
- 2.9.2 Response time of less than 0.1 s.

- 2.9.3 High-efficiency, continuous duty brushless DC Motor drive.
- 2.9.4 Fail to close limit - On power failure the actuator will close the valve to the position set as the close limit using stored energy in built-in capacitors. Capacitors to be recharged within 1 minute of power recovery.
- 2.9.5 Desired closing time on power failure 15 s.
- 2.9.6 Sealed enclosure to IP68 with powder coated finish.
- 2.9.7 115 V / 1 phase 60 HZ AC power supply
- 2.9.8 4-20 mA analog position control and output of valve position
- 2.9.9 Operation with ambient temperature range of -30 to + 70 °C
- 2.9.10 Additional switches indicating full open and full closed position
- 2.9.11 Manual override hand drive
- 2.9.12 Geartrain lubricated for life.
- 2.9.13 Seating and operating torque requirements to suit valve and operating conditions specified.
- 2.9.14 Standard of Acceptance: Rotork CVQ 1200.

3 EXECUTION

3.1 GENERAL VALVE INSTALLATION REQUIREMENTS

- 3.1.1 Installation, and testing of valves are covered under Section 40 20 00.

3.2 CONTROL VALVE TESTING

- 3.2.1 Control valves to be tested with valve manufacturer representative during commissioning to verify operation and correct setup.
- 3.2.2 Provide control valve commissioning report from Valve manufacturer representative indicating valve installation is compliant with manufacturer's recommendations.

END OF SECTION

TECHNICAL SPECIFICATON			
SECTION	Division 40 Process Integration Section 40 90 00 Instrumentation and Control for Process Systems		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1	GENERAL	2
1.1	SCOPE.....	2
1.2	REFERENCE STANDARDS	2
1.3	SUBMITTALS	2
2	PRODUCTS	2
2.1	GENERAL	2
2.2	PRESSURE TRANSMITTERS.....	2
2.3	PRESSURE GAUGES	3
3	EXECUTION	3
3.1	INSTALLATION	3

Revision History

Version #	Status	Date	Description of Revisions	Author
0	Issued for Tender	April 15, 2016	Original	Neal Whiteside

Macintosh HD:Users:nealwhiteside:Documents:WEL:001-Projects:025 - Puntledge Des:600-specs:40 90 00 Instrumentation.docx

1 GENERAL

1.1 SCOPE

1.1.1 This section identifies includes instrumentation required.

1.2 REFERENCE STANDARDS

1.2.1 Instrumentation to be mechanically installed in accordance with Section 40 200 and electrical connection as per Division 26 (Electrical).

1.2.2 IEC 60529, "Degrees of Protection Provided by Enclosures (IP Codes)," Ed. 2.1 (Geneva: International Electrotechnical Commission, 2001)

1.2.3

1.3 SUBMITTALS

1.3.1 Provide submittals as per Section 01 33 00 for the following items prior to ordering:

1.3.2 Provide submittals as per Section 01 33 00 for the following items prior to testing of equipment of this section:

- Pressure transmitters – manufacturer's product data.

2 PRODUCTS

2.1 GENERAL

2.2 PRESSURE TRANSMITTERS

2.2.1 Provide gauge type pressure transmitters with the following characteristics:

- Epoxy coated die cast aluminum IP 66 housing
- Ceramic process isolating diaphragm
- 13 mm stainless steel male ANSI MNPT connection
- With LCD local display
- Rated for at least a maximum working pressures of 1250 kPa (180 psig), and over pressure limit of 1860 kPa (270 psig)
- Measuring range(s) as shown on drawings.
- Accuracy +/- 0.2%
- 24 V DC Supply voltage
- Supply voltage surge protection
- 4-20 mA Output
- Printed nameplate with instrument number, manufacturer, maximum working pressure, and serial no.

2.2.2 Standard of acceptance: Endress + Hauser Cerabar M PMC51

2.2.3 Alternate Manufacturers: Rosemount

2.3 PRESSURE GAUGES

2.3.1 Range as shown on drawings

2.3.2 dual scales, in kPa and psig

2.3.3 to ANSI B-40.1

2.3.4 100 mm diameter stainless steel case with stainless steel or copper alloy internals, lower mount case style

2.3.5 Silicone Fill

2.3.6 1% accuracy

2.3.7 re-calibration adjustment accessible from face of gauge

2.3.8 13 mm stainless steel male NPT connection

2.3.9 Standard of Acceptance: Marsh Quality Gauge Series 100 mm

3 EXECUTION

3.1 INSTALLATION

3.1.1 Installation by mechanical trade, electrical connection by electrical trade (see corresponding sections).

END OF SECTION

WHITESIDE ENGINEERING LTD.
WATER UTILITY CONSULTING

TECHNICAL SPECIFICATON

SECTION	Division 48 Electrical Power Generation Section 48 10 00 Supply of Turbine and Generator Unit		
PROJECT	Department of Fisheries and Oceans Puntledge River Hatchery Water Supply Energy Recovery		
DATE	November 16, 2016	VERSION	2

Table of Contents

1	GENERAL	2
1.1	SCOPE	2
1.2	REFERENCE STANDARDS	2
1.3	SUBMITTALS	3
1.4	WARRANTY	4
2	PRODUCTS	4
2.1	TURBINE OPERATING CONDITIONS	4
2.2	TURBINE CASING	4
2.3	WEARING RINGS	5
2.4	IMPELLER	5
2.5	TAPPINGS	5
2.6	BEARINGS	5
2.7	SHAFT	6
2.8	COUPLING AND SHAFT GUARDS	6
2.9	MECHANICAL SEALS	6
2.10	TOOTHWHEEL & SPEED SENSING	6
2.11	GENERATOR	7
2.12	TURBINE BEARING AND GENERATOR TEMPERATURE SWITCHES	8
2.13	BASEPLATE	8
2.14	NAMEPLATES	8
2.15	SPARE PARTS	9
2.16	UNIT DIMENSIONS	9
2.17	ACCEPTABLE MANUFACTURERS	9
3	EXECUTION	10
3.1	FACTORY TESTING	10
3.2	INSTALLATION	10
3.3	ON-SITE INSTALLATION INSPECTION	10
3.4	COMMISSIONING AND PERFORMANCE FIELD TESTS	11

1 GENERAL

1.1 SCOPE

- 1.1.1 This Section covers the design, supply, delivery, testing and commissioning of a new horizontally mounted split case double suction, side suction and side discharge pump operating in reverse as a turbine with a generator and baseplate including all other associated appurtenances, and other work as specified to produce a fully functional generating system suitable for the operation intended.
- 1.1.2 Installation of the turbine and generator unit will be completed as per Section 48 10 01.
- 1.1.3 The Contractor shall be responsible for the supply, delivery, installation inspection, testing and commissioning of pump as turbine. The scope of work includes, but is not limited to the:
- Supply of horizontally mounted split case double suction pumps, all complete with inverter duty rated motors rated for use in reverse.
 - Supply all pumps complete with all required accessories and spare parts as described in this specification.
 - Provide certified non-witnessed factory pump tests. Factory test certificates shall be provided for all pumps delivered to the site. Repeat tests will be required for all certified tests which fail to achieve the Manufacturers shop submittal curves for performance, efficiency and power.
 - Provide Manufacturer's factory trained and certified field representatives (FTR) to supervise installation contractor during all stages of pump delivery, grouting of baseplate and alignment, installation, pump site acceptance testing, any pump adjustments, troubleshooting, commissioning, re-adjustment after initial hours of operation and all related testing the equipment, and final acceptance of the installed pumps.
 - Provide training for the Owner and Operation staff in all aspects of all new pump operations.
 - Provide spare parts as indicated.

1.2 REFERENCE STANDARDS

- 1.2.1 The following standards apply to this section:
- EEMAC Standard MG1, Motors and Generators.
 - EEMAC Standard M1-6, Motors and Generators.
 - EEMAC Standard MG2, Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.
 - CSA C22.2 No. 100, Motors and Generators.
 - CSA C390, Energy Efficiency Test Methods for Three-Phase Induction Motors.
 - IEEE 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings
 - NSF/ANSI 61, Drinking Water System Components
 - ASTM A276, Stainless Steel Bars and Shapes
 - ASTM A536, Ductile Iron Castings
 - ANSI/HI1.1-1.6, Centrifugal Pumps

1.3 SUBMITTALS

1.3.1 Provide submittals as per Section 01300 for the following items prior to ordering:

- Pump as Turbine Unit including:
 - Turbine model, serial no., identification number, tag no., and Specification Section number.
 - Guaranteed performance data curves showing head (m), capacity (ML/d and L/s), and power demand (kW) at rated speed.
 - Assembly and installation general arrangement drawings including pump and motor.
 - Baseplate drawings with anchor bolt details and minimum foundation installation and levelling requirements.
 - Details of the pump and drive unit foundation, include type, size, number and arrangement of and/or bolts, dimensional drawings for sole and base plates, and all other information required in this specification.
 - Weight of turbine, generator, shaft assembly, and baseplate.
 - Moment of inertia of turbine, shaft, and generator.
 - Complete electrical schematic and wiring diagram where applicable.
 - Pump-motor speed torque curve.
 - Provide detailed information on paint and coating. This information should include details of the products and application method.
 - List any ancillary equipment provided.
 - List of special accessories or tools for the adjustments or removal of parts required for any piece of equipment.
 - Generator Data including:
 - Electrical nameplate data
 - Dimension, total weight and layout
 - Wiring schematic to suit motor terminations
 - RTD product data and wiring schematics
 - Enclosure type and mounting (e.g. horizontal, vertical).
 - Conduit box dimensions Bearing type.
 - Bearing lubrication.
 - Allowable number of starts / cycles per hour.

1.3.2 Provide submittals showing factory test curve completed prior to shipping of turbine.

1.3.3 Provide submittals as per Section 01300 for the following items prior to commissioning of equipment of this section:

- Operations and maintenance manual including shop drawing submittal plus operating instructions and recommended periodic maintenance requirements and instructions including inspection, lubrication, maintenance testing and instructions for normal maintenance procedures.

1.4 WARRANTY

1.4.1 The Contractor warrants that all equipment covered by or supplied under this contract shall:

- Comply with the specifications for the said equipment.
- Be free from defects in design, manufacturer, workmanship or materials.
- All pump and motor assemblies shall carry the manufacturer's warranty of 12 months after Substantial Performance.
- Repair any breakage, damage, defects or deterioration (other than those due to the negligence of parties other than the Contractor or the imposition on the equipment of extraordinary working conditions or to normal wear and tear) that occurs at the Contractor's expense for the duration of the warranty period.

2 PRODUCTS

2.1 TURBINE OPERATING CONDITIONS

- 2.1.1 Fluid: clear water, temperature of 5 to 20°C.
- 2.1.2 Duty: Continuous duty.
- 2.1.3 Electrical Grid connection: 575 V / 3 phase / 60 Hz.
- 2.1.4 Hydrostatic Pressure Rating: Pump casing (both suction and discharge) shall be rated for a hydrostatic maximum pressure of 1700 kPa (250 psi) including surge allowance.
- 2.1.5 Normal working pressures: 1035 kPa (150 psi) upstream / 70 kPa (10 psi) downstream.
- 2.1.6 System curves and operating points, as shown on Drawing M-005. Provide turbine capable of operating across range of system curves provided.
- 2.1.7 Desired output of 110 kW electrical power (approx. 115 kW brake horsepower) at turbine curve intersection with design system curve.
- 2.1.8 Mechanical efficiency of 82% or greater at design point.
- 2.1.9 Synchronous speed at 60 Hz electrical supply: 1200 RPM maximum.
- 2.1.10 Installation configuration as shown on Mechanical Drawings.
- 2.1.11 Capable of continuously operating within identified operating range with no damage to the pump, vibration, recirculation, or cavitation problems.

2.2 TURBINE CASING

- 2.2.1 Provide axially split casing along the shaft centreline with the following features.
- 2.2.2 Constructed from ASTM A536 Ductile Iron.
- 2.2.3 Lifting lugs or eye bolts on the upper-casing half.
- 2.2.4 Suction and discharge flanges shall be in conformation with ANSI B16.5 Class 150.
- 2.2.5 The casing shall be of the volute type and designed to produce a smooth flow with gradual changes in velocity. The casing shall be split on the horizontal centre line with the suction and discharge nozzles and casing feet cast integral with the lower casing half. The interior of the pump shall be easily inspected by removing the upper half of the casing. This shall be done without disturbing the pipe connections or pump alignment.
- 2.2.6 The upper and lower half of the casing shall be accurately located to eliminate mismatch between the two halves that would impair both hydraulic and mechanical performance.

- 2.2.7 Casing construction shall meet or exceed the Hydraulic Institute Standards for horizontal split case pumps.
- 2.2.8 Each part of the turbine that contains liquid under pressure shall be capable of withstanding a hydrostatic test at not less than the Hydrostatic Pressure Rating.
- 2.2.9 Suction and discharge flanges shall contain drilled, tapped, plugged and gauge connections.
- 2.2.10 Casing Lining: Inside of the casing shall be coated with Belzona Supermetaglide or approved equal
- 2.2.11 Casing Coating: Outside of casing shall be painted with manufacturer's standard two-component epoxy paint.
- 2.2.12 Surface preparation, mixing and application and safety requirements shall be in accordance with the lining manufacturer's printed instructions and as specified.
- 2.2.13 Lining shall be continuous throughout and shall extend to the outside of all flanges with neat finish around bolt holes.
- 2.2.14 All linings shall be NSF/ANSI 61 approved for potable water.

2.3 WEARING RINGS

- 2.3.1 Provide wearing rings with the following features.
- 2.3.2 Removable wearing rings on the casing.
- 2.3.3 Constructed from stainless steel compatible with impeller material.
- 2.3.4 Accurately machined on all faces.

2.4 IMPELLER

- 2.4.1 Provide the turbine impeller with the following features.
- 2.4.2 Enclosed double suction type.
- 2.4.3 One piece, Type 316 cast stainless Steel.
- 2.4.4 Statically and dynamically balanced.
- 2.4.5 The impeller shall be firmly secured to the shaft by a key positioned by shaft sleeves and both locked in place by a shaft lock nuts external to the stuffing box in the pump bearing housing.

2.5 TAPPINGS

- 2.5.1 Provide the pump with the following NPT tapped and plugged openings:
- 25 mm vacuum priming tap on casing upper half.
 - Water seal connections on casing upper half
 - Drain on lower half of casing
 - 6mm taps on the suction and discharge flanges at the horizontal centreline of the flanges.

2.6 BEARINGS

- 2.6.1 Anti-friction type ball or roller bearing type. Outboard bearing to be thrust bearing and inboard bearing to be radial type held by two bearing brackets. If bearing brackets are not cast integrally with casing, machine and dowel brackets to casing so that perfect alignment between bracket and casing results. Oil or grease lubricated.
- 2.6.2 L-10 rating of a minimum of 100,000 hours at specified operating conditions as set out by the latest Anti-Friction Bearing Manufacturer's Association.

- 2.6.3 Designed to prevent lubricant escaping and to prevent water from entering.
- 2.6.4 Interchangeable inboard and outboard bearings.
- 2.6.5 Provide tapped openings for the addition and draining of lubricant or lifetime lubricated bearings.

2.7 SHAFT

- 2.7.1 AISI 420 alloy steel shaft provided with shaft protection sleeve against pumped medium. The construction shall be such that the pump shaft is always completely dry not in touch with pumped medium.
- 2.7.2 A shaft nut located inside the pump bearing housing where they are protected against leakage from the shaft seal shall be used to secure and align the impeller and shaft sleeves in place.
- 2.7.3 Compatible high chrome 1.4138 (27-29 per cent) steel shaft sleeve.
- 2.7.4 Sized to transmit full-driver power, prevent undue deflection or whip under all starting or running conditions. Provide shaft sleeves that position the impeller on the shaft.
- 2.7.5 Shaft/Pump Coupling: Provide flexible mechanical shaft couplings to connect the turbine to the generator.
- 2.7.6 Provide flexible elastomer claw type shaft couplings manufactured by Flender / Siemens or approved equal.

2.8 COUPLING AND SHAFT GUARDS

- 2.8.1 Provide guards around all revolving parts with the following features:
 - Designed to meet Worksafe BC requirements for workplace health and safety.
 - Designed to be firmly held in place but removable for maintenance.
 - Provide appropriate warning sign on guards.

2.9 MECHANICAL SEALS

- 2.9.1 Provide mechanical seals, with the following features on the turbine.
- 2.9.2 Silicon carbide rotary, carbon stationary, Viton elastomers
- 2.9.3 Gland, rotary holder and Hardware: Type 316 stainless steel
- 2.9.4 Hastelloy C springs
- 2.9.5 Acceptable Suppliers: John Crane or approved equal.

2.10 TOOTHWHEEL & SPEED SENSING

- 2.10.1 Equip generator or turbine shaft with a toothwheel having a minimum of 4 teeth for speed-measurement
- 2.10.2 Install one inductive proximity probes to provide square-wave speed pulses for the speed-monitoring device (by others).
- 2.10.3 Use three wire type probes, suitable for 12-24VDC input and producing minimum 5VDC output amplitude.
- 2.10.4 Equip probes with LED's to provide visual indication when they detect a passing wheel tooth.
- 2.10.5 Use a threaded and double-nut connection to allow adjustment of the airgap between the probes and the toothwheel

- 2.10.6 Use thread-locking compounds to secure the probes after confirming correct operation during commissioning.

2.11 GENERATOR

- 2.11.1 Provide generator sized to work over the entire range of the turbine as specified without infringing on the motor service factor.
- 2.11.2 The generator shall be fabricated such that the motors are suitable for Variable Frequency Drive controls complete with windings and bearing RTD's or soft starters.
- 2.11.3 All generators are to be inverter duty rated in accordance with NEMA MG-1 Part 31 and IEEE-522.
- 2.11.4 Generator shall be CSA approved.
- 2.11.5 Provide "NEMA premium" efficiency 575V, 60Hz, 3-phase.
- 2.11.6 Provide removable lifting lugs.
- 2.11.7 Power factor correction capacitors: Provide capacitors for power factor correction to a minimum power factor of 0.93.
- 2.11.8 Constant speed motor: clearly indicate on shop drawing the KVAR rating of capacitors to improve power factor for full load condition to be 0.93 lagging.
- 2.11.9 Unless noted otherwise, prior to shipment from motor manufacturer's factory, subject motors to routine tests as defined by EEMAC MG1-12.
- 2.11.10 Motors and individual components thereof to perform at full nameplate rating in ambient conditions specified. Motor output power to meet operating conditions without infringing upon motor service factor rating.
- 2.11.11 Utilize a NEMA design B squirrel cage induction motor, provided that this design meets starting and operating requirements of equipment. Minimum starting and breakdown torque as indicated in EEMAC MG1. If larger load torque or WK^2 requirements are encountered, other motor design type selection is acceptable subject to prior acceptance by Engineer.
- 2.11.12 Motors to operate continuously at rated load without exceeding maximum temperature rise above ambient temperature as indicated.
- 2.11.13 Maximum temperature rise – 80°C above an ambient of 40°C .
- 2.11.14 Size for duty point conditions without including service factor.
- 2.11.15 Power supply variations: A combination of ± 10 per cent voltage variation, two percent phase voltage imbalance and continuous operation at rated load in specified ambient is not to raise winding hot-spot temperature beyond insulation class rating.
- 2.11.16 Unless otherwise indicated, design for a minimum number of hot starts per hour as determined by driven equipment manufacturer, but not less than two.
- 2.11.17 Do not exceed the maximum locked rotor current values as listed in EEMAC Standard MG1 for the specified EEMAC design and rating.
- 2.11.18 Sound pressure level required per NEMA MG 1
- 2.11.19 Enclosure Frame to be EEMAC standard regarding frame/horsepower relationships for single speed applications.
- 2.11.20 Enclosure type to be totally enclosed, fan cooled (TEFC) rating with moisture trap, drain or other anti-condensation device and breather plug to prevent entry of foreign material, for ambient temperature at 40°C .

- 2.11.21 Terminal boxes: Waterproof, cast iron or heavy wall steel, split design, threaded conduit holes, field rotatable in 90 degree steps for bottom, side or top conduit entry. Oversize the main termination box to accommodate multiple conductors per phase terminations.
- 2.11.22 Ancillary devices: Separate termination box. The size of the terminal box shall be per manufacturer's standard.
- 2.11.23 Provide moisture proof Class F Insulation to suit the motor windings.
- 2.11.24 Temperature rise - 80EC above an ambient of 40EC.
- 2.11.25 Ambient operating temperature to be 40°C.
- 2.11.26 Service Factor: 1.15, with inverter duty rating for pumps equipped with constant speed motor. Provide Inpro/Seal bearing isolators
- 2.11.27 To avoid the shaft current, provide insulated bearing on non-drive end and shaft grounding ring or grounding brush at drive end
- 2.11.28 Pulsating motor currents – Full load and peak current variations to comply with EEMAC MGI-20.82.
- 2.11.29 Starter winding – Copper conductors with ends brought in to terminal box.
- 2.11.30 Rotor – Indicate direction of rotation by means of arrow on non-driving end. Painted arrows are not acceptable.
- 2.11.31 Inrush kVa/horsepower no greater than NEMA MG1 minimum code.G

2.12 TURBINE BEARING AND GENERATOR TEMPERATURE SWITCHES

- 2.12.1 Platinum, 100 ohm RTDs
- 2.12.2 Provide one RTDs for each phase embedded in the generator windings
- 2.12.3 Provide two RTDs for inside and outside bearing of the turbine.
- 2.12.4 Identify suitable RTD ranges and alarm set-points for bearing temperature and generator windings.

2.13 BASEPLATE

- 2.13.1 Mount the turbine and generator on a common base plate having the following features.
- 2.13.2 Base designed to allow for grouting, and anchor bolt holes.
- 2.13.3 Apply primed and finished paint to all exterior ferrous surfaces. Paint shall be high solids 2-component epoxy. Colour matching turbine.
- 2.13.4 Anchor Bolts: Provide 316 stainless steel anchor bolts and hardware to anchor the turbine and generator to the baseplate.
- 2.13.5 Baseplate anchors to concrete foundation by Section 48 10 01. Provide 6 holes in baseplate for anchors.
- 2.13.6 Levelling set screws: Provide levelling set-screws on baseplate to assist with installation of baseplate prior to grouting.

2.14 NAMEPLATES

- 2.14.1 Provide a Type 316 stainless steel name plate on the turbine inscribed with the following information:
- Manufacturer's name.
 - Year of manufacture.
 - Model number.
 - Serial number.
 - Impeller diameter (mm).

- Speed (RPM).
- Nameplate Capacity (L/s).
- Corresponding Nameplate total dynamic head (m).
- Nameplate Efficiency at nameplate capacity and head (%)
- Nameplate design point shaft power in kW - approx. 105 kW.

2.14.2 Provide a Type 316 stainless steel name plate on the generator inscribed with the following information:

- Manufacturer's name.
- Year of manufacture.
- Model number.
- Serial number.
- Speed (RPM).
- Nameplate input shaft power,
- Nameplate electrical efficiency,
- Nameplate Output Power – 100 kW.

2.15 SPARE PARTS

2.15.1 Provide a list of "standard" spare parts that are included with the system, including at a minimum the following spare parts:

- .1 One set of casing wear rings.
- .2 One set of pump bearings.
- .3 Two sets of all gaskets and O-rings.
- .4 One complete set of mechanical seal for each line item of pump.

2.15.2 All spare parts shall be suitably marked and packaged in protective cartons.

2.16 UNIT DIMENSIONS

2.16.1 Turbine unit overall dimensions shall fall within the following range:

- Overall length of unit including generator, baseplate and turbine: 2400 mm or less
- Width from Suction Flange to Discharge Flange: 1100 mm or less
- Height from baseplate invert to flange centrelines: 450 mm or less

2.17 ACCEPTABLE MANUFACTURERS

- Turbine: KSB or approved equal.
- Generator: Weg, Teco Westinghouse, Baldor or approved equal.

3 EXECUTION

3.1 FACTORY TESTING

- 3.1.1 The following tests shall be conducted:
- 3.1.2 Generators: All motors shall be assembled, tested, and certified at the motor factory and the working clearances checked to ensure that all parts are properly fitted. All computations shall be recorded and certified and dated copies of the test results shall be furnished.
- 3.1.3 Turbines: All turbines shall be tested at the factory. The manufacturer shall submit independent certification documentation of factory testing facility.
- 3.1.4 The turbines shall be hydrostatic and performance tested in accordance with the applicable ANSI/HI test standard. The acceptance criteria shall be per the standard with total head, efficiency meeting the requirements at the rated rpm for the specified requirements. The acceptance criteria shall include the following requirements unless specifically indicated otherwise:
- ANSI/HI 14.6 Acceptance Grade: 1U.
 - Efficiency Tolerance: -0%.
- 3.1.5 If turbines do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.
- 3.1.6 Hydrostatic test data to demonstrate that turbine when subject to hydrostatic pressure(s) will not leak or fail structurally.
- 3.1.7 A minimum of seven hydraulic test points readings between shutoff head and 10 per cent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.
- 3.1.8 Curves showing head, flow, kW, efficiency, and NPSH requirements.
- 3.1.9 A minimum one-hour continuous running test shall be conducted. Rated flow rates shall be used during the test.
- 3.1.10 Factory Tests: All pumps shall be factory-tested for performance. Non-witnessed pump certified curves and other test results shall be submitted to the Engineer and no equipment shall be shipped until the Engineer and Owner has approved the test data. All costs associated with rescheduling or conducting subsequent tests will be borne by the Contractor at no additional cost to the Owner.

3.2 INSTALLATION

- 3.2.1 Equipment shall be installed by Section 48 10 01, provide complete written instructions for installation.

3.3 ON-SITE INSTALLATION INSPECTION

- 3.3.1 Provide the services of factory-trained and certified manufacturer's representatives to supervise, operate, test, adjust, and troubleshoot the installation as required until satisfactory completion of testing and commissioning.
- 3.3.2 Test piping connections to prove the pump nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.
- 3.3.3 Submit the signed report describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to the requirements of the Specification for the service intended and is ready for permanent operation.
- 3.3.4 Inspection to include:

- 3.3.5 Soundness (without cracked or otherwise damaged parts).
- 3.3.6 Completeness of installation as specified and as recommended by the manufacturer.
- 3.3.7 Correctness of setting, alignment and relative arrangement of various parts of the system.
- 3.3.8 Vibration testing on the pump bearings and motor bearings for each pump. The tests are to be conducted by a company certified and experienced in this line of work. The results are to be submitted for review by the Engineer.
- 3.3.9 Vibration is not to exceed the guidelines stated in the Hydraulic Institute Standards.
- 3.3.10 Equipment bearing check.
- 3.3.11 Operating, testing and adjusting will prove the equipment is satisfactorily installed to operate under the intended conditions as specified.
- 3.3.12 Equipment will not be accepted without the manufacturer representative's report, attesting, in writing that all installation and testing has been completed to his satisfaction.
- 3.3.13 Modify or replace equipment or materials failing required tests at no extra cost to the contract.
- 3.3.14 Perform additional testing required due to changes of materials due to failure of materials or construction to meet specifications at no extra cost to the Contract.

3.4 COMMISSIONING AND PERFORMANCE FIELD TESTS

- 3.4.1 Each system shall be commissioned and performance field-tested by the Contractor under the supervision of the Manufacturer after installation as soon as is practicable to demonstrate satisfactory operation without perceptible or damaging cavitation, noise, vibration, or overheating of bearings beyond specified limits. The vibration limits used for shop testing with a temporary machinery support structure shall also be applicable to the field testing condition with a proper rigid support structure below the machinery.
- 3.4.2 Provide a direct employee(s) of the Manufacturer to be present during all field tests. The employee shall be trained for all tests to be conducted. The employee shall be familiar with the project with correspondence traceable from the inception of the manufacturing.
- 3.4.3 The following field testing shall be conducted:
 - Start up, checks and operates the system over its entire range.
 - Obtain concurrent readings of motor voltage, amperage, suction head and discharge head for at least four operating conditions.
 - Check each power lead to the generator for proper current balance.
 - Electrical and instrumentation tests shall conform to the requirements of the Sections under which that equipment is indicated.
 - Confirm operation of alarms and shutdowns, automatic operation of unit.

END OF SECTION

WHITESIDE ENGINEERING LTD.
WATER UTILITY CONSULTING

TECHNICAL SPECIFICATON

SECTION	Division 48 Electrical Power Generation Section 48 10 01 Install of Turbine and Generator Unit		
PROJECT	Department of Fisheries and Oceans Puntledge River Hatchery Water Supply Energy Recovery		
DATE	April 15, 2016	VERSION	0

Table of Contents

1 GENERAL2

1.1 SCOPE2

1.2 REFERENCE STANDARDS2

1.3 SUBMITTALS2

2 PRODUCTS2

2.1 CONCRETE ANCHORS2

3 EXECUTION2

3.1 INSTALLATION2

3.2 ON-SITE INSTALLATION INSPECTION.....3

3.3 COMMISSIONING AND PERFORMANCE FIELD TESTS.....3

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1 GENERAL

1.1 SCOPE

- 1.1.1 Section 48 10 00 covers the design, supply, delivery, testing and commissioning of a new horizontally mounted split case double suction, side suction and side discharge pump operating in reverse as a turbine with a generator and baseplate including all other associated appurtenances, and other work as specified to produce a fully functional generating system suitable for the operation intended.
- 1.1.2 Installation of the turbine and generator unit will be completed as per this section.

1.2 REFERENCE STANDARDS

- 1.2.1 The following standards apply to this section: ANSI/HI1.1-1.6, Centrifugal Pumps

1.3 SUBMITTALS

- 1.3.1 Include Submittals supplied under Section 48 10 00 with project Operations and Maintenance Manual.

2 PRODUCTS

2.1 CONCRETE ANCHORS

- 2.1.1 Provide epoxy adhesive anchors for baseplate as shown on drawings.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Equipment shall be installed by the Contractor in accordance with the Manufacturer's written instructions. Install unit on a concrete pad and align thereon.
- 3.1.2 Coupling halves must be disconnected and only reconnected after alignment.
- 3.1.3 Set base on metal shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support.
- 3.1.4 Final Coupling Alignment: Perform only after base is installed and piping is connected and pump nozzle connections have been tested.
- 3.1.5 If realignment is required piping must be disconnected prior to alignment, piping reconnected and alignment checked prior to connecting coupling halves.
- 3.1.6 After alignment is correct, grout using high-grade non-shrink grout. Fill entire base and leave no gaps or voids. Do not embed levelling nuts in grout.
- 3.1.7 All equipment shall be field-tested by the Contractor under the supervision of the Manufacturer to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, and shaft run out or other defects. The final pump and motor installation shall be secure in position and neat in appearance.
- 3.1.8 The turbine cannot be put into operation until such time that the unit has been tested, accepted and commissioned by the manufacturer's representative.
- 3.1.9 All finishes damaged during installation shall have factory-supplied field touch-up provided.
- 3.1.10 Lubricants: Provide the complete initial lubrication of all equipment in accordance with the manufacturer's recommendations. Provide a complete schedule of all manufacturer's recommended lubricants. Fill grease and oil, as required for the initial operation of the equipment.

3.2 ON-SITE INSTALLATION INSPECTION

3.2.1 Coordinate with Section 48 10 00, provide staff to assist with supplier install inspection.

3.3 COMMISSIONING AND PERFORMANCE FIELD TESTS

3.3.1 Coordinate with Section 48 10 00, provide electrician to assist during performance tests.

END OF SECTION

WHITESIDE ENGINEERING LTD.
WATER UTILITY CONSULTING

TECHNICAL MEMORANDUM # 1			
SUBJECT	Process Narrative		
PROJECT	Fisheries and Oceans Canada Puntledge River Hatchery Water Supply Energy Recovery		
TO	David Laird, DFO Energy Specialist	FROM	Neal Whiteside
DATE	November 14, 2016	FILE REF	WEL File # 52.310
VERSION	3	STATUS	Issued for Tender

1. BACKGROUND

1.1. PURPOSE

This memorandum provides an overview of the operation of the revised Puntledge River Hatchery water supply system with new Energy Recovery system in place. The memorandum applies to the normal operation of the water supply to the hatchery using the gravity Penstock supply. The operation of the hatchery using the pumped supply is unchanged.

The intent of the memorandum is to serve as a guide for programming of the system controls for the project. Following construction this memorandum will also be a reference for operation of the system.

1.2. PEER REVIEW

This memorandum has been reviewed as part of the design review completed by Golder Associates (Allan Bronsro, P.Eng.).

1.3. DEFINITIONS / ABBREVIATIONS

STATION EQUIPMENT

CV1A – 300 mm dia. high-flow tank control valve – solenoid globe valve with dual solenoid valves

CV3A - 200 mm dia. low-flow tank control valve – solenoid globe valve with dual solenoid valves

XX-00 – Instrumentation label (see Table 3)

TCV – Turbine Control Valve, located immediately downstream of turbine.

NOMENCLATURE

tbd – to be determined

TDH – Total dynamic head, pressure difference across equipment in m WC

UNITS

kW = kilowatts

LPM – litres per minute

m WC = Meters of water column, equal to 1.4223 psi

2. DESIGN CRITERIA

The following design criteria in Table 1 apply to the water supply system.

Table 1 Design Criteria

Category	Criteria Description	Criteria	Comments
Electrical	BC Hydro Program	Net Revenue Metering	
	Generator Nameplate Rating	100 kW	Maximum per net revenue metering program.
	Net Revenue Maximum Output	110 kW	
	Generator Maximum Output	100 kW	
	Generator Potential	600 V	
	Phase	3 phase AC	
	Frequency	60 Hz	
Hatchery Water Demands	Maximum flow	35,000 Lpm (583 L/s)	Typical max. for hatchery operations
Elevations (above sea level, geodetic datum)	Comox Lake water levels		
	Max. recorded	136.0 m	
	Typical	133.5 m	
	Min. recorded	130.5 m	
	Valve Room floor	22.55 m	
	Supply Pressure transmitter	22.86 m	
	Valve Room existing piping CL	23.16 m	
	Head Tank water level	30.15 m	
HGL	Max. Supply HGL	136.0 m	Equipment should be designed for this static pressure (plus additional allowances for surge, etc.)
	Typical Supply HGL	128.0 m	Typical Penstock HGL at hatchery connection. (equates to 125.6 m HGL / 146 psi at PT _s at typ. Flow)
	Min. Normal Supply Pressure / HGL	109.0 m	Energy recovery turbine system curve should allow for operation at this lower pressure.
	Static Downstream HGL	30.15 m	Head tank water level
Turbine Design	Turbine Nameplate Flow	9,720 Lpm 162 L/s	Delivers 100 kW BHP
	Turbine Nameplate TDH	74.1 m	
	Turbine Nameplate Mech. Eff.	83.8%	
	Turbine Design Flow	10,440 Lpm 174 L/s	Delivers 115 kW BHP
	Turbine Design TDH	82 m	
	Turbine Design Mech. Eff.	82%	

The typical schedule for water use at the Puntledge River Hatchery is shown in Table 2.

Table 2: Typical Water Use Schedule

Water Use(s)	Period	Flow Range (Lpm)	Comments
Incubation	Dec. 1 to Feb. 1	8,000 - 15,000	
Rearing	Feb. 1 to May 31	12,000 – 32,000	Flows increase through period
Spring Clean-up	Jun. 1 to Jun. 15	0 – 2,000	Flows variable
Summer Chinook Capture	Jun. 16 to Jul. 31	32,000	
Summer Shutdown	Aug. 1 to Sep. 15	0 – 2,000	Minimal Usage, also corresponds to yearly BCH penstock maintenance shutdown
Fall Capture	Sep. 16 to Nov. 30	25,000 – 35,000	Flows increase through period

3. INSTRUMENTATION

3.1. INSTRUMENTS

The following table lists the instruments used in control of the water supply system.

Table 3: List of Instrumentation for Water Supply System in Aeration Building

Tag	Description	Existing?	Range	Use
FT-01	Penstock Flow Meter	Existing (2016)	0 – 56,775 LPM	Measures high pressure gravity flow from Penstock (Comox Lake)
FT-02	River Supply Flow Meter	Existing (2016)	0 – 56,775 LPM	Measures pumped flow from Puntledge River
LT-01	Rearing Head Tank Level	Existing	0-100%	Alarm, used to control valves (CV1A, CV3A, OR TCV as appropriate).
LT-02	Incubation Tank Level	Existing	0-100%	Alarm, Alternate signal used to control valves (CV1A, CV3A, OR TCV).
PT-01	Penstock Supply Pressure	Replacement	0 - 200 psi	Shutdown turbine if reading is less than setpoint (100 psi). Alarm.
PT-02	Header Pressure	Replacement	0- 30 psi	Monitor only.
RT-01	Turbine Rotating Speed	New	0 – 1800 RPM	Used to monitor shaft rotational speed esp. at start-up / shutdown. Normal value 1220 RPM. Alarm at overspeed (value tbd)
TT-01	Water Temperature	Existing		Incubation tank water temperature
TT-02	Valve Room Thermostat	Replacement	0-40 deg. C	Turns on main ventilation fan
TT-03	Control Room Thermostat	New	0-40 deg. C	Turns on control room ventilation fan
TT-04	Turbine Inside Bearing RTD probe	New	tbd	RTD on inside bearing (between turbine and generator)
TT-05	Turbine Bearing RTD probe 2	New	tbd	RTD on outside bearing
TT-06	Generator Temperature RTD probe (Phase A)	New	tbd	RTD's embedded in generator windings
TT-07	Generator Temperature	New	tbd	RTD's embedded in generator windings

Tag	Description	Existing?	Range	Use
	RTD probe (Phase B)			
TT-08	Generator Temperature RTD probe (Phase C)	New	tbd	RTD's embedded in generator windings
XT-01	CV1A Valve Position	Replacement	0-100% valve travel	Monitor % open of valve as measured by valve stem travel.
XT-03	CV3A Valve Position	Replacement	0-100% valve travel	Monitor % open of valve as measured by valve stem travel.
XT-05	TCV Valve Position	New	0-100%	Monitor butterfly valve position (% open)
XT-10	Valve 10 Valve Position	Existing	Open/Closed	Bypass valve, n/o allows for isolation of rearing head tanks from incubation tanks.

It is noted that tank spillover occurs (to Jack Creek Overflow) at 80% level as measured by LT-01 or LT-02.

In addition, the electrical system contains instrumentation to measure power factor, amperage, and voltage to derive power being generated by the turbine.

4. TURBINE SELECTION

The turbine selection is a horizontal split case pump running in reverse (i.e. pump as turbine). Summary information for the design turbine is as follows:

- Type: Axially split volute, horizontal mounting
- Turbine Suction: 150 mm dia. flanged connection
- Turbine Discharge: 200 mm dia. flanged connection
- Impeller diameter: 454 mm dia.
- Operating Speed: 1220 rpm
- Nameplate capacity: 162 L/s (9720 Lpm) at 74.1m TDH
- Mechanical Energy at nameplate: 99 kW (83.8% mechanical efficiency)
- Generator: 100 kW, 3 phase, 60 Hz, 6-pole (1200 rpm) premium efficiency.

5. WATER SUPPLY SYSTEM OPERATING CONDITIONS

5.1. SUMMARY

The control of the water supply flow is matched to hatchery water demands, by maintaining a constant level in the Incubation and/or rearing head tanks. The levels in these tanks as transmitted by the existing level transmitters in each tank are used as the process variable for modulating the water supply to these tanks. The operator can select which level transmitter (incubation or rearing head tank) is used as the process variable (in some cases only one set of tanks is in use).

The use of the level transmitters as the controlled process variable will remain the same.

The hatchery water supply will be controlled with a programmable logic controller (PLC) in the aeration building control room. The PLC has outputs to the hatchery's SCADA system and a local human machine interface located in the control room.

5.2. CONTROL VALVES

The three control valves used to control water supply gravity flows are as follows.

Table 4: Control Valves

Valve Tag	Physical Description	Upstream Pressure (psi)	Downstream Pressure (psi)	Function
CV1A	300 mm dia. angle-style globe valve with solenoid piloting for level control and valve position transmitter	125 to 155	10	Controlled to maintain downstream tank level.
CV3A	200 mm dia. angle-style globe valve with solenoid piloting for level control and valve position transmitter	125 to 155	10	Controlled to maintain downstream tank level.
TCV	300 mm dia. high-performance butterfly valve	15 to 155	10	Opens to allow turbine to operate, may be throttled to reduce turbine output power to max. allowed or to maintain tank level.

The turbine on/off status and modulation of the control valves would be controlled based on water levels in the aeration head tanks from the existing level transmitters. The turbine valve, TCV, would be controlled as necessary to limit power produced. Note that the TCV position would not be controlled by the level transmitters but by the sensed power output from the generator. This valve would also be controlled to close in the event of a BCH grid power failure.

Normal operation of the control valves relative to hatchery water demands would be as per Table 5. The corresponding yearly operating schedule is as per Table 6.

Table 5: Proposed Normal Operation

Flow Range (Lpm) ^{1,2}	Water Supply System Operation	Corresponding Lead / Lag Order
< 7,500	Turbine OFF, CV3A modulating to maintain tank level.	CV3A, CV1A
7,500 - 10,500	Turbine ON providing 100% of flow, TCV throttled to maintain tank level.	TCV, CV3A, CV1A
10,500 – 21,000	Turbine ON providing 10,500 Lpm +/- CV3A to provide remainder of flow modulating to maintain tank level, TCV modulated as required to limit power output from generator to maximum allowed.	TCV, CV3A, CV1A
21,000 – 34,500	Turbine ON providing 10,500 Lpm +/- CV1A to provide remainder of flow modulating to maintain tank level, TCV modulated as required to limit power output from generator to maximum allowed.	TCV, CV1A, CV3A
> 34,500	Turbine ON providing 10,500 Lpm +/- CV3A full open (capacity of 10,500 Lpm). CV1A modulating to maintain remainder of flow, modulating to maintain tank level. TCV modulated as required to limit power output from generator to maximum allowed.	TCV, CV1A, CV3A

Notes:

- Flow ranges are approximate, subject to refinement based on observed hydraulics during commissioning.
- Maximum flow for turbine of 10,500 subject to turbine curves and output power limit imposed by BC Hydro (nominally 110 kW wire power).
- Maximum recommended flow velocity through control valves for **continuous** duty is 5.5 m/s. Velocity limit corresponds to flows of 10,500 Lpm for CV1A and 24,000 Lpm for CV3A. Avoid prolonged

operation with either control valve full open.
--

Table 6: Typical Yearly Operating Schedule

Water Use(s)	Period	Flow Range (Lpm)	Water Supply System Operation
Incubation	Dec. 1 to Feb. 1	7,500 - 15,000	Turbine ON, CV3A modulating to maintain tank level for flows > 10,500.
Rearing	Feb. 1 to May 31	12,000 - 32,000	Turbine ON, CV1A or CV3A modulating to maintain tank level
Spring Clean-up	Jun. 1 to Jun. 15	0 – 2,000	Turbine OFF, CV3A modulating to maintain tank level
Summer Chinook Capture	Jun. 16 to Jul. 31	32,000	Turbine ON, CV1A modulating to maintain tank level
Summer Shutdown	Aug. 1 to Sep. 15	0 – 2,000	Turbine OFF, CV3A modulating to maintain tank level
Fall Capture	Sep. 16 to Nov. 30	25,000 – 35,000	Turbine ON, CV1A modulating to maintain tank level

6. TURBINE OPERATING CONTROLS

6.1. TURBINE STARTING SEQUENCE

Starting procedure for the turbine is as follows:

1. Generator disconnected from grid. Isolation valves open, TCV closed, Bypass Control valve CV1A and/or CV3A in operation.
2. Open TCV slowly (30 s cycle). When turbine break-away torque is achieved, turbine will speed up according to free spinning curve. Speed shall be monitored.
3. When speed of turbine achieves synchronous speed (1200 rpm), generator shall be switched to the grid, reactive power of grid will magnetize generator, asynchronous speed will occur, and generator will feed to the electrical network. Turbine should now be operating according to turbine characteristic curve.
4. Continue to open TCV opening cycle to completely open position or until power meets max. allowable.
5. Turbine will now operate at its normal operation point. Bypass control valves CV1A and/or CV3A will have automatically closed corresponding amount of flow through turbine.

6.2. TURBINE OPERATION

While the turbine is operating, TCV may be required to throttle the flow to either:

1. For hatchery flows of 7,500 to 10,500 LPM; reduce the flow to maintain head tank levels (control signal from LT1 or LT2), or
2. For hatchery flows greater than 10,500 LPM, reduce power produced by the generator to less than the wire power output requirement of the net-revenue metering program, i.e. 110 kW (control signal from Power Meter).

A control loop is used to modulate the TCV position to prevent overflowing of the head tanks where hatchery demands are less than turbine un-throttled output (approximately 10,500 Lpm). This control loop would only be activated when the turbine is set as 'lead' and CV1A and CV3A valves are fully closed.

When hatchery flow requirements are less than minimum acceptable operating point for the turbine (approximately 7,500 Lpm), the turbine would be shutdown. The shutdown signal would come from comparison of the power meter signal (ET-1) to a minimum power set-point (initially set at 50 kW but subject to turbine curve).

Similarly, a control loop is used to modulate the TCV position to limit the power as required by the net revenue metering program to 110 kW (or less). If power produced is less than 110 kW (or BC Hydro waives this requirement), this control loop would not constrain the TCV position.

6.3. NORMAL TURBINE STOPPING SEQUENCE

Stopping procedure is directly reverse to starting procedure, as follows

1. Close TCV slowly from open position (30 s full cycle), reducing turbine output to 0 kW with generator free spinning at 1200 rpm. Bypass control valve CV3A in AUTO operation to maintain tank level (opens gradually to replace flow from turbine).
2. When power of turbine drops to 0 kW, generator shall be disconnected from the grid.
3. Continue TCV closing cycle, turbine will slow down accordingly.
4. TCV valve fully closed, turbine stopped. CV3A (and/or CV1A control valves in AUTO operation to maintain tank levels.

6.4. TURBINE STOPPING SEQUENCE FOLLOWING POWER FAILURE

In the event of a power-failure the turbine will free-spin as it will not see any natural braking loads. Accordingly the turbine must be stopped by closing off the flow through the turbine. The stopping cycle duration is balanced to limit turbine maximum speeds and transient pressures. A 10 second closing cycle is used to limit surge pressures created.

The TCV is equipped with a fail-safe in closed position valve actuator. The TCV valve actuator is equipped with capacitors that automatically operate to close the valve when power is lost to the TCV. The stopping sequence is as follows:

1. Power-failure occurs
2. TCV Closure cycle starts.
3. Turbine power output drops to 0 kW and turbine initially speeds up (to approx.. 1800 rpm).
4. Turbine slows down as TCV closes.
5. CV1A or CV3A to remain in same position as prior to power failure.
6. UPS provides power to CV1A and CV3A.
7. CV1A and/or CV3A to open and modulate to maintain tank level.

7. VENTILATION

The ventilation system design criteria is as follows:

- Allow for generator and controls losses of 9.2 kW (8% of 115 kW)

- Limit temperature rise to 10 °C, for maximum room temperature of 38 °C based on design outdoor temperature of 28 °C (BCBC 2012, Table C-2 July 2.5% exceedance for Courtenay, BC)
- Design air flow 1800 CFM (0.85 m³/s).
- Design air pressure 90 Pa across fan. Negative pressure in room of approximately 45 Pa.

A primary exhaust fan with backdraft damper and gravity inlet damper is provided linked to a thermostat to provide required room ventilation.

A secondary fan is provided for circulation of air in the control room (also thermostat controlled).

8. ALARMS / SHUTDOWNS

The following alarms and shutdowns are provided for the system.

Table 7: List of Alarms and Shutdowns for Water Supply System in Aeration Building

Description	Existing /New	Function	Setpoint	Action
Rearing Head Tank High Level	Existing	From tank level transmitter, protect against overflows	90 %	Alarm only
Rearing Head Tank Low Level	Existing	From tank level transmitter, maintain water supply	60 %	Alarm only
Incubation Tank High Level	Existing	From tank level transmitter, protect against overflows	90 %	Alarm only
Incubation Tank Low Level	Existing	From tank level transmitter maintain water supply	60 %	Alarm only
Penstock Supply High Pressure	Existing	From PT1	160 psi	Alarm only
Penstock Supply Low Pressure	Existing	From PT1	100 psi	Alarm, turbine shutdown
Generator Bearing temperature	New	From TT-04 or TT-05	tbd	Turbine shutdown
Generator Winding Temperature	New	From TT-06 to TT-08	tbd	Turbine shutdown
Turbine Overspeed	New	From RT-01	1500 rpm +/-	Alarm

Note the Puntledge River Pump Station will remain a secondary supply with the same controls and alarms as existing.

Prepared by,

WHITESIDE ENGINEERING LTD.



Neal Whiteside, M.A.Sc., P.Eng.
Principal

Issued for Tender

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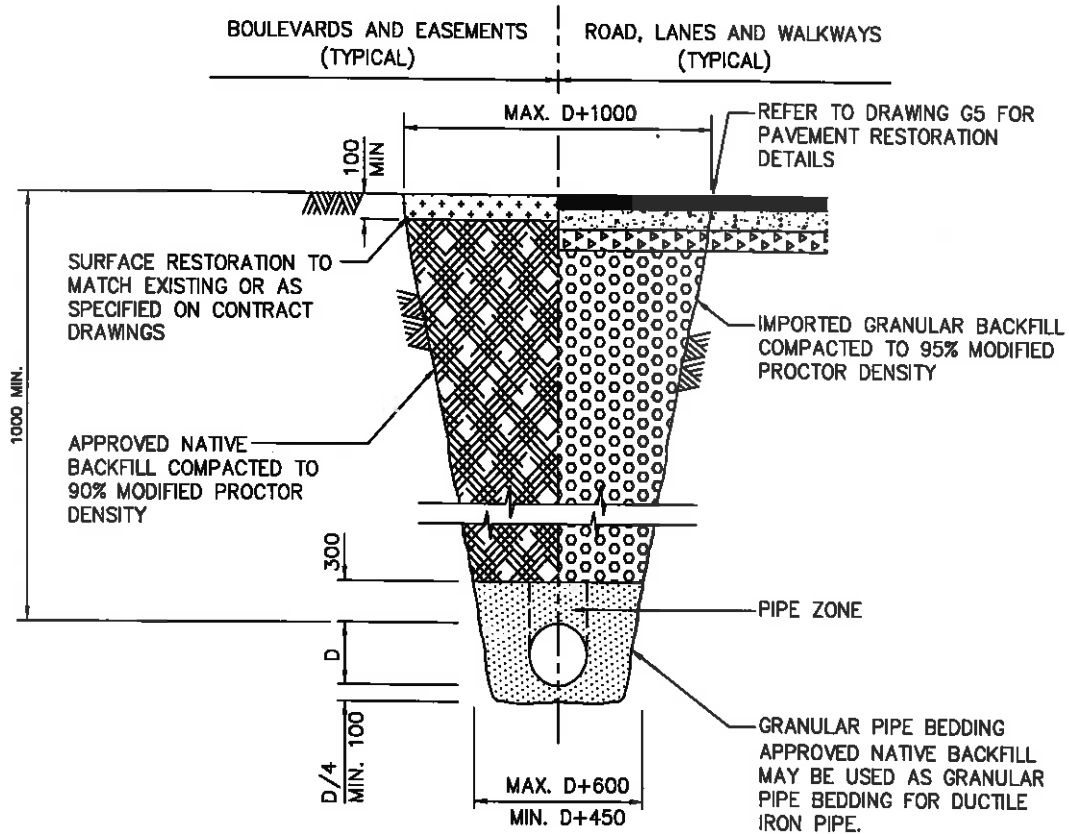
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Revision History

Version #	Status	Date	Description of Revisions	Author
0	Draft	April 18, 2016	Original	Neal Whiteside
1	Peer Review Issue	May 13, 2016	Added tachometer to instrument table, revised generator HP, updated Table 3, updated CV capacities in Table 5.	Neal Whiteside
2	Tender Issue	June 28, 2016	Revised CV1A & CV3A backup power to come from UPS. Revised generator max. output to match single line (140 kW). Added peer review note.	Neal Whiteside
3	Tender Issue	November 14, 2016	Modified to suit generator max output = 100 kW.	Neal Whiteside

WELshared:001-Projects:052 - Puntledge Const:310-Process Narrative:TM-Process Narrative-v3.docx



NOTE: 1. TRENCHING TO COMPLY WITH ALL REQUIREMENTS OF WORKSAFE BC.
 2. REFER TO CONTRACT DRAWINGS, SECTION 31 23 01 FOR DETAILED SPECIFICATIONS.

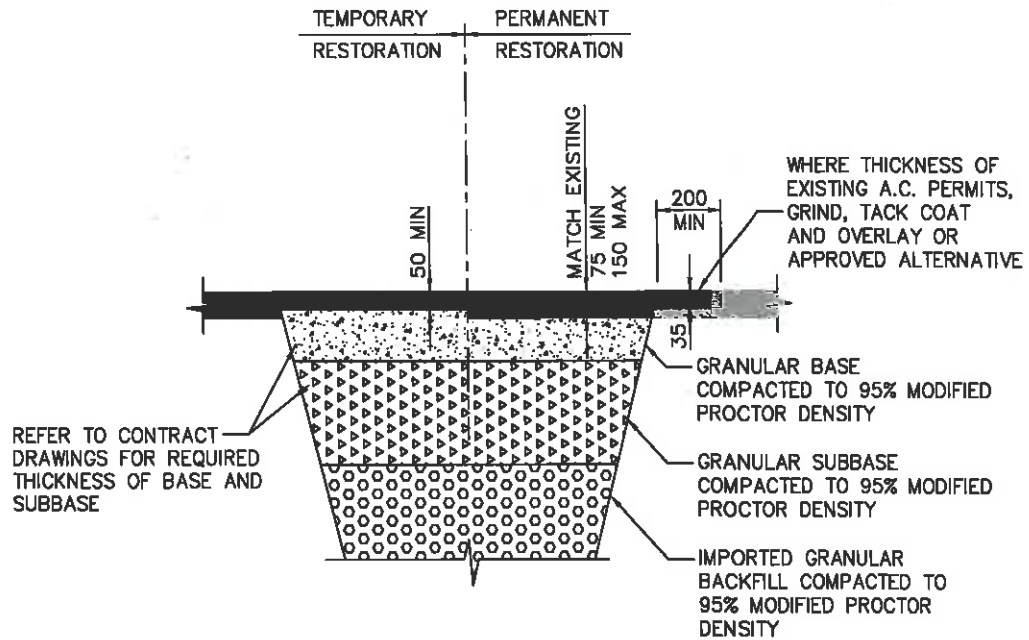
NOT TO SCALE

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UTILITY TRENCH

DRAWING NUMBER:

G4



NOTE: 1. REFER TO CONTRACT DRAWINGS, SECTIONS 31 23 01 AND 32 12 16 FOR DETAILED SPECIFICATIONS.

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PAVEMENT RESTORATION

DRAWING NUMBER:

G5