

INCH CREEK HATCHERY WELL 3 VFD UPGRADE

ELECTRICAL SPECIFICATION



Fisheries and Oceans
Canada

Pêches et Océans
Canada

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Division 26 - Electrical

Section 26 05 00 Common Work Results

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PART 1 GENERAL

1.1 General Clauses

- .1 This section includes general clauses applicable to the supply and installation of all electrical systems indicated and described. It is intended to supplement the requirements of contract documents.
- .2 The Contractor shall provide all labour, materials, tools, equipment, fabrication, and technical expertise, required for the work.
- .3 It is the intent of the Drawings and Specifications to supply sufficient information and direction to the Contractor, for the Contractor's provision of a complete, workable, and operational installation. Where work and/or materials is not specifically mentioned in the specifications or shown on the drawings, but necessary to complete the work, the Contractor shall provide the work and/or materials as if specifically mentioned in the documents.

1.2 Definitions

- .1 For the purposes of this contract, the following definitions shall apply:
 - a) 'Provide'; includes supply and install.
 - b) 'Owner'; Fisheries and Oceans Canada
 - c) 'Engineer'; a duly authorized representative of Ready Engineering (BC) Corporation (Ready).
 - d) 'Delivery'; includes all equipment, insurances, coordination, permits, and manpower to transport and off-load contract materials.
 - e) 'Suitable'; to current code requirements, safe, and in general appearance, as equipment for effective and operational use.
 - f) 'As-built Drawings'; Contractor provided contract document redline mark-ups that show all as-installed information.

1.3 Scope of Work

- .1 The electrical project includes in general terms, provision of the following:
 - a) Supply and install one new pump controller for Well No. 3. The pump controller shall be called VFD3 & Bypass Control Panel. The controller shall have one Variable Frequency Drive (VFD) that can be selected to run Well 3 pumps 1, 2 or 3. This panel shall include one VFD, isolation contactors and bypass contactors; complete with enclosure and operator interface devices.

- b) Integration of new VFD3 & Bypass Control Panel into existing pumping system.
- c) Electrical connections to existing instrumentation and new motors.
- d) Removal of the Pump No. 2 existing soft starter. (Turn over to Hatchery).
- e) Coordination with Inch Creek personnel during any down time of Well #3 pumps to ensure Well #4 can be run. If Well #3 is out of service for more than an hour then Well #4 must be put into service. (Refer to the Single Line Diagram (SLD) on Drwg. 11-31-422).
- f) Start up and commissioning of new VFD3 & Bypass Control Panel, inclusive of the variable frequency drive done by the manufacturer's approved field service representative.

1.4 Contract Drawings and Specification

- .1 The drawings and specification are complimentary to each other and what is called for by one shall be binding as if called for by both.
- .2 Should any discrepancy appear between the drawings and specifications or within the drawings or the specifications themselves, which leaves the Contractor in doubt as to the true intent and meaning of the work, the Contractor shall request an Engineer's ruling prior to the Contractor beginning the work. If this is not done, it will be assumed that the most expensive alternative has been allowed for at the Contractor's expense.
- .3 The Engineer reserves the right to make minor changes or alterations after the contract award and prior to; material order, equipment assembly or installation as applicable, where contract value is not changed.
- .4 The Engineer reserves the right to change the location of equipment, switches, outlets, etc., to within 1000mm of points indicated in the documents without involving additional charges to the Contract, providing the electrical trade is advised prior to the installation of the equipment.

1.5 Codes and Standards

- .1 Provide work to all adopted revisions, editions and versions, of codes and standards applicable to the location of work including:
 - a) C22.1, Canadian Electrical Code Part 1, current edition.
 - b) British Columbia Building Code.
 - c) Work Safe BC, Occupational Health and Safety Regulations.
 - d) Local By-laws and Regulations.
 - e) Specified reference Standards.
- .2 Notify the Engineer, of contract drawing and specification work changes required by Authorities Having Jurisdiction (AHJ), prior to making the changes.

1.6 Permits and Fees

- .1 Pay all permit fees for the work.

1.7 Site Visit

- .1 There will not be a formal site visit for tenderers. If required, the Contractor may arrange a site visit during tender, so that the he can examine all local and existing conditions which may affect the installation or performance of the work. To get to the site, travel approximately 10 kilometres east from Mission along Lougheed Highway (Highway 7) to Dewdney. The hatchery is 3 km off the highway. Turn off the highway at Hawkins Pickle Road just before Highway 7 crosses railway tracks. After 1.5 km, the name of the road changes to Bell Road. Then follow hatchery signs. The Inch Creek Hatchery Contact: James Weger - Operations Manager .The hatchery phone number is 604-826-0244.
Hours of operation @ Inch Creek Hatchery: 9am to 3pm daily, 7 days per week
- .2 If existing conditions are evident during the site visit which may affect the work, the Contractor must report to the Engineer and request instructions on performance requirements to complete the work based on found conditions.

1.8 Shop Drawings

- .1 Following are the requirements for electrical shop drawing submittals:
 - a) Provide to the Engineer for review:
 - i. Electronic copies of the shop drawings in .pdf format.
 - b) Shop drawings shall be submitted in a timely manner to allow the Engineer's review. The Contractor shall allow at least 5 working days for Division 26 shop drawings to be reviewed by the Electrical Engineer.
 - c) Shop drawings shall be submitted as a complete package, for the complete work, unless otherwise approved by the Engineer.
 - d) Shop drawings shall include a cover page that identifies the following:
 - i. project name,
 - ii. date submitted and
 - iii. Contractor's name, address, and phone number.
 - e) Each individual shop drawing shall include identification as to the exact piece of equipment that it represents pertaining to the project. The Contractor shall use drawing detail numbers and equipment name where identified on the drawings, to clarify shop drawing identification. Where a shop drawing is submitted without sufficient information to allow the Engineer to identify what the shop drawing represents, the Engineer will return the entire shop drawing package to the Contractor without further review and require the Contractor to resubmit the shop drawings after identification update is provided by the Contractor.
 - f) Shop drawings will be only reviewed by the Engineer for general conformity with the design concept. The Engineer's shop drawing review does not relieve the Contractor and/or the supplier and/or manufacturer from responsibility for correct

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design, details and dimensions, and of responsibility of checking for errors and/or omissions.

- g) Shop drawings shall include all site coordination details such as fastening and seismic support, installation space, and installation environment. Coordination shall include with electrical equipment coordination with all trades.
- h) Shop drawings shall include catalogue sheets, manufacturer's bulletins, wiring diagrams, dimensional data and operating descriptions.
- i) Shop drawings shall include interconnection wiring diagrams that show terminal numbers, cabling and conductors, number of conductors, and conductor gauge. Cabling information shall include manufacturer's requirements for shielding, twisting of pairs, minimum and maximum resistance, capacitance, reactance, etc.
- j) Shop drawings shall show wiring diagram modifications where changes or differences are made by the proposed equipment as compared to the contract documents.
- k) Submit breaker trip curves and fuse curves for all breakers and fuses greater than 40A rating.
- l) Where the Engineer determines in shop drawing review that the proposed equipment does not meet that specified or that insufficient information is presented, the Contractor shall re-submit the shop drawing(s) with request for the additional information. The Contractor shall then provide the supplemental information to the Engineer for review. Supplemental information shall be submitted as specified for shop drawing submissions pertaining to the specific equipment only; resubmission of all shop drawings as a complete package is not required.

1.9 As Built Drawings

- .1 Following are the requirements for electrical as-built drawings:
 - a) Maintain at least one set of white prints on the jobsite and record all work as-installed and be completed to current installation conditions at least daily:
 - .i Installation location
 - .ii Mounting details
 - .iii Wire gauges
 - .iv Conduit and cabling details inclusive of path and part numbers
 - b) As-built mark-ups shall be to the same standard and detail as the contract drawings. Mark-ups shall be to scale, or the dimensions shall be noted. They shall show all changes made in the Contract including:
 - .i site changes made by Engineer's construction instructions
 - .ii addendums, and
 - .iii change orders.
 - c) As-built mark-ups shall include tabulated Bill of Materials lists, that show the equipment provided in detail. The Bill of Materials lists shall include:
 - .i equipment description,
 - .ii manufacturer and
 - .iii manufacturer's part numbers.
 - d) Spare parts Bill of Materials shall be included in the same format as the Contractor's equipment Bill of Materials.
 - e) As-built mark-up drawings shall be provided to the Engineer:

- .i on-site during each site visit made by the Engineer,
 - .ii off-site when requested by the Engineer for project progress review,
 - .iii at system startup, and
 - .iv at final completion.
- f) Contract progress payments will include the Engineer's consideration for completeness of as-built drawings. Where as-built drawings are not up-to-date or accurate, to the approval of the Engineer, progress payments will be reduced by an amount determined by the Engineer to reflect the state and condition of the as-built drawings.
- g) Final contract payment will not be considered by the Owner until the Contractor's final as-built drawings, to the approval of the Engineer, have been received by the Engineer.

1.10

Operating and Maintenance (O+M) Manuals

- .1 Following are the requirements for electrical Operating and Maintenance Manuals:
- a) 3 copies of O+M manuals shall be provided by the Contractor. 3 copies to be turned over to the Owner at site.
 - b) The O+M shall include items specific to the equipment and system operations pertaining to the work provided in this project. The Contractor is not responsible to collect data from equipment and systems that are not included in the contract work.
 - c) The O+M manuals are to include:
 - .i equipment shop drawings,
 - .ii schematic and line diagrams,
 - .iii instrumentation set points,
 - .iv normal operating parameters such as operating voltage and ampacity,
 - .v testing parameters for trouble shooting such as cable resistance measurements,
 - .vi Contractor's contact information inclusive of telephone number and email address,
 - .vii equipment supplier contact information inclusive of telephone number and email address
 - .ix Copy of the electrical permit and final electrical inspection report as applicable,
 - .x Copy of special inspection reports as applicable.
 - d) O+M manual draft submission: 1 copy of the O+M manual shall be provided by the Contractor to the Engineer, prior to the system start-up. The O+M manual submission will be reviewed by the Engineer for content, clarity and completion. The Engineer will return the O+M manual to the Contractor at site during the start-up. Note that operating values that have not been entered into the O+M prior to start-up shall be collected by the Contractor during start-up and entered into the O+M.
 - e) It is intended that the O+M manuals be complete at the site start up date with the exception of minor revisions for parameter adjustments made

during commissioning. The Contractor shall make sufficient allowance for timing and work to provide completed O+M manuals prior to job completion. All costs to turn over the O+M manuals as specified is the Contractor's.

- f) All electrical O+M copies shall be bound in separate hard back binders and include table of contents and tab dividers.

1.11 **Warranty**

- .1 The Contractor shall warranty the work, equipment and materials supplied, for a period of one year after final completion. The Contractor shall repair, replace and otherwise make good the electrical installation should failure, malfunction or deficiencies become known during that period. Execution of warranty shall be at no cost to the Owner.

1.12 **Electrical Permit and Electrical Inspector's Report**

- .1 The Contractor shall provide copy of the electrical permit prior to construction.
 - a) Permit copy shall be posted at the job site.
 - b) Permit copy shall be included in the electrical O+M manual; one copy for each manual.
- .2 The Contractor shall provide copy of the Electrical Inspector's final electrical inspection report or copy of FSR's request for inspection report.
- .3 Report copy shall be included in the electrical O+M manual; one copy in each manual.
- .4 Inspection report copy shall be included in the general contract O+M manual, on copy in each manual.

Part 2 **PRODUCTS**

2.1 **Materials and Equipment**

- .1 Provide new and approved equipment, free of defects. Equipment must bear an approval label for use in British Columbia.
- .2 Equipment approval labels are to be affixed to each component and where specified, shall be affixed to a complete assembly.
- .3 If approval labels are missing, the Contractor shall arrange for Electrical Safety Branch to inspect and approve (usually at the job site) the equipment, under the SPECIAL INSPECTION PROGRAM. All costs for approvals are the Contractor's.

- .4 Re-use existing materials and equipment where identified in the documents as allowed for use, where found suitable by the Contractor. Where existing materials and/or equipment identified for re-use are found by the Contractor, during construction, as un-suitable for re-use, the Contractor shall report the findings to the Engineer and request instructions, for addendum and/or for contract change; as applicable.
- .5 Install all materials and equipment in accordance with the most stringent of the:
 - a) manufacturer's recommendations,
 - b) the Engineer's instructions, and
 - c) code requirements.

Where conflict arises between the most stringent installation requirements, the Contractor shall report to the Engineer and request further instructions from the Engineer.
- .6 All equipment and systems shall be provided to the approval of Work Safe BC requirements.
- .7 Provide WHMIS data sheets on all equipment and material, where required by Work Safe BC.

2.2 Equivalents and Substitutions

- .1 Where equipment and materials is specified by manufacturer, "or approved equivalent" is implied unless specifically noted otherwise as 'Pre-approved Required Equipment' or 'No Substitutions'. All references to manufacturer's model numbers and other pertinent information indicated is intended to establish minimum standards of performance, function and quality. Equivalent compatible Canadian listed equipment approved for use in British Columbia, from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met and are approved by the Engineer in shop drawing submittal. Submit full technical data, including revised wiring diagrams as applicable, with request for approval of equivalence in shop drawing submission.
- .2 No Substitution Equipment:
 - a) Yaskawa JVOP-180 LCD Operator for the VFD. (This is to match other VFD controls on site that the operators are familiar with).
- .3 Contractors who propose equivalent equipment shall provide:
 - a) Revised wiring and mounting details, and other pertinent supporting information as required by the Engineer, to show that the proposed is equivalent (to the approval of the Engineer),
 - b) All Engineering changes required for implementing the substituted equipment inclusive of all drawing changes, layout changes, and

coordination details shall be provided by the Contractor. Drawing details are to be provided in editable electronic format, in AutoCAD release 2000 or newer, for the Engineer's review and approval in shop drawing submission.

- .4 As-built drawings shall show the revised wiring, mounting and other details necessary to detail the installation and integration of the substituted equipment.

2.03 Control Panel Integration and Approved Panel Shops

- .1 The Contractor shall provide the services of a CSA (or equivalent) certified panel shop for control panel assembly, integration and testing.
- .2 Controls panels shall bear the mark of CSA (or equivalent) for the complete assembly.
- .3 Where CSA (or equivalent) certification is not available for the assembly (due to equipment approvals), the Contractor shall have the assembly inspected and certified to the approval of the British Columbia Safety Authority or equivalent. Approval includes Standards Council of Canada's Accreditation or British Columbia Safety Authority Special Inspection Program. All costs for special inspections shall be included by the Contractor.
- .4 Certification approval copy shall be provided by the Contractor in the electrical O+M manuals.
- .5 The panel shop to be used by the Contractor for this project must be identified with the Contractor's tender submission. The identified panel shop must be used for the work unless otherwise approved by the Engineer.

Part 3 EXECUTION

3.1 Permits, Licenses and Fees

- .1 The Contractor shall submit drawings and specifications, as required, to the inspection authorities for approval and permit applications.
- .2 The Contractor shall pay for and furnish all required permits for the electrical work.
- .3 The Contractor shall provide permit copy to the Engineer, shall post copy at the job site and shall install copy in each Electrical O+M.
- .4 The Contractor shall coordinate with the inspection authorities, (authorities having jurisdiction) for final certificates. Final certificates (no deficiencies) shall be furnished by the Contractor to the Engineer and to the Owner prior to job close out. Work shall not be considered complete until these certificates are submitted.

3.2 Codes and Standards

- .1 Perform work in accordance with Canadian Electrical Code, current edition, and the requirements of local and regional authorities having jurisdiction.
- .2 Perform the work to Work Safe BC requirements.

3.3 Workplace Safety

- .1 The Contractor shall be entirely responsible for the safety of all personnel, his and others, working on the electrical equipment.

3.4 Excavation, Backfill, Cutting and Patching

- .1 All excavation, backfill, backfill materials, compaction, cutting and patching required for electrical installation shall be included in the work.

3.5 Equipment Identification

- .1 All field components shall be clearly labelled with lamicoïd labels; Dymo tape or equivalent labels are not acceptable.
- .2 Labels shall have minimum 5mm black letters on white background unless otherwise indicated or specified.
- .3 Submit a list of equipment label wording with shop drawings.
Unless other wise specified or indicated on the drawings, fasten lamicoïd labels with at least two self-tapping screws.

3.6 Conduit and Cable Identification

- .1 Conduits and Cables:
 - a) All conduits and cables - power and control, shall be clearly identified at:
 - each termination point,
 - in in-ground pull boxes where cables pass through the box without termination,
 - at the extents of wall and floor penetrations (both sides of penetration).
 - b) Cable and conduit tag labels shall be a manufactured product specific for labelling cables and shall be:
 - Flat, rigid, non-adhesive labels fastened by tie wraps, one tie wrap at each end,
 - 12.7mm by 50.80mm or larger,
 - An equivalent label approved by the Engineer during shop drawing review.

- c) Cable labelling shall include:
- the cable designation as listed on the drawings and include the source identity,
 - the conduit designation as listed on the drawings,
 - Where cable and/or conduit designation are not listed on the drawings, the Contractor shall provide a designation, label the cable and/or conduit and show the designation on the as-built drawings,
 - Labelling may be either legible hand written or type written, and use a permanent marking print,
- .2 Conductors:
- a) All conductors, power and control, shall be clearly identified at each termination point.
- b) Conductor tag labels shall be a manufactured product specific for labelling conductors and shall be:
- Heat shrink tubing, or the Engineer's approved equivalent,
 - Labelling may be either legible hand written or type written, and use a permanent marking print,
 - Conductor labelling shall include the conductor designation as listed on the drawings and include the source and destination identity.
 - Where a conductor designation is not listed on the drawings, the Contractor shall provide a designation, label the conductor and show the designation on the as-built drawings.

3.7 Contractor Testing

- .1 All electrical power, control and alarm systems shall be tested and calibrated by the Contractor to ensure that they are operating in accordance with the intent of the drawings and specifications. If the Contractor is in doubt as to the intended operation, the Contractor shall obtain clarification.
- .2 Contractor testing shall be completed by the Contractor prior to the Contractor's request for the Engineer's site inspection.
- .3 Contractor testing shall be completed by the Contractor prior to the Contractor's request for the Engineer's site visit for process start up and commissioning.
- .4 The Contractor shall supply all necessary instruments, meters, equipment and qualified personnel to make tests on electrical equipment and wiring during construction or after installation when requested by the Engineer.

- .5 The tests shall include:
 - a) Insulation resistance tests in accordance with the Canadian Electrical Code before energizing circuits and equipment.
 - b) All tests as recommended in manufacturer's instructions.
 - c) Phase rotation tests.
 - d) Grounding system and bonding connections.
 - e) Operational test of each piece of equipment.
- .6 The Contractor shall make good all defective equipment, systems and wiring discovered during his testing program.
- .7 The Contractor shall provide all required personnel, including equipment supplier's field representatives and subcontractors as necessary to complete testing.
- .8 When the Contractor is completely satisfied that the system is completely operational and ready for inspection, he shall report to the Engineer that the system is ready for Engineer's review.
- .9 The Contractor shall submit copy of the Contractor's test data prior to the Engineer site visit.

3.8 Test Report

- .1 The test report shall include all measurements.
- .2 When included with these specifications, the Contractor shall complete the testing data sheets, inclusive of measurements, data recording and form submittal to the Engineer.

3.9 Commissioning

- .1 The Contractor shall completely test and demonstrate the electrical systems to the satisfaction of the Engineer, in the presence of the Engineer and in the presence of the Owner's representative.
- .2 The Contractor shall assist the Engineer and the Owner in commissioning the system. Commissioning is the process of advancing a project from the stage of static installation, to full working order in compliance with the needs of the process.
- .3 The Contractor's start-up and commissioning personnel shall include the attendance of manufacturer's field representatives as identified in specific specification sections.

3.10 Commissioning Coordination

- .1 The Contractor shall coordinate timing and personnel for the process commissioning, with the Owner's representative, the Engineer, other required sub-contractors, and the various vendor representatives, to be on-site and available for witness or service, as applicable.

3.11 Special Areas

- .1 The Contractor shall follow industry accepted supply and installation practices and adhere to all code regulations for hazardous locations, damp, wet and corrosive locations, and areas subject to extreme temperatures or vibrations.

3.12 Making Good

- .1 The Contractor shall repair damages caused to the Owner resultant of work done by the Contractor. Work done by the Contractor includes all work by the Contractor, the Contractor's sub-contractors, and includes delivery services directed by the Contractor.

3.13 Protection of Work

- .1 The Contractor shall properly cover and protect from damage and weather, all equipment and material related to his work.

3.14 Clean-Up

- .1 Upon completion of the work, the Contractor shall remove all tools, debris, and surplus material, and shall leave the area neat and clean, to the Engineer's approval.

3.15 Coordination

- .1 The Contractor shall coordinate information flow between the; Contractor, suppliers, manufacturers and field technicians, to insure that correct and current information is used to fabricate and install the equipment.

3.16 Workmanship

- .1 Work shall be done in accordance with good practice and by tradesmen accredited and skilled in the performance of electrical work.
- .2 The Engineer shall determine whether workmanship is acceptable. Work approved by the Electrical Inspector or other authorities may still be rejected by the Engineer.

- .3 Grounds for rejection may be, but not limited by the following:
- a) Poor appearance
 - b) Poor quality materials
 - c) Conduit or wiring connections incompatible with standard of enclosures used
 - d) Insufficient support or fastenings
 - e) Materials installed in a manner or location that will impede other trades or make future maintenance awkward, costly or impossible.

3.17 Contractor's Responsibilities

- .1 The Contractor shall review all equipment, material or installation of the same, which appears inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of authorities having jurisdiction, or of any necessary items of work omitted from the Contract Documents.
- .2 During the course of this construction, existing conditions that are found by the Contractor or his sub-trades, that are personnel or process hazards, shall be reported by the Contractor to the Engineer. Where requested by the Engineer, the Contractor shall prepare a written summary of the found hazards. Resulting work action will be directed by the Engineer or Owner's designate as required.

3.18 Supplier Responsibilities

- .1 The Contractor shall be responsible for insuring that all his suppliers of equipment and material have sufficient information to determine whether their equipment and material to be supplied, is suitable for the intended use shown in these documents.
- .2 The Contractor shall notify his suppliers as follows:
- a) All suppliers shall insure their equipment and material is suitable for the installation intended. If his equipment is found to be deficient, it shall be removed and replaced with suitable equipment, all at no cost to the Owner.
 - b) The supplier shall insure when applying for "equivalent" status to specified equipment, that his equipment is truly equivalent. If his equipment is discovered to be deficient in this respect, it shall be removed and the specified equipment supplied by the Contractor, all at no cost to the Owner or Engineer.

3.19 Seismic Restraint

- .1 The Contractor shall provide seismic restraint for all provided electrical equipment.
Seismic restraints shall be provided to the required extent.

- .2 Seismic restraints shall be provided as detailed in the Electrical Contractor's Association of British Columbia Seismic Restraint Standards Manual – Guideline for Electrical Systems. Where the guidelines do not provide detail for specific equipment, the Contractor shall obtain seismic details from a Professional Engineer registered in British Columbia who specializes in such said designs. The Contractor shall provide and implement the engineered seismic restraint system as designed.
- .3 All provided seismic restraint systems shall be documented in the O+M manual and be inserted in the corresponding equipment section.

3.20 Inspection of Work

- .1 The Contractor shall coordinate with the; Engineer, the Owner's representative, and Electrical Safety Branch for inspection timing and requirements. It is the Contractor's responsibility to ensure that sufficient notice is provided to have inspections completed.
- .2 Note: the BC Safety Branch authority requirements for inspection(s) must be adhered to, and are not substituted by inspections by the Electrical Engineer, or by the Owner. Where work is to be covered, approval must be given by both the BC Safety Branch Authority and by the Engineer. Coordination with the Electrical Safety Authority and with the Engineer is entirely the responsibility of the Contractor.
- .3 The Contractor shall provide the Engineer at least two (2) normal working days advanced notice for request of Engineer's site visit prior to electrical work being covered.
- .4 The Contractor shall provide the Engineer at least ten (10) normal working days advanced notice for start-up and for commissioning timing.

END OF SECTION

Division 26 - Electrical

Section 26 24 19 Motor Control Centres

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PART 1 GENERAL

1.1 Scope of Work

- .1 The Contractor shall provide a free-standing panel to control three pumps in Well 3. The panel is to replace 3 existing solid state reduced voltage, soft starters in the MCC. There is limited space in the Well #3 pumphouse and the MCC cannot be expanded to house the new VFD. A new panel is to be provided across the room and wiring extended as required to and from the MCC.
- .2 There is also limited space to mount the new motor control panel which will house Well 3 motor control equipment. The panel can be equal in height to an MCC section, however the width must be limited to 610 mm. (Anything wider will not fit between a diesel genset vent hood and the diesel fuel tank). Drawing 11-31-398 has a sketch of a possible layout for the panel. The sketch and list of materials are to be used as a guideline with the manufacturer providing shop drawings of actual equipment to be provided.
- .3 Well 3 can provide a limited amount of water and only one of the three pumps can run at any one time. The Hatchery has decided to provide one VFD to run the three pumps and a switching scheme to select which pump will run. As Well 3 is a critical water source the motor control panel will have built-in ready to use bypass contactors which can be selected with panel mounted selector switches.
- .4 Protection and alarms for each pump must function when that pump is in operation.
- .5 There will be provision in the pumphouse for a future control panel with remote I/O for control and monitoring of the pumphouse equipment; this panel will be provided by DFO.
- .6 Pump 1 and 3 SSRV starters will be left in the MCC as installed spares until they are either required or the space is required.
- .7 The relay panel that is part of the MCC has control switches for the existing Well 3 controls, these switches shall be relabelled as spare or not in use.

1.2 Shop Drawings and Product Data

- .1 Submit shop drawings in accordance with 26 05 00 for review and approval.
- .2 Shop drawings are to include:
 - a) wiring diagrams and equipment layouts.
 - b) field connection requirements inclusive of terminals and lug gauges and locations.

- c) enclosure dimensions with structural assembly and layout.
- d) VFD ratings and capacity; include efficiency estimate at motor rated FLA

1.3 Operation and Maintenance Data

- .1 Provide operation and maintenance data for the Motor Controls in accordance with 26 05 00.
- .2 Include operation and maintenance data for each drive component.

Part 2 PRODUCTS

2.1 Enclosure

- .1 Single freestanding enclosure, NEMA 12 rated, steel, powder coated grey on the exterior and white on the interior.
- .2 Cable entry through top of enclosure.
- .3 Incoming lugs and ground lugs located near top of enclosure.
- .4 Door mounted main breaker operator interlocked with door opening mechanism to prevent opening of enclosure door while VFD is energized.
- .5 Door exterior mounted operator interface, devices as shown on the drawings.
- .6 Door exterior mounted programmable relay with expansion module, as shown on the drawings.
- .7 Door interior pamphlet holder.
- .8 Door interior wiring diagram. Diagram provided by VFD/panel supplier (as-built).
- .9 Enclosure size as indicated on the drawings is approximate. Any change in size must be approved by the Engineer.
- .10 Before placing VFD enclosure sectionalize diesel tank grate to create a permanent, solid base for the enclosure to stand on. Galvanize cut portions of the grate to prevent any rusting.
- .11 Overload resets shall be door mounted buttons with extension rods so the panel door does not need to be opened to reset an overload device.

2.2 Variable Frequency Drive

.1 Capacities as follows, to provide continuous pump motor operation at rated service factors:

a) Capacity to supply one 20HP, 208VAC, 3 phase pump motor. Note that one of the pumps is 17 Hp.

.2 The standard of acceptance for each VFD is the Yaskawa CIMR-PU2A0056FAA series with a Yaskawa JVOP-180 LCD Operator. To match existing Hatchery equipment.

There is no substitution allowed for the Yaskawa JVOP-180 LCD Operator unless it is no longer available. If substitution is needed, approval will be required from the project Engineer.

.3 Requirements include:

- a) Microprocessor based inverter logic, isolated from all power circuits.
- b) Pulse Width Modulated (PWM) power electronic system.
- c) Adjustable carrier frequency, including a low noise, low carrier frequency function.
- d) Modbus RTU via RS485, or Modbus TCP/IP communications port. A door mounted programming/ monitoring port for a laptop to be connected.
- e) Ethernet/IP Communication Card.
- f) 4-20mA analog input, programmable for speed reference or PID Feedback
- g) 0-10V or 4-20mA analog output, programmable for output frequency or current
- h) 120VAC rated digital outputs, for running and fault status
- i) Independent digital inputs for run control, external fault, external reset, and control selection
- j) Control power loss ride through, capable of 2 seconds
- k) Fault history, with the last 10 fault indications and time stamp
- l) The following minimum protective functions:
 - Overheat
 - Motor overload (electronic overload)
 - VFD overload
 - Short circuit
 - Overvoltage
 - Undervoltage
 - Input phase loss
 - Output phase loss
 - Output ground fault
 - Overcurrent

.2 Keypad/Operator Interface that provides plain language readouts of:

- Output frequency
- Output Voltage

- Output current
 - Output power
 - I/O status
 - Heatsink temperature
 - Fault Conditions
- .3 The following equipment, in addition to the VFD, is to be included in the VFD panel:
- Breaker
 - Line reactor
 - dV/dT output filter
 - 500VA control transformer
 - Cooling fans
 - Selector switches, pushbutton, push-to-test indicating lights, relays, terminals and fused terminals, and wireway as indicated in drawings
 - Contactors and a programmable relay to allow for bypass and pump selection capabilities.
- .4 The VFD panel is a control panel, and the certification requirements listed in section 26 05 00 2.3 are applicable.
- .5 The Contractor is to coordinate and include the services of the VFD supplier and integrator in their tender. Services include on site commissioning by an approved manufacturer's representative. Commissioning includes field start up services to program the VFD, and train hatchery staff on VFD operation and general trouble shooting.

2.3 Bypass and Isolation Contactors

- .1 Provide bypass and isolation contactors with selector switches, elapsed time meters etc. as shown on the drawings.

2.4 Equipment Identification

- .1 Provide lamicoid label with starter designation information, black plate, 5mm white letters, 25mm X 50mm, engraving to be determined. Controls panels shall bear the mark of CSA (or equivalent) for the complete assembly. Refer to label wording on schematic diagrams.

PART 3 Execution

3.1 Programming

- .1 The VFD manufacturer's field representative shall provide final programming during start up and commissioning.

- .2 Programming shall include complete operational requirements for the system to the requirements of the engineer.
- .3 The VFD supplier is to coordinate with the engineer during shop drawing stage to ensure programming parameters are correct in conjunction with the schematic requirements.
- .4 Programming is to include the following:
 - Local operation selection at the Local/Off/Remote hand switch shall allow VFD keypad speed control.
 - VFD shall ride through short duration power outage and continue operation of the pumping operation after short duration outage.
 - VFD shall restart the pumping operation after power failure when continued called both by Local or Remote, except in VFD Alarm conditions (automatic reset of minor VFD alarms, automatic restart after power return)
 - The programmable relay will be programmed to allow for safe pump switching and bypassing of the VFD. The operator must be able to perform the following operations in a safe manner with time delays as specified by the VFD vendor to protect equipment and personnel:
 - Switch from one pump to another via a 3 position switch. The programmable relay will allow for sufficient ramp down of the operating pump and VFD before switching to another pump.
 - Switch from VFD to bypass operation.
 - Switch from one pump to another via the same 3 position switch described above while in bypass operation. The programmable relay will allow for sufficient ramp down of the operating pump before switching to another pump.

3.2 Training

- .1 The VFD manufacturer's field representative that performs the final programming and commissioning shall train the Owner's representatives on all operation of the new equipment. Training shall include reference to, and revision of, the O&M literature pertaining to specific process operations.

3.3 Phase Rotation

- .1 Confirm the phase rotation and running current of each pump prior to demolition. After the new equipment is installed demonstrate the phase rotation is unchanged and record running current at 100% speed.

END OF SECTION