

SPECIFICATIONS AND CONTRACT DOCUMENTS

FOR

DFCM

**LOGAN FES WARM WATER INTERIM HATCHERY FACILITY
PHASE II
DFCM PROJECT #09167520**

February 2010



**J-U-B Engineers, Inc.
57-09-023**

DOCUMENT 00010

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SECTION 01100
SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General Description of Work.
- B. Excavation
- C. Location
- D. Work Sequence

1.2 GENERAL DESCRIPTION OF WORK

- A. The Logan Fisheries Experiment Station (FES) Warm Water Hatchery Facility Phase II Project consists of the following WORK:

Installation of new warm water hatchery equipment for an endangered fish species (June Sucker). The new equipment will be installed in an existing building. The improvements inside the building will include: constructing a new concrete floor approximately 3 feet above the existing building floor over approximately $\frac{3}{4}$ of the building area, installation of new aquaculture equipment including new round fish culture tanks, associated piping, valves and pumps to feed and drain the new tanks, installation of a drum filter, biofilter, CO2 stripper, UV reactor, and electrical systems for the new aquaculture equipment, and integration of the new equipment into the existing electrical control system and appurtenances.

Other construction items include two items that will be bid as Alternates 1 and 2. Bid Alternate 1 includes constructing a reinforced concrete pad for parking on the east side of the building with a reinforced gravel access from the south. Bid Alternate 2 includes the installation of pre-engineered building insulated steel panels on the exterior of the building, removal of existing windows, and installation of new windows.

1.3 EXCAVATION

- A. This project will require a minimal amount of excavation inside of the existing fish hatchery building to construct new footings to support new aquaculture equipment. Also, some minor excavation will need to be done to improve an existing gravel access road and to construct a new concrete pad on the east side of the building.

1.4 LOCATION

- A. The WORK is located at the Logan Fisheries Experiment Station, at 1465 West 200 North in Logan, Utah.

1.5 SEQUENCE OF WORK

- A. The WORK is to be performed in a manor as to not disrupt the operation of the experiment station, including the operation of the existing June Sucker facility. Any disruption of service to these areas will be coordinated with the FES staff and Engineer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01150

AMERICAN RECOVERY AND REINVESTMENT ACT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Buy American Provisions
- B. Wage Rate Requirements

1.2 BUY AMERICAN REQUIREMENTS

- A. CONTRACTOR shall comply with the Buy American requirements stated in Sections 01600 and 01610.
- B. CONTRACTOR shall also comply with the Buy American provisions given on the attached document entitled "American Recovery and Reinvestment Act Requirements."

1.3 WAGE RATE REQUIREMENTS

- A. CONTRACTOR shall comply with the Davis Bacon Wage requirements given on the attached document entitled "American Recovery and Reinvestment Act Requirements."

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

American Recovery and Reinvestment Act Requirements

Funds for this project are provided by the Federal Government from the American Recovery and Reinvestment Act, Public Law 111-5, (ARRA) and the following provisions apply.

A. REQUIRED USE OF AMERICAN IRON, STEEL, AND MANUFACTURED GOODS—SECTION 1605 OF THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 (2 CFR §176.140)

This award term and condition implements (i) Section 1605(a) of the American Recovery and Reinvestment Act of 2009 (Pub. L. 111-5) (Recovery Act), by requiring that all iron, steel, and manufactured goods used in the project are produced in the United States.

"Domestic iron, steel, and/or manufactured good"

(1) Is wholly the growth, product, or manufacture of the United States; or

(2) In the case of a manufactured good that consists in whole or in part of materials from another country, has been substantially transformed in the United States into a new and different manufactured good distinct from the materials from which it was transformed. There is no requirement with regard to the origin of components or subcomponents in manufactured goods or products, as long as the manufacture of the goods occurs in the United States.

“Manufactured good” means a good brought to the construction site for incorporation into the building or work that has been—

(1) Processed into a specific form and shape; or

(2) Combined with other raw material to create a material that has different properties than the properties of the individual raw materials.

“Public building” and "public work" means a public building of, and a public work of, a governmental entity (the United States; the District of Columbia; commonwealths, territories, and minor outlying islands of the United States; State and local governments; and multi-State, regional, or interstate entities which have governmental functions).

The award official may add other iron, steel, and manufactured goods to the list in paragraph (b)(3) of this award term and condition if the Federal government determines that—

The cost of domestic iron, steel, and/or manufactured goods would be unreasonable.

The cost of domestic iron, steel, and/or manufactured goods used in the project is unreasonable when the cumulative cost of such material will increase the overall cost of the project by more than 25 percent;

The iron, steel, and/or manufactured goods is not produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality; or

The application of the restriction of section 1605 of the Recovery Act would be inconsistent with the public interest.

B. WAGE RATE REQUIREMENTS UNDER SECTION 1606 OF THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009

a) Section 1606 of the Recovery Act requires that all laborers and mechanics employed by contractors and subcontractors on projects funded by the Recovery Act shall be paid Davis-Bacon wage rates (as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code). These regulations also apply to any sub-contract.

Davis-Bacon wage rates for Cache County, Utah may be found at the following website:

<http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=Davis-Bacon&docid=UT20080044>

See: GENERAL DECISION: UT20080044 12/25/2009 UT44

Date: December 25, 2009

The contractor will be required to submit weekly a copy of all payrolls to the DIVISION. The required weekly payroll information may be submitted using the recommended Form WH-347, which is available for this purpose from the Department of Labor Web site: <http://www.dol.gov/whd/forms/wh347.pdf>

The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

SECTION 01200

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Schedule of values.
- B. Applications for payment.
- C. Change procedures.
- D. Defect assessment.

1.2 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702.
- B. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section.
- D. Include in each line item, amount of Allowances specified in this section.
- E. Include within each line item, direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.3 APPLICATIONS FOR PAYMENT

- A. Submit three copies of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Submit at intervals stipulated in the Agreement.
- E. Submit with transmittal letter as specified for Submittals in Section 01300.

- F. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
 - 1. Construction progress schedules, revised and current as specified in Section 01300.

1.4 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on DFCM Construction Change Directive Form.
- C. The Architect/Engineer may issue a Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and specifications, and a change in Contract Time for executing the change. Contractor will prepare and submit estimate within 10 days.
- D. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01600.
- E. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation.
- F. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work which are not pre-determined, execute Work under Construction Change Directive. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.
- G. Construction Change Directive: Architect/Engineer may issue directive, on DFCM Form signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- H. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect/Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

- I. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- J. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- K. Change Order Forms: DFCM Change Order Form
- L. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- M. Correlation Of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - 3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer will direct appropriate remedy or adjust payment.
- C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.
- D. Defective Work will be partially repaired to instructions of Architect/Engineer, and unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer. Owner.
- E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- F. Authority of Architect/Engineer to assess defects and identify payment adjustments, is final.
- G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of required Work.
 - 5. Products remaining on hand after completion of the Work.

6. Loading, hauling, and disposing of rejected products.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed products list.
- D. Shop drawings.
- E. Product data.
- F. Manufacturers' instructions.
- G. Manufacturers' certificates.
- H. Construction photographs.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control.
- B. Section 01700 - Contract Closeout.

1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer accepted form.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail name or number(s), and specification Section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- E. Supply signed verification from each manufacturer that all submitted items to be used on the project are manufactured in the United States.

- F. Schedule submittals to expedite the Project, and deliver to Engineer at 1047 S. 100 W. Suite 180 Logan, Utah 84321. Coordinate submission of related items.
- G. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- H. Provide space for Contractor and Engineer review stamps.
- I. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- J. Distribute copies of reviewed submittals to affected parties. Instruct parties to promptly report any inability to comply with provisions.

1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule in duplicate within 10 days after date established in Notice to Proceed for Engineer review. Submit progress schedule no later than pre-construction conference.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- E. Indicate estimated percentage of completion for each item of Work at each submission.
- F. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

1.5 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Owner-Contractor Agreement, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.6 SHOP DRAWINGS

- A. Submit the number of opaque reproductions which Contractor requires, plus five (5) copies which will be retained by Engineer.
- B. Except as may otherwise be indicated herein, the ENGINEER will return prints of each submittal to the CONTRACTOR with its comments noted thereon, within 15 calendar days following their receipt by the ENGINEER. It is considered reasonable that the contractor shall make a complete and acceptable submittal to the engineer by the second submission of a submittal item. The STATE OF UTAH reserves the right to withhold monies due to the contractor to cover additional costs of the engineers for review beyond the second submittal. The engineers maximum review period for each submittal, including all resubmittals, will be 15 days per submittal. In other words, the maximum review period for that submittal could be 45 days.
- C. After review, distribute in accordance with Article on Procedures above and for Record Documents described in the General Conditions.
- D. Fabrication of an item shall be commenced only after the engineer has reviewed the pertinent submittals and returned approved copies to the contractor.

1.7 PRODUCT DATA

- A. Submit the number of copies which the Contractor requires, plus three (3) copies which will be retained by the Engineer.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. After review, distribute in accordance with Article on Procedures above and provide copies for Record Documents described in the General Conditions.

1.8 MANUFACTURERS' INSTRUCTIONS

- A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- C. Identify conflicts between manufacturers' instructions and Contract Documents.

1.9 MANUFACTURER'S CERTIFICATES

- A. Provide written signed certification that products are manufactured in the United States.

- B. When specified in individual specification Sections, submit manufacturer's certificate to Engineer for review, in quantities specified for Product Data.
- C. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- D. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.10 CONSTRUCTION PHOTOGRAPHS

- A. None required.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance/control of installation.
- B. References.
- C. Construction observation and testing laboratory services.
- D. Manufacturers' field services and reports.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01600 - Material and Equipment.

1.3 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from the Engineer.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.4 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents.
- B. Should specified reference standards conflict with Contract Documents, request clarification from Engineer.

- C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.5 CONSTRUCTION OBSERVATION AND TESTING LABORATORY SERVICES

- A. Owner will appoint and employ for services of Engineer to perform Construction Observation and testing.
- B. The Engineer will observe all tests run by the Contractor in the field.
- C. The Contractor shall be responsible for providing the equipment and manpower to assist the Engineer in taking tests.
- D. The Contractor shall provide the equipment and manpower to conduct all tests as required in the specifications.
- E. The Contractor shall notify the Engineer of the time in which tests are to be run forty-eight (48) hours prior to testing.
- F. Reports will be submitted by the Engineer, to the Contractor indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- G. Cooperate with Engineer; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - 1. Notify Engineer 48 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with Engineer and pay for additional samples and tests required for Contractor's use.
- H. Retesting required because of non-conformance to specified requirements shall be performed by the Engineer. Payment for retesting will be charged to the Contractor by deducting inspection or testing charges from the Contract Sum/Price.

1.6 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 15 days of observation to Engineer for review.

1.7 PROJECT LIMITS

- A. Confine all equipment, tools, and materials to the easements and project sites shown on the plans.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 INSTALLATION

- A. The contractor shall inspect material or equipment upon the arrival on the job site and immediately prior to installation and reject damaged and effective items.
- B. The contractor shall verify measurements and dimensions of the work as an integral step of starting each installation.
- C. Where installations include manufactured products the contractor shall comply with manufacturer applicable instruction and recommendation for installation, to whatever extent these are more explicit or more stringent than applicable requirement indicated in the Contract Documents.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
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SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 GENERAL

1.2 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures.

1.3 TEMPORARY ELECTRICITY

- A. Provide, maintain and pay for temporary electricity as needed for construction.

1.4 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of site, to protect public safety, and to protect existing facilities, fish in the existing warm water hatchery, and adjacent properties from damage from construction operations.
- B. Provide protection for plant life designated to remain. Replace damaged plant life.
- C. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

1.5 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment as needed.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion and puddling.

1.6 DUST CONTROL

- A. This item shall consist of furnishing and applying POTABLE water required in construction and for dust control, in accordance with the requirements of these specifications.
- B. Water, when required, shall be applied at the locations and in the amounts required to properly compact the work. An adequate water supply shall be provided by the Contractor. The equipment used for watering shall be of ample capacity and of such design as to assure uniform application of water in the amounts required.

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- C. If required, watering shall be done at night or at other times when evaporation loss will be at a minimum.
- D. In watering of subgrades, the Engineer may direct the Contractor to apply water in such quantities that the subgrade shall be compacted at a moisture content in excess of "optimum moisture." In no case will the Contractor be required to apply water in excess of three percent (3%) of optimum moisture.
- E. The Contractor shall also apply water during the course of the work to control dust, maintaining all embankment and base courses in a damp condition.
- F. The Contractor shall provide sufficient equipment to apply water as directed for controlling dust caused by construction activities. If dusty conditions continue to exist due to insufficient or inadequate watering practices or lack of watering equipment, it shall cause the closing down of those operations affected until remedied. Watering shall be done on Saturdays, Sundays, and Holidays at the same frequency and amounts as specified for work days at the Contractor's expense.
- G. Watering equipment shall consist of water-tight tanks mounted on trucks, adequately powered, and capable of applying water as required. The water shall be applied under pressure from the tank through a spray apparatus as directed. The spray apparatus shall be equipped as to provide uniform, unbroken spread of water over the surface being watered. A suitable device for positive shut-off and for regulating the flow of water shall be located so as to permit positive drive control from the cab.

1.7 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize amount of bare soil exposed at one time.
- C. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosion of surface silts or clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation, promptly apply corrective measures.

1.8 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

- B. Equipment and fuel storage shall be kept secured. Waste oil and waste fluids shall not be stored or changed at any construction site.
- C. Prevent moist soil or other contaminants from being transferred into facilities.
- D. Comply with “**Disinfection of Non-Hatchery Vehicles and Heavy Equipment Entering a Utah Division of Wildlife Resources Fish Hatchery**” attached to this section.

1.9 SECURITY

- A. Provide security and facilities to protect work from unauthorized entry, vandalism or theft.

1.10 NOISE CONTROL

- A. Construction involving noisy operations, including starting and warming up of equipment, shall be restricted to the hours between 7:00 a.m. and 7:00 p.m. on weekdays. Noisy operations shall be scheduled to minimize their duration and to ensure their completion by 7:00 p.m.
- B. Notification of special circumstances or emergency conditions that require work beyond the hours specified above shall be provided as follows:
 - 1. The Contractor shall notify the Engineer 48 hours in advance of any proposed extended work hours for preauthorization. Notification shall include a written request for authorization to perform work specified and the circumstances that warrant this request. This notification shall include any additional measures to mitigate noise generated by this construction activity if deemed necessary by the Engineer.
 - 2. If an emergency situation occurs that warrants extended hours, the Contractor shall notify the Engineer immediately upon determining the need for this work.

1.11 TREE AND PLANT PROTECTION

- A. **CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS:** All landscaped areas and other surface improvements which are damaged by actions of the Contractor shall be restored to a condition equal to or better than it was prior to construction. Areas shall not be cleared until related construction activities require the work.

1.12 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity

in immediate work area to minimize damage.

1.13 ACCESS ROADS

- A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.
- B. Extend and relocate as Work progress requires. Provide detours necessary for impeded traffic flow in excess of two hours.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide and maintain access for emergency vehicles.
- E. Provide means of removing mud from vehicle wheels before entering streets.

1.14 PARKING

- A. Do not allow construction personnel to park in any way which may affect the access of emergency vehicles or FES personnel.
- B. Arrange for temporary surface parking to accommodate construction personnel.
- C. When site space is not adequate, provide additional off-site parking.

1.15 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove waste materials, debris, and rubbish from site periodically and dispose off-site in approved solid waste facilities at no additional cost to owner.
- C. Provide necessary containment and clean-up of all hazardous/dangerous materials on-site that result from Contractor's actions.
- D. Dispose of all hazardous/dangerous waste in approved hazardous waste facilities that result from Contractor's actions.

1.16 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used



JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

State of Utah
Department of
Natural Resources

MICHAEL R. STYLER
Executive Director

Division of
Wildlife Resources

JAMES F. KARPOWITZ
Division Director

**Disinfection of Non-Hatchery Vehicles and Heavy Equipment
Entering a Utah Division of Wildlife Resources Fish Hatchery**

Due to the possibility of introducing a disease or unwanted organisms to our facility during construction all equipment will need to be cleaned and disinfected before being brought onto the hatchery grounds. The possibility of introducing disease and Aquatic Nuisance Species are a major concern, but viruses, fungus, parasites and bacterial diseases are also a concern.

Whirling disease and the Aquatic/Terrestrial Nuisance Species, especially New Zealand mud snail, are now found statewide. If one of these organisms happened to be introduced into a hatchery, the facility would be shut down for an indefinite period of time, with the possibility of ending trout production forever.

The following are protocols for bringing vehicles, heavy equipment and non-fish culture personnel and equipment onto a Division Fish Culture Facility will be followed for all agencies/companies and their employees:

The construction field supervisor is responsible for notifying the Hatchery Supervisor of any vehicles entering the facility for the first time. If the Supervisor is not available another hatchery staff members will be designated to act in his place. The designated hatchery staff member will inspect all vehicles and heavy equipment before entering the facility where fish are being reared. Our main concern is to insure that all equipment is free of mud and dirt, etc. that may harbor disease or Aquatic Nuisance Species.

The following must be done:

1. The day before any vehicles or heavy equipment are brought onto the station, they will need to be washed and allowed to dry overnight. All mud or clumps of dirt need to be removed. Washing by a hot water pressure washer is preferred. If the vehicles have been working around a lake, river or pond they will need to be disinfected. This has to be done with a 1000-ppm solution of chlorine, which will be sprayed onto the vehicle after it has been washed. Spray chlorine on the entire vehicle paying particular attention to the vehicle's underside, tires and wheels. A 1,000-ppm solution is 72 milliliters of household bleach/gallon of water. Rinse the chlorine off of the vehicle afterwards.

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2. Vehicles leaving hatchery grounds and going to a landfill, then returning to the hatchery will not need to be washed again. If they are muddy, the vehicle will need to be washed and be free of mud before entering the hatchery grounds.

3. All vehicles or heavy equipment leaving the hatchery will not need to be washed again when returning, as long as they do not go into muddy areas or waterways. When the heavy equipment is brought back onto the site, a designated hatchery employee will need to inspect it.

END OF SECTION

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SECTION 01600

MATERIALS AND EQUIPMENT
(Items Purchased by General Contractor)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Transportation and Handling.
- C. Product Delivery.
- D. Storage and protection.
- E. Product options.
- F. Proposed Substitutions or "or equal" Item
- G. Owner Supplied Equipment.

1.2 PRODUCTS

- A. Products: New material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include the Fluidized Sand Biofilter CO₂ Stripper and the Low Head Oxygenator.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- C. This project is funded through the American Recovery and Reinvestment Act (ARRA). All iron, steel and manufactured goods must be American made, unless American made goods are not available, cannot be acquired in a timely fashion, or add more than 25% to the cost of the project. CONTRACTOR shall notify ENGINEER of any materials needed for this project that cannot be obtained from U.S. manufacturers prior to starting construction.
- D. The above requirement does not preclude a minimal use of foreign material provided the cost of material used does not exceed 5% of the total cost of materials to complete the project.
- E. Provide interchangeable components of the same manufacturer, for similar components where more than one choice is available.

1.3 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions and deliver to project site in undamaged condition in manufacturer's unopened containers and packaging.
- B. Promptly review shipments to assure that products comply with requirements, quantities are correct, and products are undamaged. Replace damaged products at no additional cost to OWNER.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- E. The contractor shall provide additional protection during handling to prevent marring and otherwise damaging product, packaging and surrounding surfaces.

1.4 PRODUCT DELIVERY

- A. STATE OF UTAH will not accept any deliveries addressed to CONTRACTOR or its Subcontractors.

1.5 STORAGE AND PROTECTION

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of fabricated products, place on sloped supports, above ground.
- C. Provide off-site storage and protection when site does not permit on-site storage or protection.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for review. Periodically review to assure products are undamaged and are maintained under specified conditions.

1.6 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions (or equal): Submit a request for substitution for any manufacturer not named.
- C. Products Specified by Naming One Manufacturer with no Substitutions: Use the product and Manufacturer as specified.

1.7 PROPOSED SUBSTITUTIONS OR "OR EQUAL" ITEM

- A. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other suppliers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:
 - 1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR
 - 2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER's decision shall be final.
 - 3. The ENGINEER may require the CONTRACTOR to furnish additional data about the proposed substitution.
 - 4. The STATE OF UTAH may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.
 - 5. Acceptance by the ENGINEER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.
 - 6. The CONTRACTOR shall be responsible for resultant changes which the accepted substitution requires in the CONTRACTOR'S WORK, the WORK of its subcontractor and of other contractors.
- B. The procedure for review by the ENGINEER will include the following:
 - 1. If the CONTRACTOR wishes to provide a substitution item, the

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CONTRACTOR shall make written application to the ENGINEER on the "Substitution Request Form."

2. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s) shall be within the 30 day period after award of the Contract.
 3. Wherever a proposed substitution item has not been submitted within said 30-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Document.
 4. The CONTRACTOR shall certify that the proposed will perform adequately the functions and achieve the results called for by the general design, and be similar and of equal substance to that indicated, and be suited to the same use as that specified.
 5. The ENGINEER will evaluate each proposed substitution within a reasonable period of time.
 6. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized with out the ENGINEER's prior written acceptance of the CONTRACTOR's "Substitution Request Form."
 7. The ENGINEER will record the time required by the ENGINEER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.
- C. The CONTRACTOR's application using the "Substitution Request Form" shall contain the following statements and information which shall be considered by the ENGINEER in evaluating the proposed substitution:
1. The evaluation and acceptance of the proposed substitution will not prejudice the CONTRACTOR's achievement of substantial completion on time.
 2. Whether or not acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adopt the design to the proposed substitution.
 3. Whether or not incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.
 4. All Variations of the proposed substitution from the items originally specified will be identified.

5. Available maintenance, repair, and replacement services will be indicated. The manufacturer shall have a local service agency which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
 6. Itemized estimate of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.
- D. Without any increase in cost to the STATE OF UTAH, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the WORK, whether or not the ENGINEER accepts the proposed equipment or material. The CONTRACTOR shall reimburse the STATE OF UTAH for the charges of the ENGINEER for evaluating each proposed substitution.

1.8 OWNER SUPPLIED EQUIPMENT

- A. Pieces of equipment to be supplied by the Owner are listed on drawing sheet A-102.
- B. The items that will be supplied by the Owner are listed below:
 - Cyclobio Sand Filter (Biofilter)
 - CO₂ Stripper
 - Low Head Oxygenator (LHO) and Header Tank
 - RFM 4872 Drum Filter
 - Small Rectangular Tanks (Existing)
- C. The Biofilter, CO₂ Stripper, and the LHO and Header Tank will be delivered to the site by the manufacturer. For these items, the Contractor will be required to:
 - Offload from the delivery truck.
 - Place at location shown on plans.
 - Provide electrical service, disconnect boxes, and controls.
 - Provide plumbing to the equipment.
 - Provide and install sand.
 - Provide level concrete pads with floor anchors for the equipment.
 - Install as shown on the plans and as specified in Sections 13135, 13210, and 13211.

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- D. The RFM 4872 Drum Filter will be delivered to the project site by the Owner. The Contractor will be required to upgrade and install the Drum Filter as shown on the plans and as outlined in Section 13208.
- E. The small rectangular tanks are already in the existing building. These tanks are to be placed in the locations shown on the plans and plumbed according to the plans. The tanks will be supported by the cinder blocks that are currently supporting the tanks. The tanks will be adjusted to the elevations called for on the plans by placing composite wood boards between the cinder blocks and the bottoms of the tanks. The composite boards will be furnished by the Contractor.

END OF SECTION

SECTION 01610

MATERIALS AND EQUIPMENT
(Pre-Purchased Items from Manufacturers)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product Delivery.
- C. Product Options.
- D. Proposed Substitutions or "or equal" Item

1.2 PRODUCTS

- A. Products: Fluidized Sand Biofilter, CO₂ Stripper and the Low Head Oxygenator (LHO) and Header Tank as specified in Sections 13135, 13210, and 13211 and as shown on the aquaculture drawing set.
- B. Provide interchangeable components of the same manufacturer, for similar components where more than one choice is available.
- C. This project is funded through the American Recovery and Reinvestment Act (ARRA). All iron, steel and manufactured goods must be American made, unless American made goods are not available, cannot be acquired in a timely fashion, or add more than 25% to the cost of the project.
- D. MANUFACTURER shall provide written letter stating that products are made in the United States.

1.3 PRODUCT DELIVERY

- A. Products shall be delivered to the Logan Fisheries Experiment Station (FES) located at the following address:

1465 W. 200 N.
Logan, UT 84321
Phone 435-752-1066

- B. Products shall be delivered to the (FES) within 12 weeks of the date of the purchase order.

- C. Products shall be delivered to the (FES) undamaged.
- D. The MANUFACTURER will NOT be required to:
 - Offload from the delivery truck.
 - Place at location shown on plans.
 - Provide electrical service, disconnect boxes, and controls.
 - Provide plumbing to the equipment.
 - Provide and install sand.
 - Provide level concrete pads with floor anchors for the equipment.
 - Install the equipment.

1.4 PRODUCT OPTIONS

- A. Products of manufacturers named or approved equal meeting the specifications and dimensional as detailed in the aquaculture drawing set. Submit a request for substitution for any manufacturer not named.

1.5 PROPOSED SUBSTITUTIONS OR “OR EQUAL” ITEM

- A. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words “or equal” indicating that a substitution is permitted, materials or equipment of other suppliers may be accepted if sufficient information is submitted by the MANUFACTURER to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:
 1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the MANUFACTURER.
 2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER’s decision shall be final.
 3. The ENGINEER may require the MANUFACTURER to furnish additional data about the proposed substitution.
 4. The ENGINEER may require the MANUFACTURER to furnish a special performance guarantee or other surety with respect to any substitution.

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5. Acceptance by the ENGINEER of a substitution item proposed by the MANUFACTURER shall not relieve the MANUFACTURER of the responsibility for full compliance with the specifications and for adequacy of the substitution.
 6. The MANUFACTURER shall certify that the proposed will perform adequately the functions and achieve the results called for by the general design, and be similar and of equal substance to that indicated, and be suited to the same use as that specified.
- B. The MANUFACTURER shall provide the following information which shall be considered by the ENGINEER in evaluating the proposed substitution:
1. All Variations of the proposed substitution from the items originally specified will be identified.
 2. Available maintenance, repair, and replacement services will be indicated. The manufacturer shall have a local service agency which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

END OF SECTION

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SECTION 01700
EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Testing, adjusting and balancing.
- F. Protecting installed construction.
- G. Project record documents.
- H. Operation and maintenance data.
- I. Manual for materials and finishes.
- J. Manual for equipment and systems.
- K. Spare parts and maintenance products.
- L. Product warranties and product bonds.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
- B. Provide submittals to Architect/Engineer required by authorities having jurisdiction.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy all of building as specified in Section 01100.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.

- B. Coordinate temporary shut down of phase 1 system for cleaning with hatchery personnel at least 7 days before shut down. Allow time for hatchery personnel to remove fish from phase 1 system before cleaning the new aquaculture equipment.
- C. Clean new aquaculture equipment as quickly as possible to allow phase 1 equipment to be put back into service as soon as possible.
- D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer seven days prior to start-up of each item. Provide 14 days prior to startup of aquaculture system.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative and / or Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01300 that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- E. Required instruction time for each item of equipment and system is specified in individual sections.

1.6 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings on new equipment.
- D. Protect installed piping and fittings from potential damage from traffic prior to the installation of the new concrete floor.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic from landscaped areas.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.

- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.

- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.

- G. Submit documents to Architect/Engineer with claim for final Application for Payment.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.

- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

- D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

- E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.

- f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
- 3. Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.

1.9 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes in final form within 10 days after final inspection.
- E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.
- F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- H. Additional Requirements: As specified in individual product specification sections.
- I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.10 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.

- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes in final form within 10 days after final inspection.
- E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- G. Include color coded wiring diagrams as installed.
- H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.
- I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- J. Include servicing and lubrication schedule, and list of lubricants required.
- K. Include manufacturer's printed operation and maintenance instructions.
- L. Include sequence of operation by controls manufacturer.
- M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- N. Include control diagrams by controls manufacturer as installed.
- O. Include Contractor's coordination drawings, with color coded piping diagrams as installed.
- P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

- Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- R. Include test and balancing reports as specified in Section 01400.
- S. Additional Requirements: As specified in individual product specification sections.
- T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

1.12 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.
- F. Submit prior to final Application for Payment.
- G. Time Of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 - 2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface debris removal.
- B. Stripping construction site of plant life and grass including root systems to a minimum six inch depth.
- C. Removal and disposal of shrubs and grasses.

1.2 RELATED SECTIONS

- A. Section 01500 – Construction Facilities and Temporary Controls

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.

3.2 PROTECTION

- A. Locate, identify, and protect utilities that remain from damage.
- B. Protect all trees from damage which are to remain.
- C. Protect plant growth, and features designated to remain, as final landscaping or outside of construction limits.
- D. Retain and protect bench marks, survey monuments, and existing structures and utilities from damage or displacement.
- E. Protect roads, fences, and other items to remain during construction.
- F. Protect all adjoining property.

3.3 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees, brush and shrubs within construction limits and in areas for which easements have been acquired. Remove stumps and roots completely. Take care not to disturb existing utilities.
- C. Limit clearing and construction operation to areas required for construction and designated by the ENGINEER.

3.4 REMOVAL

- A. Remove debris and extracted plant life from site. Open burning and burial in trenches is prohibited.
- B. Strip all heavy soils, heavy growths of grass, and sod that comprise the organic root-zone and dispose of On-site at locations provided by the Owner. The depth of stripping will generally be twelve (12) inches. Topsoil material shall be placed along perimeter of the new building as directed by the engineer. Dispose stripped material at a location approved by the engineer. Spread the stripped material over the excavated material disposal locations. Level excess stripped material.
- C. Topsoil stockpile shall be separated from other soil materials to prevent contamination.
- D. Dispose all materials at locations that are in compliance with all Federal, State, and Local Regulations.
- E. Grade areas in which groundwater is encountered to drain.

3.5 OBSTRUCTIONS

- A. Remove and replace fences, fence post, signs and any structures encountered during construction to a condition equal to or better than it was prior to construction.

3.6 CLEANUP

- A. Upon completion of the site work and project, clean the entire work area. Remove all excess excavated material, rocks, boulders, logs, trees, pipe, or debris of any type from the site and dispose at a site acceptable to Federal, State, and Local Regulations.

END OF SECTION

SECTION 02140

DEWATERING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Trench Dewatering.
- B. Dewatering for Structures.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control.
- B. Section 01500 - Construction Facilities and Temporary Controls.
- C. Section 02222 - Excavation.
- D. Section 02225 - Trenching and Backfilling for Utilities.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PREPARATION

- A. Furnish, install and operate all necessary machinery, appliances and equipment to maintain all excavations and trenches free from water during construction.

3.2 DEWATERING

- A. Dispose of water in such a manner that it does not cause injury to public or private property, or cause a nuisance or a menace to the general public.
- B. Comply with State of Utah, Water Quality Standards, latest edition, for discharge of water to surface water.

- C. The Contractor shall be fully responsible for complying with the permitting performance requirements. Contractor may devise dewatering system to achieve such requirements.
- D. Draw static water level to at least one foot (1') below the bottom of the excavation prior to excavation to maintain the undisturbed state of the foundation soils and allow placement of bedding material and backfill to the required density.
- E. Compact native soil prior to placing backfill or foundation material according to Section 02223 of these specifications.
- F. Prevent softening of the bottom of excavations and the formation of "quick" conditions or "boils" during excavation.
- G. Additional cost for trench bottom stabilization, due to inadequate dewatering system, will be incidental to the work.
- H. Control surface runoff to prevent entry or collection of water in excavations.
- I. Install and operate the dewatering system so that adjacent structures or property are not endangered by the reduction in the groundwater level.

3.3 TERMINATION

- A. Allow groundwater to return to static level to maintain the undisturbed state of the natural foundation soils, prevent disturbance of the compacted backfill, and prevent flotation or movement of structures and gravity or pressure pipe.

3.4 TESTING

- A. Monitor and sample dewatering discharge for compliance with referenced permits.
- B. Monitor wastewater from dewatering operations for changes in visual or odor components indicating the presence of contaminants including, but not limited to, gasoline, pesticides and other hazardous materials and toxins.
- C. Cease dewatering operations and notify Engineer, and regulatory agencies, immediately upon encountering contaminants in water.
- D. Maintain explosive atmosphere-detection device on-site. Periodically measure atmosphere for explosivity at mid-height of excavation.

END OF SECTION

SECTION 02205
SOIL MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Trench Backfill Soil Materials.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control.
- B. Section 02207 - Aggregate Materials
- C. Section 02222 – Excavation for Structures.
- D. Section 02223 – Backfilling and Compacting for structures.

1.3 REFERENCES

- A. ASTM D2487 - Classification of Soils for Engineering Purposes.
- B. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- C. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures in place by Nuclear Methods (Shallow Depth).
- D. AASHTO T-180 - Moisture-Density Relations of Soils Using a 10-lb Rammer and eighteen (18) inch Drop.
- E. ANSI/ASTM D-1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer with an eighteen (18) inch drop.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Samples: Submit, in airtight containers, 45 lb. (20 kg) sample of each type of imported trench backfill to testing laboratory.
- C. Materials Source: Submit name of imported materials suppliers. Provide materials from same source throughout the work. Change of source requires Engineer's approval.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. Subsoil Type S1: Excavated and re-used material, graded, free of lumps larger than 4 inches, rocks larger than 4 inches, frozen material, and debris.
- B. Use Subsoil Type S1 for trench backfill and structure backfill.

2.2 SOURCE QUALITY CONTROL

- A. Inspection and testing will be performed under provisions of Section 01400.
- B. Tests and analysis of soil material will be performed in accordance with AASHTO T-180, ASTM D2922, ANSI/ASTM D-1557, ANSI/ASTM D-698, and ASTM D3017. A minimum of three tests must be done.
- C. If tests indicate materials do not meet specified requirements, change material and retest at no cost to Owner.
- D. Source to be free of biohazard materials and organisms. Important material sources must be approved by Division of Wildlife Resources.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials on site.
- B. Stockpile in sufficient quantities to meet project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 02207

AGGREGATE MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate materials for structural fill/pipe bedding under the raised floor section in the building, sand under the new round aquaculture tanks, gravel road roadbase, import fill, and drain rock.

1.2 RELATED SECTIONS

- A. Section 01025 - Measurement and Payment.
- B. Section 01300 - Submittals.
- C. Section 01400 - Quality Control.
- D. Section 02205 - Soil Materials.
- E. Section 02223 – Backfilling and Compacting for Structures.
- F. Section 02225 – Trenching and Backfilling for Utilities.
- G. Section 02230 – Gravel Approach.
- H. Section 15100 – Pipe.

1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D2049 - Test Method for Relative Density of Cohesionless Soils.
- C. ASTM D2487 - Classification of Soils for Engineering Purposes.
- D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures in place by Nuclear Methods (Shallow Depth).

- G. AASHTO T-180 - Moisture-Density Relations of Soils Using a 10-lb Rammer and eighteen (18) inch Drop.
- H. ANSI/ASTM D-1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer with an eighteen (18) inch drop.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Samples: Submit, in airtight containers, 45 lb. (20 kg) sample of each type of aggregate material to testing laboratory. Submit test results to Engineer.
- C. Materials Source: Submit name of aggregate materials suppliers. Provide materials from same source throughout the work. Change of source requires Engineer approval.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

- A. No imported aggregate materials from streams or rivers will be accepted. The Contractor shall provide documentation of the source of all imported aggregate materials used on this project.
- B. Aggregate Type A1: Natural stone or crushed rock; free of clay, shale, organic matter; graded in accordance with ANSI/ASTM C136, ASTM D2487 Group Symbol GM GC; to the following limits:
 - 1. Minimum Size: 1 inch (25 mm)
 - 2. Maximum Size: 2 inch (50 mm)Use for structure foundation drainage material, as indicated on the Drawings.
- C. Aggregate Type A2: Clean angular crushed rock; free of clay, shale, and organic matter; graded in accordance with ANSI/ASTM C136, within the following limits: (Alternative gradations will be considered)

<u>Sieve Size</u>	<u>Percent Passing</u>
½ inch	100
3/8 inch	20 to 30
No. 50	2 to 8
No. 100	0 to 2

Use for structural fill inside of the building between the top of the existing concrete floor and the bottom of the concrete floor to be constructed.

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- D. Coarse Aggregate Type A3: 1 ½ inch minus angular, crushed, free of shale, clay, friable material and debris; graded in accordance with ANSI/ASTM C136, Group Symbol GW; within the following limits: (Alternative gradations will be considered)

<u>Sieve Size</u>	<u>Percent Passing</u>
1 ½ inch	100
1 inch	80 to 95
¾ inch	75 to 85
½ inch	60 to 80
⅜ inch	55 to 75
No. 4	35 to 60
No. 10	25 to 45
No. 50	8 to 25
No. 200	2 to 8

Use for roadbase course material, structural foundation material and as shown on the Drawings.

- E. Aggregate Type A4: Sand, free of shale, clay, friable material and debris; graded in accordance with ANSI/ASTM C136; within the following limits: (Alternative gradations will be considered)

<u>Sieve Size</u>	<u>Percent Passing</u>
¾ inch	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

Use for bedding material under the 8 foot diameter aquaculture tanks as shown on the plans.

- F. Pit Run Type A5: Durable material free of shale, clay, organic matter, friable material and debris meeting the following limits: (Alternative gradations will be considered)

<u>Sieve Size</u>	<u>Percent Passing</u>
6 inches	100
4 inches	98 to 100
3 inches	95 to 100
2 inches	75 to 100
1 inch	40 to 80
No. 4	25 to 60
No. 200	5 to 12

Use for the import trench backfill, structural fill material, site fill material, and where specified elsewhere and shown on the Drawings.

- G. Aggregate Type A6: Native material, free of organic material, friable materials and debris. Maximum allowable size is four (4) inches. Use for trench backfill and structure backfill.

2.2 SOURCE QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400.
- B. Tests and analysis of aggregate material will be performed in accordance with ASTM C136 and ASTM D2487. A minimum of three (3) tests of each material source must be done.
- C. If tests indicate materials do not meet specified requirements, change material and retest at no cost to Owner.
- D. Source to be free of biohazard materials and organisms. Important material sources must be approved by Division of Wildlife Resources.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials on site.
- B. Stockpile in sufficient quantities to meet project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- E. Upon removal, do not mix material with native materials.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent freestanding surface water.

3.3 PLACEMENT OF TYPE A2 AGGREGATE

- A. Place Type A2 aggregate in lifts not exceeding 8" inches in height.
- B. Consolidate aggregate lifts using vibration equipment prior to placing subsequent lifts.

END OF SECTION

SECTION 02211

ROUGH GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of topsoil and subsoil.
- B. Cutting, grading, filling and rough contouring the site.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Testing fill compaction.
- B. Section 02110 - Site Clearing.
- C. Section 02205 – Soil Materials.
- D. Section 02207 – Aggregate Materials.
- E. Section 02223 - Backfilling and Compacting for Structures
- F. Section 02225 - Trenching and Backfilling for Pipe Lines.

1.3 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of utilities remaining, by horizontal dimensions, elevations or inverts, and slope gradients, referenced from permanent improvements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Subsoil: Type S1 specified in Section 02205, excavated material, graded, free of lumps larger than 4 inches, rocks larger than 4 inches in the largest dimension, and debris.
- B. Granular Fill: Type A1, A2, A3, A4, A5 and A6 specified in Section 02207.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known underground, above ground and aerial utilities. Stake and flag locations.
- C. Coordinate work with utility companies to remove and relocate utilities, as necessary.
- D. Protect above and below grade utilities that remain.
- E. Protect soil from erosion.
- F. Protect bench marks, existing structures, fences, and sidewalks from excavating equipment and vehicular traffic. Replace in kind if damaged.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas excavated.
- B. Stockpile in area designed on site.
- C. Do not excavate wet topsoil.
- D. Stockpile topsoil to depth not exceeding 8 feet.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated.
- B. Stockpile in area designated on site.
- C. Do not excavate wet subsoil.
- D. Grade all saturated soil areas to drain upon encountering them.

- E. Stockpile subsoil to a depth not exceeding 8 feet.

3.5 FILLING

- A. Fill areas to contours and elevations with approved materials.
- B. Granular Fill: Place and compact materials in continuous layers not exceeding 8 inches loose depth to 95% of ASTM D-1557.
- C. Subsoil Fill: Place and compact material in continuous layers not exceeding 8 inches loose depth to 92% of ASTM D-1557.
- D. Make grade and alignment changes gradual. Blend slope into level areas.
- E. Remove surplus fill materials from site.
- F. Abate dust during construction using water from an approved source.
- G. Place topsoil along perimeter of building as directed by the engineer.

3.6 FIELD QUALITY CONTROL

- A. Field review and testing will be performed under provisions of Section 01400.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557 and with Section 01400.

END OF SECTION

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ROUGH GRADING
SECTION 02211-4

SECTION 02222

EXCAVATION FOR STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation for structures.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control.
- B. Section 01500 - Construction Facilities.
- C. Section 02205 - Soil Materials.
- D. Section 02140 - Dewatering
- E. Section 02211 - Rough Grading
- F. Section 02223 - Backfilling and Compacting for Structures.
- G. Section 02225 - Trenching and Backfilling for Pipelines.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Verify location of potentially conflicting utilities, underground, above-ground and overhead.
- C. Coordinate with utility owners to allow relocation of utilities if necessary.
- D. Identify limits of excavation to protect vegetation where possible.
- E. Protect all plant life outside the limits of construction.

- F. Identify and protect all bench marks, existing structures, drainage way, etc.

3.2 EXCAVATION

- A. Underpin or shore up adjacent structures which may be damaged by excavation work, including utilities.
- B. Excavate subsoil to the lines and grades shown on the plans required to accommodate building and structure construction.
- C. Dewater excavation as necessary. See Section 02140.
- D. Excavate subsoil to the required line and grade to accommodate structure construction operations.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavated area.
- F. Hand trim excavation. Remove loose matter.
- G. Remove lumped subsoil, frozen subsoil and boulders.
- H. Notify Engineer of unexpected subsurface conditions.
- I. Correct unauthorized excavation at no extra cost to Owner.
- J. Correct areas over-excavated by filling with aggregate A5 material and compacting to ninety five percent (95%) ANSI/ASTM D-1557 Density.
- K. Stockpile excavated material in a designated place. Stock piles must be protected from eroding until final placement is achieved.
- L. Repair damage to other utilities.

3.3 EXCAVATION FOR FOOTINGS

- A. Preparation: To minimize differential settlement it is essential that earth surfaces upon which footings will be placed, be compacted in accordance with the compaction requirements and be protected from rain and runoff. No footing shall be placed on saturated material. Footing foundation material which becomes saturated during construction due to lack of protection by the Contractor shall be over excavated to suitable material and backfilled with suitable foundation soil at no cost to the owner.
- B. Foundation trenches shall be protected from ground water by providing a low spot

and pumping or by other means which disposed of subsurface water. See Section 02140 – Dewatering.

3.4 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01400.
- B. Provide for visual inspection of bearing surfaces and compaction testing.

3.5 PROTECTION

- A. Protect excavated area by methods required to prevent cave-in or loose soil from falling into trench.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation, from freezing.
- C. Prevent water from ponding on excavated surfaces.

END OF SECTION

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EXCAVATION FOR STRUCTURES
SECTION 02222-4

SECTION 02223

BACKFILLING AND COMPACTING FOR STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Backfilling areas excavated for new footings.
- B. Placement of imported structural fill, geotextile fabric and sand under raised floor.
- C. Consolidation and compaction.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01400 - Quality Control.
- C. Section 02140 – Dewatering.
- D. Section 02205 - Soil Materials.
- E. Section 02207 - Aggregate Materials.
- F. Section 02222 - Excavation for Structures.
- G. Section 02225 - Trenching and Backfilling for Pipelines.
- H. Section 03300 - Cast-in-Place Concrete.

1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb Rammer and 18 inch Drop.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Samples: Submit 45 lb. sample of each type of aggregate and soil materials to testing laboratory, in air-tight containers.
- C. Submit all sample and compaction test results to Engineer.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

- A. Coarse Aggregate A5 or A6 specified in Section 02207.

2.2 FOUNDATION MATERIALS

- A. Type A1 Aggregate as specified in Section 02207, and as shown on the drawings.

2.3 STRUCTURAL FILL MATERIALS UNDER RAISED FLOOR

- A. Type A2 Aggregate as specified in Section 02207, and as shown on the drawings.
- B. Type A4 Sand as specified in Section 02207 under the new round aquaculture tanks on top of geotextile fabric as shown on the drawings.

2.4 GEOTEXTILE FABRIC

- A. Non-woven class II geotextile fabric.
- B. Free from tears or defects that will adversely alter fabric's physical properties.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify fill materials to be used are acceptable.

3.2 PREPARATION

- A. Footings - cut out soft areas of subgrade not capable of insitu compaction. Backfill with Type A1 fill as necessary and compact to density equal to or greater than requirements for subsequent backfill material.
- B. Prior to placement of foundation material, compact subgrade to ninety-five percent (95%) of its maximum dry density in accordance with ANSI/ASTM-D1557 or to density requirements for subsequent backfill materials. Scarify, wet and recompact, if necessary, to achieve densities.
- C. Prior to placement of any fill material under the new raised floor, cap or place perforated stainless steel plates over open drain pipes as indicated on the drawings.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with the material(s) specified in Part 2 of this section and as shown on the drawings.

- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces. If wet, frozen, porous, spongy or other unsuitable materials are encountered, backfill with import backfill at no additional cost to Owner.
- C. Aggregate Type A1, A3, A5 and A6: Place and compact materials in continuous layers not exceeding eight (8) inches loose depth.
- D. Aggregate Type A2: Place and consolidate in continuous layers not exceeding eight (8) inches loose depth. At locations where new pipes will be installed, place and consolidate material to an elevation that is higher than the required spring line elevation of the pipes. After consolidating the material, remove material along the alignments of the pipes to allow pipes to be placed at the grades called for on the drawings. Place and consolidate material above pipes taking precautions to avoid damaging the pipes.
- E. Aggregate Type A4: Place and compact in continuous layers not exceeding eight (8) inches loose depth under round aquaculture tanks on top of fabric as shown on the plans. At locations where new pipes will be installed, place and compact material to an elevation that is higher than the required spring line elevation of the pipes. After consolidating the material, remove material along the alignments of the pipes to allow pipes to be placed at the grades called for on the drawings. Place and compact material around and above pipes taking precautions to not damage the pipes.
- F. Subsoil Type S1 Fill: Place and compact material in continuous layers not exceeding eight (8) inches loose depth
- G. Compact fill materials to ninety-five percent (95%) maximum density as determined by ANSI/ASTM-D1557. Unless noted otherwise on the Drawings.
- H. Employ a placement method that does not disturb or damage existing and new structures or utilities.
- I. Maintain moisture content within 1% below and 3% above of optimum moisture content for backfill materials to attain required compaction density.
- J. Remove surplus and unusable backfill materials from site.
- K. Make gradual grade and alignment changes. Blend slope into level areas.

3.3 GEOTEXTILE FABRIC

- A. Place fabric on top of Type A2 Aggregate at locations that will be under new round aquaculture tanks as shown on the plans.
- B. Use 12 foot wide rolls of fabric, rolled out in the east/west direction (in line with the rows of tanks).

- C. No joints in the fabric will be allowed under the tanks.
- D. Cut holes in fabric as needed to allow for new aquaculture pipes to pass through.
- E. Cut and place smaller pieces of fabric (aprons) on top of the first fabric layer at locations where pipes pass through the fabric. The aprons shall be cut to fit tightly around the pipes and cover all holes and tears in the fabric around the pipes. Provide 12" of apron overlap beyond any holes and tears around pipe penetrations.

3.4 TOLERANCES

- A. As specified in drawings.

3.5 FIELD QUALITY CONTROL

- A. Field testing will be performed under provisions of Section 01400.
- B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM C136 and ANSI/ASTM-D1557 and with Section 01400.
- C. Compaction testing will be performed in accordance with ANSI/ASTM-D1557 and with Section 01400.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.6 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500.
- B. Recompact fills subjected to vehicular traffic before placement of subsequent layers.

3.7 TEST SCHEDULE

- A. Spread Footings – 1 test per footing
- B. Building Floor – 3 tests of Type A4 material (1 test per row of new round aquaculture tanks).

END OF SECTION

SECTION 02225

TRENCHING AND BACKFILLING FOR PIPELINES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation for pipelines.
- B. Compacted bedding over pipelines.
- C. Backfilling and compaction.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control
- B. Section 01500 - Construction Facilities and Temporary Controls
- C. Section 02140 – Dewatering.
- D. Section 02211 - Rough Grading:
- E. Section 02222 – Excavation for structures.
- F. Section 02223 - Backfilling and Compaction for Structures.
- G. Section 15100 - Pipe

1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.

1.5 FIELD MEASUREMENTS

- A. Verify that survey bench mark and intended elevations for the Work are as shown on drawings.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

- A. Soil Materials: Subsoil Type S1 as specified in Section 02205.
- B. Aggregate Materials: Type A2, A3, A4, A5 or A6 as specified in Section 02207.

BEDDING MATERIALS

- A. Type B1 - Pea Gravel: Natural stone; free of clay, shale, organic matter; graded in accordance with ANSI/ASTM C136, to the following:
 - 1. Minimum Size: 1/4 inch
 - 2. Maximum Size: 5/8 inch.
- B. Type B2 - Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, or organic matter; uniform in size with no material larger than 3/4".
- C. Type A4 – Sand: As specified in Section 02207.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify fill materials to be reused if acceptable.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify, maintain and protect existing utilities remaining, which pass through work area.
- C. Protect bench marks, existing structures, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- D. Protect above and below grade utilities which are to remain.

- E. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with Type A1 fill, Section 02207, and compact to density equal to or greater than requirements for subsequent backfill material to a point 4" below the bottom of the pipe.
- F. Provide means by which natural drainage ways can be diverted away during trenching. Do not permit runoff water to enter the trench.

3.3 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation.
- B. Have utility poles supported which may become undermined by excavation.
- C. Excavate subsoil required for water piping, sewer piping, culverts and other utilities.
- D. Cut trenches sufficiently wide to enable safe installation of utilities and allow review, meeting dimensions shown on the plans. Minimize the length of open trenches.
- E. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- F. Provide trench bracing in strict accordance to safety standards.
- G. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- H. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd, measured by volume.
- I. Correct unauthorized excavation using suitable backfill materials, at no cost to the Owner.
- J. Correct areas over excavated by error using suitable backfill materials, at no cost to the Owner.
- K. Stockpile excavated material in area designated on site.
- L. Provide means for removing ground water from trench. No pipe shall be laid in a trench with standing water in it.

3.4 BEDDING

- A. Support pipe and conduit during placement and compaction of bedding.
- B. Install bedding material to 12" above pipe.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Granular Fill: Place and compact materials in continuous layers not exceeding 8 inches loose depth.
- D. Soil Fill: Place and compact material in continuous layers not exceeding 8 inches loose depth.
- E. Employ a placement method that does not disturb or damage pipe in trench.
- F. Maintain moisture content within 2% of optimum moisture content for fill materials to attain required compaction density.
- G. Leave fill material stockpile areas completely free of excess fill materials.
- H. Install magnetic locator tape 12" above pipe surface.
- I. Provide a minimum cover over new sewer pipe of 3 feet. If 3 feet of cover cannot be obtained next to the building, wrap sewer pipe with insulation.

3.6 FIELD QUALITY CONTROL

- A. Field review and testing will be performed under provisions of Section 01400.
- B. Tests and analysis of fill material if required by Engineer will be performed in accordance with ANSI/ASTM C136 and with Section 01400.
- C. Compaction testing if required by Engineer will be performed in accordance with ANSI/ASTM D1556, ANSI/ASTM D1557, and with Section 01400.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no cost to the Owner.
- E. Frequency of Compaction Tests: (Trench)
 - 1. Horizontal Location:
Test at start of trench with subsequent tests at every 100' along the trench length.

2. Vertical Location:

At every horizontal location, obtain one test at half the depth of the trench, one test at the top of the trench, and subsequent test(s) at locations where materials or construction procedures change.

3.7 PROTECTION OF FINISHED WORK

- A. Protect trench excavation to prevent cave in.
- B. Maintain and protect finished Work until project is completed.
- C. Recompact fills subjected to vehicular traffic.

3.8 SCHEDULE

- A. Water lines, gravity sewer pipe, and conduits under pavement or structures:
 - 1. Bedding Fill: Type B1, B2, or A4; Bottom of pipe to 12 inches over pipe, compacted to 95 percent of maximum dry density in accordance with ANSI/ASTM D1557.
 - 2. Backfill: Subsoil Type S1 (Section 02205); if native material is unacceptable, Type A2, A3, A4, A5 or A6 (Section 02207). Compaction as required on the plans;
- B. Water lines, gravity sewer pipe, and conduits at all other locations:
 - 1. Bedding Fill: Type A2, or A4; Bottom of pipe to 12 inches over pipe, compacted to 92 percent of maximum dry density in accordance with ANSI/ASTM D1557.
 - 2. Backfill: Subsoil Type S1 (Section 02205); if native material is unacceptable, Type A2, A3, A5 or A6 (Section 02207). Compaction as required on the plans;

END OF SECTION

LOGAN FES WARM WATER
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TRENCHING AND BACKFILLING FOR PIPELINES
SECTION 02225-6

SECTION 02230
GRAVEL APPROACH

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Subgrade preparation to lines and grades shown on the drawings.
- B. Placement of geotextile reinforcement Grid.
- C. Place, grade and compact base course material.
- D. Dust and Surface Water Control.

1.2 RELATED SECTIONS

- A. Section 02207 – Aggregate Materials.

1.3 REFERENCES

- A. American Society for Testing Materials (ASTM).
- B. American Association of Safety and Highway Transportation Officials (AASHTO)

PART 2 PRODUCTS

2.1 BASE COURSE MATERIAL

- A. Aggregate Type A3 as defined in Section 2207.

2.2 GEO GRID

- A. Tensar Geo Grid (Provided by others).

PART 3 EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. Prior to placing Geotextile and base course, the subgrade shall be scarified to a depth of not less than 6", moistened or dried to optimum moisture content, and compacted to at least 95% maximum Modified Proctor Density as determined in accordance with ASTM D1557 (AASHTO T-180), and shall be within 2% of optimum moisture content.

3.2 PLACEMENT OF GEOTEXTILE GRID

- A. Place geotextile grid per manufacturers instructions at location shown on the drawings.

3.3 PLACEMENT OF BASE COURSE

- A. Protect against “pumping” moisture to surface by limiting travel on exposed subgrade. Where it is determined by the Owner that construction vehicle traffic (other than proof rolling) has caused subgrade instability, remove disturbed soils and replace with sand backfill at no additional cost to the Owner.
- B. Apply water soluble herbicide for nonselective control of annual and perennial weeds in strict accordance with manufacturers instructions and all laws and regulations.
- C. Place base course material on the prepared subgrade and geotextile grid. The material shall be back-dumped and spread in a uniform lift thickness.
- D. Handle and spread materials in a manner that will prevent segregation of sizes. When vibrating or other acceptable types of compaction equipment are used, the entire course may be placed in one layer, provided the ability of the equipment to achieve specified compaction to the full layer depth is demonstrated. In no case shall compacted lift thickness be greater than 8”.
- E. When base course is constructed in more than one layer, the previously placed layer shall be cleaned of loose and foreign matter. Upper layer of base course shall not be less than 1-1/2”, nor shall fine materials be added to reach final grade.
- F. Overstressing the subgrade soil and base course shall be avoided by utilizing equipment in spreading and dumping that exerts only moderate pressure on the soil. Avoid excessive travel on lower base course lifts. Severe rutting, cracking or yielding is an indication of overstressing the soil. Any ruts or cracks which develop in the base course during spreading or compacting shall be repaired as directed at no additional cost to Owner.
- G. Base course shall be compacted to no less than 95% maximum Modified Proctor Density, as determined by ASTM D1557 (AASHTO T-180). Moisture content shall be maintained to within 1.5% of optimum throughout placing and compaction operations.
 - 1. Compaction shall always be commenced along the edge of the area to be compacted and the roller shall gradually advance toward the center of the area to be compacted.
 - 2. Compaction equipment shall be operated along lines parallel or concentric with the centerline of the road being constructed, and no material variation therefrom will be permitted.

- H. Base course shall be graded smooth and match the cross section shown in the drawings. The approach shall be graded to match closely to the existing ground surface, but be free of abrupt grade changes along the length of the approach. Completed thickness of base course shall be equal to or greater than the thickness indicated on the drawings.
- I. The top surface of compacted base course shall be finished by blading or rolled with equipment designed for that purpose.

3.4 DUST AND SURFACE WATER CONTROL

- A. Dust control measures shall be implemented by application of water to all work areas, storage areas, haul and access roads, or other areas affected by work.
- B. All work shall be in compliance with the Federal, State and local air pollution standards, and not cause a hazard or nuisance to personnel and the public in the vicinity of the work.
- C. Other methods of dust control for haul and access roads may include chemical treatment, light bituminous treatment or other method as approved by the Owner.
- D. Surface water shall be controlled to the extent that the areas to receive pavement, walks or slabs are not allowed to become wet from runoff from adjacent areas. Surface water shall be directed away from these areas but not directed toward adjacent property, buildings, or any improvement that may be damaged by water. Surface water shall not be allowed to enter sanitary sewers.

3.5 FIELD QUALITY CONTROL

- A. Testing and inspection of placed Base Course will be provided by the Owner. Tests provided by the Owner are as follows:

<u>Item</u>	<u>Type</u>	<u>Frequency</u>
Base Course Aggregate Sampling	ASTM D75	Each day or 1 test/500 sq. yd., or as required.
Atterberg Limits	ASTM D2419, D423, and D424	As required
Sieve Analysis	ASTM C136	As required
Bearing Ratio	ASTM D1883	As required
Maximum Density	ASTM D1557, Method D	As required
In-place Density	ASTM D2167, D2922 and D3017	As required

- B. If tests indicate that sub-base and/or base course do not meet specified requirements, remove defective work, replace and retest at no cost to Owner.

END OF SECTION

SECTION 02750

PRECAST PRESLOPED TRENCH DRAINS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Precast trench drains.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01400 - Quality Control.
- C. Section 01500 - Construction Facilities.
- D. Section 02223 – Backfilling and Compacting for Structures.
- E. Section 03300 – Cast-In- Place Concrete.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
 - B. Submit manufacturer's product data and installation data in compliance with Section 01300.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. ABT Inc PolyDrain
 - 2. Hubbell Polycast
 - 3. ACO Polymer Products, Inc.
 - 4. Or Approved Equal

2.2 DRAIN TRENCH

- A. Pre-fabricated polyester polymer concrete interlocking sections with radiused bottom and precast sloped bottom along the length of the trench.
- B. Minimum continuous bottom slope = 0.6% along the channel.
- C. Drain width = 4" to 6".

- D. Minimum Drain Depth = 4”.
- E. Precast sections measuring between 3 feet long and 5 feet long each.

2.3 GRATES

- A. Galvanized steel with ¼” diameter circular holes.
- B. 62 psi minimum load capacity.
- C. Provide locking mechanism to secure each grate section to trench drain sections.

2.4 ACCESSORIES

- A. Transition fittings.
- B. End plates.
- C. Provide for connections to 4” diameter circular drain pipes out of the bottom of the trench drains at locations shown on the plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all materials delivered to the site are in compliance with these Specifications.

3.2 INSTALLATION

- A. Install in accordance with the manufacturer's recommendations. Ensure precast sections are plumb and true.
- B. Install at the locations shown on the drawings with drain pipes.
- C. Set trench drains at elevation required to ensure positive floor drainage to the drains.
- D. Ensure positive drainage slope along the entire length of trench drains (0.6% min).
- E. Provide a minimum of 4” of concrete on each side of the drain and below the drain.
- F. Isolate the concrete encapsulating the trench drain with crack control joints 4” away from the edges of the grate on all sides of trench drain.
- G. Provide water tight connection to drain pipes below trench drains.

END OF SECTION

SECTION 03100

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete.
 - 2. Form accessories.
 - 3. Form stripping.

- B. Related Sections:
 - 1. Section 03200 - Concrete Reinforcement.
 - 2. Section 03300 - Cast-in-Place Concrete.
 - 3. Section 05500 - Metal Fabrications: Product requirements for metal fabrications for placement by this Section.
 - 4. Section 13000 – Pre-Engineered Steel Buildings
 - 5. Section 13050 – Aquaculture Equipment

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 347 - Guide to Formwork for Concrete.

- B. ASTM International:
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 318.

- B. For wood products furnished for work of this Section, comply with AF&PA.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Products storage and handling requirements.

1.5 COORDINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.

2.2 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off type, metal, fixed length, 1 inch back break dimension, free of defects.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders or through bolts are not permitted.
- C. Form Anchors and Hangers:
 - 1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
 - 2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
 - 3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
 - 1. Manufacturers:
 - a. Arcal Chemical Corporation Arcal-80.
 - b. Industrial Synthetics Company Synthex.
 - c. Nox-Crete Company Nox-Crete Form Coating.
 - d. Substitutions: Section 01600 - Product Requirements.
- E. Corners: Chamfer, type; 1 x 1 inch size; maximum possible lengths.
- F. Bituminous Joint Filler: ASTM D1751.
- G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

3.2 INSTALLATION

- A. Earth Forms:
 - 1. Earth forms are permitted at trench drain locations and interior spread footings only.
- B. Formwork - General:
 - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 - 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 - 5. Complete wedging and bracing before placing concrete.
- C. Forms for Smooth Finish Concrete:
 - 1. Use steel, plywood or lined board forms.
 - 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 - 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 - 4. Use full size sheets of form lines and plywood wherever possible.
 - 5. Use care in forming and stripping wood forms to protect corners and edges.
 - 6. Level and continue horizontal joints.
 - 7. Keep wood forms wet until stripped.
- D. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

- E. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- F. Obtain Architect/Engineer's approval before framing openings in structural members not indicated on Drawings.
- G. Install chamfer strips on external corners of walls.
- H. Install void forms in accordance with manufacturer's recommendations.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

- G. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 2. Place ties at least 1 inch away from finished surface of concrete.
 3. Leave inner rods in concrete when forms are stripped.
 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- I. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 4. Arrange joints in continuous line straight, true and sharp.
- J. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
 2. Do not embed wood or uncoated aluminum in concrete.
 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318, Section 6.3.
- K. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
 2. Coordinate work to avoid cutting and patching of concrete after placement.
 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- L. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
 2. Slope slabs to drain where required or as shown on Drawings.
 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

- M. Screed Supports:
 - 1. For concrete over waterproof membranes and vapor barrier membranes, use cradle, pad or base type screed supports which will not puncture membrane.
 - 2. Staking through membrane is not be permitted.
- N. Cleanouts and Access Panels:
 - 1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
 - 2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.
- B. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances as follows:
 - 1. Walls: $\frac{1}{4}$ " per 10'

2. Floors: $\frac{1}{4}$ " per 10'
3. All other concrete: as specified in ACI 117.

3.8 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.
- D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

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SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section includes the fabrication and placement of steel reinforcement for cast-in-place concrete structures, including bars, ties, supports, and welded wire fabric.

1.2 RELATED SECTIONS

- A. Submittals: Section 01300.
- B. Concrete Forms and Assesories: Section 3100.
- C. Cast-in-Place Concrete: Section 03300.

1.3 QUALITY ASSURANCE

- A. Codes and Standards: The Contractor shall comply with all requirements of the following codes and standards (most recent edition), except as modified herein:
 - 1. American Welding Society, AWS D12.1 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."
 - 2. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
 - 3. American Concrete Institute, ACI 318 "Building Code Requirements for Reinforced Concrete."
 - 4. American Concrete Institute, ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structure."
 - 5. Other References:
 - a. ASTM A82 - Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - b. ASTM A185 - Specification for Welded Wire, Fabric, Plain for Concrete Reinforcement.
 - c. ASTM A615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - d. AASHTO M31-Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - e. AASHTO M32- Cold Drawn Steel Wire for Concrete.
 - f. AASHTO M54- Fabricated Steel Bar or Rod Mats for Concrete Reinforcement.
 - g. AASHTO M55- Welded Steel Wire Fabric for Rein- forced Concrete.

1.4 SUBMITTALS

- A. Manufacturer's Data:

The Contractor shall submit the Manufacturer's specifications and installation instructions for all proprietary materials and reinforcement accessories.

B. Shop Drawings:

1. The Contractor shall submit shop drawings for the fabrication, bending, and placement of concrete reinforcement. All work shall comply with the ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Submittals shall show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies.
2. The Contractor shall submit certification of grade, chemical analysis and tensile properties of the steel furnished.
3. Also see Section 01300, SUBMITTALS.

1.5 DELIVERY, HANDLING, AND STORAGE

- A. All steel reinforcement delivered to the project site shall be bundled, tagged, and marked. Metal tags shall be used indicating the bar size, lengths, and other information corresponding to markings shown on placement diagrams in accordance with ACI 315.
- B. The Contractor shall store concrete reinforcement materials at the site in a manner that will prevent damage and accumulation of dirt or excessive rust. Store to prevent contact with the ground. Protect all reinforcement from any contact with oil, grease, or petroleum based products of any kind.

PART 2 PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. Materials specified in this section which may remain or leave residues on or within the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 REINFORCING STEEL GRADE

- A. Unless otherwise called for on the Drawings, all reinforcing steel for this project shall conform to ASTM A615 Grade 60, except for #3 stirrups or column ties which shall be Grade 40.
- B. Bar mats shall conform to the requirements of AASHTO M54 (ASTM A82).

2.3 ACCESSORIES

- A. Chairs and spacers shall be metal stock, designed for the purpose intended.
- B. All accessories shall comply with CRSI "Recommended Practice for Placing Bar Supports, Specifications and Nomenclature."

- C. Slabs on grade where the base material will not support chairs, provide supports with sand plates, horizontal runners, or concrete blocks to properly locate steel reinforcing in the slab.
- E. Wire-bar type supports shall complying with CRSI recommendations. Wood, brick, or other materials will not be accepted.
- F. Tie wire shall be 16-gauge, black, soft-annealed wire. Tie wire shall not be closer than 1-inch from surface of wall or slab after tying in place.

2.4 SPLICES AND MECHANICAL CONNECTIONS

- A. Metal Sleeve: If used for splice, provide with cast filler metal, capable of developing in tension or compression 125 percent of specified yield strength of the bar, as manufactured by:
 - 1. Erico Products, Inc., Cleveland, OH, Cadweld C-Series.
 - 2. Or equal.
- B. Mechanical Threaded Connections: Metal coupling sleeve with internal threads which engage threaded ends of bars to be spliced, and develops in tension or compression 125 percent of the specified yield strength of the bar, as manufactured by:
 - 1. Erico Products, Inc., Cleveland, OH, Lenton Reinforcing Steel Couplers.
 - 2. Richmond Screw Anchor Co., Inc., Fort Worth, TX, Richmond DB-SAE Dowel Bar Splicers.

PART 3 EXECUTION

3.1 FABRICATION

General: The Contractor shall fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice" and ACI 301. In case of fabricating errors, the heating, rebending or straightening of reinforcement will not be permitted. Submittals of reinforcement shall be in accordance with Section 01300.

3.2 GENERAL

- A. Meet requirements in the manual titled, "Placing Reinforcing Bars", published by Concrete Reinforcing Steel Institute (CRSI).
- B. Steel reinforcement shall be protected at all times from injury. When placed in the work, it shall be free from dirt, detrimental scale, paint, oil and other foreign substance. When steel reinforcement has detrimental rust, loose scale and dust which is easily removable, it shall be cleaned by a satisfactory method, if approved.
- C. All bars shall be bent cold, unless otherwise permitted. No bars partially embedded in concrete shall be field bent except as shown on the Drawings or otherwise permitted.
- D. Details of concrete reinforcement and accessories not covered herein or on the Drawings shall be in accordance with ACI 315.

- E. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for this inspection prior to close-up of the forming system or placing concrete.

3.3 INSTALLATION

- A. The Contractor shall clean reinforcement to remove all loose rust and mill scale, earth, ice, oil or grease, and other materials which reduce or destroy the bond between the concrete and reinforcing steel.
- B. The Contractor shall position, support, and secure all reinforcement to prevent displacement by formwork, construction loadings, or concrete placement operations. Steel reinforcing shall be located and supported by metal chairs, runners, bolsters, spacers and hangers, as required. Where concrete is to be placed on the ground supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. The reinforcement shall be placed to obtain the coverage for concrete protection noted on the Drawings. Where the coverage is not shown, the reinforcement shall be placed to obtain at least the minimum coverage specified hereinafter. The Contractor shall arrange, space, and securely tie bars and bar supports together with 16-gauge wire to hold reinforcement accurately and solidly in position during concrete placement operations. Wire ties shall be set so that the twisted ends are directed away from the exposed concrete surfaces. All reinforcement will be tied and secured in the correct position in the forms before placing concrete. Do not stab reinforcing into fresh placed concrete.
- C. The Contractor shall provide a sufficient number of supports of adequate strength to carry the reinforcement. Reinforcing bars shall not be placed more than 2 inches beyond the last leg of any continuous bar support. Supports shall not be used as bases for runways for concrete conveying equipment and similar construction loads.
- D. Supports or spacers of pebbles, pieces of broken stone, concrete rubble, broken brick or building blocks, metal pipe or wooden blocks will not be permitted.
- E. Splices:
 - 1. Standard reinforcement splices shall be done by lapping the ends, placing the bars in contact, and tightly wiring the splice together. The requirements of ACI 318 for minimum lap of spliced bars shall be provided. Use lap splices unless otherwise shown on the Drawings or permitted in writing by the Engineer. Stagger splices minimum of 40 bar diameters in adjacent bars unless otherwise shown on the Drawings or permitted in writing by the Engineer.
 - 2. No field welding or tacking of reinforcement will be permitted.
 - 3. Vertical bars in columns shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all column dowels.
- F. Unless otherwise shown on the Drawings, the Contractor shall provide cover as follows:

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1. Not less than 3 inches where the concrete is placed against the ground and without use of forms.
 2. Not less than 3 inches for bars smaller than No. 6 and not less than 2-inches for No. 6 bars and larger where concrete is exposed to the weather, water, or in contact with earth, but placed in forms.
 3. Not less than 1 1/2-inches for interior slabs, walls, beams, and columns.
- G. The Contractor shall provide a minimum of two No. 4 bars in the top and bottom of a slab or wall face at 45 degrees on all four corners at all openings in structural slabs and walls, unless otherwise shown on the Drawings. Bars shall extend on each side sufficiently to develop bond in each bar.
- H. The Contractor shall notify the Engineer when reinforcing is in place so that an inspection of reinforcement placement can be made prior to the close-up of formwork or the placement of concrete.
- I. Conform to ACI 301 for all placing tolerances.
- J. Bars may be moved to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter or the stipulated tolerance, the Contractor shall consult with the Engineer to determine final placement.
- K. Before constructing concrete form work for next stage of construction, the Contractor shall clean all dowels, reinforcing bars, and concrete surfaces at construction joints. All loose material and foreign objects shall be cleaned out of forms before placement of concrete.
- L. Placing Welded Wire Fabric:
1. Extend fabric to within 2-inches of edges of slab, and slab control joints and lap splices at least 1½ courses of fabric or minimum 8-inches.
 2. Tie laps and splices securely at ends and at least every 24-inches with 16-gauge black annealed steel wire.
 3. Place welded wire fabric on #4 continuous bars at 4'-0" at proper distance above bottom of slab. All slab reinforcing is to be discontinuous at slab control joints.
 4. Meet current ACI 318 and current Manual of Standard Practice, Welded Wire Fabric, by the Wire Reinforcement Institute regarding placement, bends, laps, and other requirements.
 5. All welded wire fabric shall be provided in flat sheets. Rolled fabric will not be permitted.
- M. Field Bending:
1. Straightening and Rebending: Do not straighten or rebend metal reinforcement. Field bending of reinforcing steel bars is not permitted.
 2. Unless permitted by Engineer, do not cut reinforcing bars in the field.

3.4 MECHANICAL SPLICES AND CONNECTIONS

- A. Install as required by manufacturer with threads tightened as required by referenced ICBO Report.
- B. Carefully inspect each splice and verify that each component meets manufacturer's and ICBO requirements.
- C. Maintain minimum edge distance and concrete cover.

3.5 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

- A. Hole Preparation
 - 1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
 - 2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters unless noted otherwise.
 - 3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
 - 4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
 - 5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
 - 6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during down placement.
 - 7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

END OF SECTION

SECTION 03251

EXPANSION AND CONSTRUCTION JOINTS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Work necessary to furnish and install the concrete expansion, construction, and control joints including pre-molded, pourable, and gun grade fillers.
- B. Sill Seal foam barriers around the base of the aquaculture tanks.

1.2 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

- A. Submittals: Section 01300.
- B. Concrete Reinforcement: Section 03200.
- C. Cast in Place Concrete: Section 03300.

1.3 SUBMITTALS

- A. Product Data: Furnish for the following:
 - 1. Joint fillers for horizontal and sloped joints.
 - 2. Preformed control joints.
 - 3. Water stop.
 - 4. Adhered strip seal.
 - 5. Sealants.
 - 6. Sill Seal Foam.
- B. Shop Drawings: Furnish information listed below:
 - 1. Plastic Type Water Stops: Details of construction joint types; show in sufficient detail water stop support used in both concrete pours to demonstrate water stop will remain secure until complete encasement.
 - 2. Construction Joints: Layout and location indicating type to be used.
- C. Quality Control submittals: Furnish the following documents:
 - 1. Water stop manufacturer's written instructions for product shipment, storage, handling, installation and repair.
 - 2. Joint Filler and Primer: Manufacturer's written instructions for product shipment, storage, handling, application, and repair.

3. Adhered strip seal manufacturer's written instructions for product shipment, storage, handling, application, and repair.
4. Submit placement shop drawings showing the location and type of all joints for each structure.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Prepare and protect materials for shipment in accordance with manufacturer's recommendations.
- B. Acceptance at Site: Verify that water stops delivered meet the cross-section dimensions shown and manufacturers reviewed product data prior to unloading and storage at the site.
- C. Protect hydrophilic waterstop from premature exposure to moisture which may cause premature swelling of waterstop. Protect from oil, dirt, and sunlight.

1.5 QUALITY ASSURANCE

- A. Water Stop inspection: It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the Engineer to provide for the required inspections. Not less than 24 hours notice shall be provided to the engineer for scheduling such inspections
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at its own expense.

PART 2 PRODUCTS

2.1 GENERAL

- A. All joint material specified herein shall be classified as acceptable for potable water use, by the Environmental Protection Agency, within 30 days of application.

2.3 BOND BREAKER TAPE FOR EXPANSION JOINT

- A. Adhesive-backed glazed butyl or polyethylene tape which will adhere to the premolded joint material or concrete surface.
- B. Width: Same as the joint.
- C. Location: As shown.

2.4 BOND BREAKER

- A. Provide either bond breaker tape as hereinbefore specified or a bond prevention material, non-staining type, as specified in Section 03300 CONCRETE, except where a tape is specifically called for.

2.5 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1.8 inch larger than the joint width except that one-inch diameter rod shall be used for ¾ inch wide joint.

2.6 JOINT FILLER (JF)

- A. Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/2 inch thick.

2.7 PREFORMED CONTROL JOINT

- A. One-piece, flexible, polyvinyl chloride joint former; Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex Corp., Knoxville, TN; or equal.
- B. One-piece steel strip with preformed groove; Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, CA; or equal.
- C. Provide in full-length unspliced pieces.
- D. Provide only where specifically permitted by Drawings.

2.8 JOINT SEALANT

- A. Joint sealant shall be approved for use in potable water supply systems. The specific gravity of the in-place filler after curing shall be greater than 1.0. The manufacturers of the following fillers shall provide written certification that the products are approved by the EPA and the State Department of Health for use in potable water supply systems, and will not be a hazard to health.
- B. Manufacturers and Products:
 - 1. Sikaflex 2C, Colonial White color only, as manufactured by Sika Chemical Company, Lyndhurst, NJ; submit product information for review and acceptance.
 - 2. On sloping joints, use Gun Grade material of the above products of Sikaflex 1A similar nonsag material; submit product information for review and acceptance.
 - 3. Or equal.

2.9 STEEL EXPANSION JOINT DOWELS

- A. Dowels: Round smooth steel bars; ASTM A36.

2.9 SILL SEAL FOAM

- A. ¼" thick polyethylene foam strip with a width of 7-1/2" conforming to Federal specification PPP-C-1752D.

2.10 ACCESSORIES

- A. Joint Sealant: Joint sealant shall be two-part polysulfide or urethane conforming to FS TT-S-00227. The type used shall be specifically intended for exterior, submerged control joint applications. A non-sag joint sealant shall be used for vertical joints and self-leveling for horizontal joints.
- B. Non-shrink Grout:
 - 1. As specified in Section 03300 CONCRETE.
 - 2. Compatible with joint sealant.

2.11 HYDROPHILIC WATERSTOP

- A. Hydrophilic waterstop shall be a non-bentonite modified chloroprene rubber.
- B. Manufacturers
 - 1. Greenstreak- Hydrotite
 - 2. Or equal

PART 3 EXECUTION

3.1 GENERAL

- A. Locate joints as shown, or noted on the Drawings.
- B. Verify conformance of water stops with dimensions shown and with reviewed product data prior to embedding water stops in concrete.
- C. Construct straight joints; make vertical or horizontal, except where walls intersect sloping floors.
- D. Commence concrete placement after the joint preparation is complete.
- E. Time Between Concrete Pours:
 - 1. At least 2 hours must elapse after depositing concrete in long or high columns and/or heavy walls before depositing concrete in beams, girders, or slabs supported thereon.
 - 2. For short columns and low height walls, 10 feet or less, wait at least 45 minutes prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

3. Consider beams, girders, brackets, column capitals, and haunches as part of the floor or roof system and place monolithically with the floor or roof system.

3.2 SURFACE PREPARATION

- A. Construction Joints: Prior to placement of abutting concrete, clean contact surface:
 1. Remove laitance and spillage from reinforcing steel and dowels.
 2. Roughen surface to a minimum of ¼-inch amplitude:
 - a. Sandblast after the concrete has fully cured.
 - b. Water blast after the concrete has partially cured.
 - c. Green cut fresh concrete with high pressure water and hand tools.
 3. Perform cleaning so as not to damage water stop, if one is present.
- B. Expansion Joint with Joint Sealant:
 1. Use motorized wire brush or other motorized device to mechanically roughen and thoroughly clean concrete surfaces on each side of joint from plastic water stop to the top of the joint.
 2. Use clean and dry high pressure air to remove dust and foreign material, and dry joint.
 3. Prime surfaces before placing joint filler.
 4. Avoid damage to water stop.
- C. Control Joint:
 1. Coat concrete surfaces above and below plastic water stop with bond breaker. Do not allow bond breaker to come in contact with water stop.
 2. Avoid damage to water stop.
 3. Verify that proper type and size of reinforcing and dowels are provided.

3.3 INSTALLATION OF WATER STOPS

- A. General:
 1. Join water stops at intersections to provide continuous seal.
 2. Center water stop on joint.
 3. Secure water stop in correct position to avoid displacement during concrete placement.

4. Repair or replace damaged water stop.

C. Hydrophilic Waterstop:

1. Inspect waterstop for premature swelling, discontinuity, and debris contamination prior to concrete placement. Replace unacceptable waterstop.
2. Adhere waterstop to concrete or other surfaces utilizing proper primer adhesive. For vertical applications, use nails in addition to the primer adhesive to secure waterstop to concrete.
3. Primer shall be allowed to dry for two hours prior to application of waterstop.
4. Apply waterstop the same day as primer adhesive.
5. Protect waterstop from moisture, dirt, oil, and sunlight during the progress of work.
6. Install waterstop with 2 inches minimum clear cover to concrete face.
7. Waterstop shall be butt spliced, pressing ends together ensuring no separation or air pockets.

3.4 EXPANSION JOINT INSTALLATION

A. General:

1. Place bond breaker above and below water stop when premolded joint filler and pourable joint filler is not used.
2. Joint Sealant:
 - a. Sufficient in width to completely fill the joint space where shown.
 - b. If a water stop is in the joint, cut premolded joint filler to butt tightly against the water stop and the side forms.
3. Precut premolded joint filler to the required depth, as detailed, at locations where joint filler or sealant is to be applied.
4. Form cavities for joint filler with either precut, premolded joint filler, or smooth removable accurately-shaped material.
5. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface.

C. Pourable Joint Filler:

1. General: Install in accordance with the manufacturer's written instructions, except as specified below:

- a. Apply primer prior to pouring joint filler.
 - b. Use masking tape on top of slabs at sides of joints; clean all spillage.
2. Place cold-applied, two-component fillers in accordance with manufacturer's written instructions.
- D. Steel Expansion Joint Dowels:
1. Install coated bars parallel to wall or slab surface and in true horizontal position perpendicular to the joint in both plan and section views so as to permit joint to expand or contract without bending the dowels.
 2. Secure dowels tightly in forms with rigid ties.
 3. Install reinforcing steel in the concrete as shown to protect the concrete on each side of the dowels and to resist any forces created by joint movement.

3.5 CONTROL JOINT INSTALLATION

- A. Locate reinforcing and/or dowels as shown.
- B. Install hydrophilic waterstop as shown as shown by the Drawings.
- C. Concrete surface to be dense and smooth.
- D. Install bond breaker to concrete surfaces above and below water stop.

3.6 PREFORMED CONTROL JOINTS

- A. Use only where specifically shown.
- B. Locate flush, or slightly below the top of slab.
- C. Install in accordance with manufacturer's written instructions in straight, full-length unspliced pieces.
- D. Steel Strip Type with Preformed Groove: Brace to with-stand pressure of concrete during and after placement.

3.7 SILL SEAL FOAM AROUND THE BASE OF FRP TANKS

- A. Wrap one strip of foam around the base of the round FRP aquaculture tanks to provide a barrier between the new concrete floor and the walls of the tanks as shown on the drawings. No folds will be allowed in the foam strip.

END OF SECTION

LOGAN FES WARM WATER
INTERIM HATCHERY FACILITY

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
 - 1. Foundation walls.
 - 2. Slabs on grade.
 - 3. Control, expansion and contraction joint devices.
 - 4. Sump Pump Construction and Testing

- B. Related Sections:
 - 1. Section 03100 - Concrete Forms and Accessories.
 - 2. Section 03200 - Concrete Reinforcement.
 - 3. Section 03251 – Expansion and Construction Joints.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 305 - Hot Weather Concreting.
 - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.

- B. ASTM International:
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 5. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 - 6. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
 - 7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
 - 8. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - 9. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - 10. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - 11. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on joint devices, attachment accessories, admixtures and.
- C. Design Data:
 - 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - b. Air entrained concrete work.
 - 2. Identify mix ingredients and proportions, including admixtures.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.
- B. Acquire cement and aggregate from one source for Work.
- C. Conform to ACI 305 when concreting during hot weather.
- D. Conform to ACI 306.1 when concreting during cold weather.

1.5 COORDINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type IIA - Air Entraining Portland type; ASTM C595, list appropriate blend and cement type.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical: ASTM C494 Type A - Water Reducing Type B - Retarding Type C - Accelerating Type D - Water Reducing and Retarding Type E - Water Reducing

and Accelerating Type F - Water Reducing, High Range Type G - Water Reducing, High Range and Retarding.

- C. Fly Ash: ASTM C618 Class F.
- D. Plasticizing: ASTM C1017.

2.3 ACCESSORIES

- A. Bonding Agent: Polymer resin emulsion Polyvinyl Acetate Latex emulsion Two component modified epoxy resin Non-solvent two component polysulfide epoxy Mineral filled polysulfide polymer epoxy Mineral filled polysulfide polymer epoxy resin Polyamid cured epoxy.
- B. Non-Shrink Grout: ASTM C1107, Grade A; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.
- C. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete. Tensile strength -130 ksi; toughness 15 ksi; 3/4 inch long fibers, 34 million/lb fiber count.

2.4 CONCRETE MIX

- A. Mix concrete in accordance with ACI 301. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.
- C. Provide concrete to the following criteria: See Structural notes on the Construction Drawings.

2.5 Waterproof Patching Compound

- A. Manufacturers
 1. Thoroseal
 2. Sika
 3. Xypex
 4. Substitutions: Section 01600 - Product Requirements

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify Architect/Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
- D. Separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler.
- E. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- F. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
- G. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- H. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor finish.
- I. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- J. Place concrete continuously between predetermined expansion, control, and construction joints.

- K. Do not interrupt successive placement; do not permit cold joints to occur.
- L. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 ft.
- M. Slope floor to trench drains.

3.4 CONCRETE FINISHING

- A. Provide formed concrete surfaces to be left exposed with finish as Scheduled in this section.
- B. Finish concrete floor surfaces in accordance with ACI 301.
- C. Steel trowel surfaces which are indicated to be exposed.

3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure floor surfaces in accordance with ACI 301.

3.6 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing and Inspection Services.
- B. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.
- F. Three concrete test cylinders will be taken for every 30 or less cu yds of concrete placed.
- G. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- H. One slump test will be taken for each set of test cylinders taken.
- I. One air content test will be made for each set of test cylinders taken.

- J. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.
- K. Perform leakage tests after concrete has cured and obtained its design strength, and before backfill, or other work which will cover concrete wall surfaces is begun.
 - 1. Make other equipment, i.e., stop gates, sluice gates, valves, etc., or temporary bulkheads water-tight prior to test.
 - 2. As an alternative to having watertight bulkheads, gates, or valves, accurately measure the leakage through gates, valves, and bulkheads with methods acceptable to Engineer. An assumed leakage through gates and valves based on manufacturer's recommendations is not acceptable.
 - 3. Fill with water to maximum liquid level prior to leak testing, and maintain level for 48 hours for moisture absorption by concrete.
 - 4. Close all valves and gates to the structure and measure the change in water surface for a 24-hour period.
 - 5. During test period, examine exposed portions of structure for dampness or leaks and mark visible leaks or damp spots.
- L. Test Evaluation Criteria:
 - 1. An acceptable test shall have a drop in water surface in 24-hour period with basin full less than 1/10 of 1 percent of normal volume of liquid contained in water-holding structure, after accounting for evaporation and precipitation in open basins, and damp spots or seepage are not present on walls or other areas exposed to view.
 - 2. Determine evaporation by floating an evaporation pan in structure during test period.
- M. Excessive Leakage and Leakage Test Failure: If drop in water surface exceeds test evaluation criteria or if damp spots or seepage is visible in exposed surfaces, the leak test shall be considered as failing.
- N. Repairs:
 - 1. If leakage is excessive, and if damp spots and observed seepage is present on exposed surfaces, drain water-holding structure, patch all leaks and damp spots previously marked, and make necessary repairs, and retest basin.

3.7 PATCHING

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
- C. Patch imperfections in accordance with ACI 301.

3.8 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

3.9 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Foundation Walls: 4,000 psi 28 day concrete, sack rubbed finish with honeycomb filled surface patched with cement grout mix.
- B. Floor Slabs: 4,000 psi 28 day concrete, air entrained, toweled finish with broomed surface.
- C. Footings: 4,000 psi 28 day concrete, form finish.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

SECTION 03400
PRECAST CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Precast boxes, precast vaults, precast tanks, precast concrete lids, manhole frame, and covers.

1.2 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Submit manufacturer's product data and installation data in compliance with Section 01300.

PART 2 - PRODUCTS

2.1 GROUT

- A. Conform to Section 03600 of these Technical Specifications.

2.2 FRAME AND COVER

- A. Standard traffic rated frame and grate or manhole cover if required on the Plans (see Standard Details).

2.3 PRECAST VAULTS / TANKS / MANHOLE SECTIONS / LIDS

- A. Scope
 1. Construction shall include manufacture, transportation and installation, as required of precast structures as shown and specified.
 2. Manufacturer shall demonstrate a recognized background in precast concrete production, and that he has facilities and personnel required to produce required structures.
- B. Shop Drawings
 1. The precast manufacturers shall prepare and submit shop drawings in accordance with Section 01300.
 2. Shop drawings shall be complete and shall show overall layout, unit locations, fabrication details, reinforcement, connection details, support items, dimensions, and relations to adjacent materials.

3. Manufacturer shall provide design calculations sealed by a Professional Structural Engineer licensed in the State of Utah.

C. Materials

1. Precast/concrete members shall conform to A.C.I. 318 (latest revision) Building Code Requirements for Reinforced Concrete.
2. Prestressing strand shall meet requirements of ASTM A-416 (latest revision).
3. Reinforcing bars shall meet requirements of ASTM A-615 (latest revision).
4. Welded wire mesh shall meet requirements of ASTM A-185 (latest revision).
5. Aggregates shall meet requirements of ASTM C-33 (latest revision).
6. Cement shall meet requirements of ASTM C-150 (latest revision).
7. Concrete for precast members shall have a minimum ultimate compressive strength of 3000 psi at 28 days. The concrete and the equipment producing the concrete for the precast/members shall meet the requirement so ASTM C-94 (latest revision).
8. Vault Lid: 30" Cast Iron ring and Cover labeled "Sewer"

D. Casting and Handling

1. Precast structures shall be built to the clear dimensions shown on the construction drawings. The structures shall be designed per AASHTO Specifications to carry an HS20 loading with a maximum cover as shown on the plans. The lateral effective earth pressure shall be 65 PCF.
2. Precast members shall be handled in positions consistent with their shape and design. Members shall be lifted and supported only from support points.
3. All precast structures shall have watertight joints as provided by the manufacturer, and shall be watertight.
4. Clean weld marks, dirt, or blemishes from surface of exposed members.
5. Pipe penetrations shall be Kor 'N' Seal or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all materials delivered to the site are in compliance with these Specifications.

- B. Verify structure is ready to receive piping.

3.2 INSTALLATION

- A. Install in accordance with the manufacturer's recommendations. Ensure precast sections are plumb and true.
- B. Place and compact one (1) foot of Type A1 aggregate in compliance with Section 02207 under the concrete base prior to installation.
- C. Install Cast in Place base per plans if required and Section 03300
- D. Grout pipe entrance and exit openings water tight.
- E. Place and install so no damage is inflicted to the structure, pipe, or valves.
- F. Install so the walls and ceiling are plumb and true to line and grade.
- G. Grout all joints water tight.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

SECTION 03600

GROUT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portland cement grout.
 - 2. Rapid curing epoxy grout.
 - 3. Non-shrink cementitious grout.
- B. Related Sections:
 - 1. Section 03300 - Cast-in-Place Concrete.
 - 2. Section 13000 – Pre-Engineered Steel Buildings

1.2 REFERENCES

- A. American Society of Testing and Materials:
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
 - 5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
 - 6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacing and Polymer Concretes.
 - 8. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product data on grout.
- C. Manufacturer's Installation Instructions: Submit manufacturer's instructions for mixing, handling, surface preparation and placing epoxy type and non-shrink type grouts.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver grout in manufacturer's unopened containers with proper labels intact.
- C. Store grout in a dry shelter, protect from moisture.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not perform grouting if temperatures exceed 100 degrees F.
- C. Maintain minimum temperature of 50 degrees F before, during, and after grouting, until grout has set.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I and II.
- B. Water:
 - 1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel.
 - b. Volume change increasing shrinkage cracking.
 - c. Efflorescence.
 - d. Excess air entraining.
- C. Fine Aggregate:
 - 1. Washed natural sand.
 - 2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
 - 3. Free from injurious amounts of organic impurities as determined by ASTM C40.
- D. Mix:
 - 1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID CURING EPOXY GROUT

- A. Rapid Curing Epoxy Grout: High strength, three component epoxy grout formulated with thermosetting resins and inert fillers. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids and alkalies.

<u>B. Physical Properties</u>		<u>Reference</u>
<u>Spec.</u>		
Compressive Strength	12,000 psi (7 day)	ASTM C579
Tensile Strength	2,000 psi minimum	ASTM C307
Coefficient of Expansion	30x10 ⁻⁶ in per degree F	
Shrinkage	None	ASTM C827

2.3 NON-SHRINK CEMENTITIOUS GROUT

- A. Non-shrink Cementitious Grout: Pre-mixed ready for use formulation requiring only addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides.
- B. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Setting Time:	Initial	2 hours (Approx)
ASTM C191	Final	3 hours (Approx)
Expansion:		0.10% - 0.4% Maximum
Compressive Strength:	1 day	4,000 psi
CRD-C621	7 days	7,000 psi
	28 days	10,000 psi to 10,800 psi

2.4 FORMWORK

- A. Section 03100-Concrete Forms and Accessories: Refer to this section for formwork requirements.

2.5 CURING

- A. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or with use of wet burlap method.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify areas to receive grout.

3.2 PREPARATION

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level, and maintain final positioning of components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.3 INSTALLATION - FORMWORK

- A. Construct leakproof forms anchored and shored to withstand grout pressures.
- B. Install formwork with clearances to permit proper placement of grout.

3.4 MIXING

- A. Portland Cement Grout:
 - 1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
 - 2. Prepare grout with water to obtain consistency to permit placing and packing.
 - 3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3 minutes.
 - 4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
 - 5. Do not add additional water after grout has been mixed.
 - 6. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.
- B. Mix and prepare rapid curing epoxy grout in accordance with manufacturer's instructions.
 - 1. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.
- C. Mix and prepare non-shrink cementitious grout in accordance with manufacturer's instructions.
 - 1. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.
- D. Mix grout components in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials.

3.5 PLACING GROUT

- A. Place grout material quickly and continuously.
- B. Do not use pneumatic-pressure or dry-packing methods.
- C. Apply grout from one side only to avoid entrapping air.
- D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.
- E. Thoroughly compact final installation and eliminate air pockets.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.6 CURING

- A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. After grout has attained its initial set, keep damp for minimum of 3 days.

3.7 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing and Inspection Services 01700 - Execution Requirements: Testing, adjusting, and balancing.
- B. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400.
- C. Tests of grout components may be performed to ensure conformance with specified requirements.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

SECTION 05500
METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Steel grating
- B. Shop fabricated steel stairs, ladders and rails.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01400 - Quality Control.
- C. Section 03300 - Cast-in-Place Concrete.
- D. Section 09900 - Paints and Coatings.

1.3 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- C. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
- D. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- F. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- G. ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.
- H. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- I. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- J. AWS A2.0 - Standard Welding Symbols.

- K. AWS D1.1 - Structural Welding Code.
- L. SSPC - Steel Structures Painting Council.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.5 QUALIFICATIONS

- A. Welder's Certificates: Submit under provisions of Section 01300, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.6 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on drawings instructed by the manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Sections: ASTM A36.
- B. Steel Tubing: ASTM A500, Grade B.
- C. Steel Plates: ASTM A36.
- D. Pipe: ASTM A501.
- E. Bolts, Nuts, and Washers: Stainless steel Type 304.
- F. Welding Materials: AWS D1.1; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.
- H. Touch-Up Primer for Galvanized Surfaces: Zinc rich type.

2.2 FABRICATION

- A. Fit and ship assemble in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FINISHES

- A. Galvanize in accordance with ASTM A123, structural steel members. Provide minimum 1.25 oz/sq ft galvanized coating.
- B. Aluminum in contact with concrete or galvanized metal to be coated with zinc oxide. One mil minimum thickness.

2.4 METAL GRATING

- A. General: Metal grating shall be of the design, sizes and types shown.
- B. Metal Grating: Metal grating shall be of steel or aluminum as shown. No single piece of removable grating shall weight more than 75 lb. unless otherwise specified or shown.
- C. Molnar Slip-Not Coating. Aluminum grating shall have a slip-resistant aluminum SLIP-NOT surface, as manufactured by W.S. Molnar Company (W.S Molnar Co.; Detroit, MI; (314) 923-0400) or pre-approved equal. The surfacing material shall consist by volume 90% aluminum and 10% aluminum oxide grit, 8-10 microns uniformly dispersed throughout the volume. The surfacing material shall have a bond strength to the plate (grating) of at least 2,000 psi.
- D. All grating sections and grating penetrations shall be completely banded.

2.5 ADHESIVE ANCHORS

- A. Adhesive Anchors: Unless otherwise shown or specified, all drilled, concrete or masonry anchors shall be adhesive anchors. Accompanied with ICBO report verifying strength and material equivalency.

1. Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Threaded rod shall be stainless steel Type 316.
2. Unless otherwise shown, glass capsule, polyester resin adhesive anchors will be permitted in locations not specified above. Threaded rod shall be galvanized steel.

2.6 CATWALK

- A. Design Criteria
 1. Uniform Floor Load - 100 psf
 2. Railing Loading – 50 plf uniform, 200 lb concentrated load
 3. Lateral Loading - Seismic Design Category D
 4. Concrete Compressive Strength – f'c 4000 psi
 5. Provide for additional loads as shown in the drawings
- B. Dimensions
 1. Maintain dimensions as called for on the construction drawings.
 2. Provide supports for catwalk at locations noted on plans. Coordinate with Engineer for any changes in supports.
 3. Provide sufficient distance for operation of manual winches at anchor points.
- C. Material: Structural Steel
- D. Assembly:
 1. Shop – Welded
 2. Field – Bolted
- E. Coating: Galvanized
- F. Manual Winches
 1. Provide manual winch with brake to allow operation for lifting and lowering at locations shown on the plans.
 2. Vertical lifting capacity - 800 lbs
 3. Gear Ratio : minimum 4:1
 4. Cable size and type: 3/16" galvanized
 5. Cable terminations: Swage type loop
 6. Connection to fiberglass lid: hook with safety latch attached to existing handle or eyebolt with load plate sufficient to distribute concentrated load over the fiberglass lid for lifting. Eyebolt and load plate to be stainless steel if used.
 7. Warrantee: 1 year minimum
 8. Design for accessibility and operation from catwalk level.
 9. Attach to catwalk with bolted connection (elastomeric nuts) for ease of replacement if required.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.
- C. Field verify dimensions of catwalk after installation of equipment and concrete foundations.
- D. Coordinate catwalk dimensions with piping to allow for installation of all components when complete.
- E. Verify installation parameters for access into building and around installed equipment.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain Engineers approval to field weld components.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
- G. Grind exposed joints on handrails flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

- H. Install all materials in strict accordance with manufacturer's requirements.
- I. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill cleaned and dry. Drilled anchors shall not be loaded until the concrete has reached the specified 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its specified strength in accordance with the manufacturer's instructions.
- J. Unsupported ends of abutting panels shall be secured with clips recommended by the manufacturer.

3.4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 7611

INSULATED STEEL WALL PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes insulated metal wall system including exterior doors and louvers.
- B. Related Sections:
 - 1. Section 07900 - Joint Sealers.
 - 2. Section 09900 - Paints and Coatings: Finish painting of exterior primed steel surfaces, and Interior primed steel surfaces.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- B. Metal Building Manufacturers Association:
 - 1. MBMA - Low Rise Building Systems Manual.
- C. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
- D. Underwriters Laboratories Inc.:
 - 1. UL - Building Materials Directory.

1.3 SYSTEM DESCRIPTION

- A. Wall System: Preformed insulated metal panels including interior liner sheets of vertical profile, with sub-girt framing/anchorage assembly, and accessory components.

1.4 DESIGN REQUIREMENTS

- A. Thermal resistance of Calculated Wall System: R-Value of 18.
- B. Design members to withstand dead load, applicable snow load, vertical and horizontal seismic loads, and design loads due to pressure and suction of wind calculated in accordance with 2006 IBC code.

- C. Maximum allowable deflection: 1/180 of span with imposed loads for exterior wall and roof system.
- D. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
- E. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of -40 to 100 degrees F.
- F. Size and fabricate wall systems free of distortion or defects detrimental to appearance or performance.

1.5 PERFORMANCE REQUIREMENTS

- A. Conform to applicable code for submission of design calculations, reviewed shop and erection drawings, and the State of Utah as required for acquiring permits.
- B. Cooperate with regulatory agency or authority and provide data as requested authority having jurisdiction.
- C. Provide components of each type from one manufacturer compatible with adjacent materials.

1.6 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on profiles, component dimensions, fasteners, performance characteristics.
- C. Samples: Submit two samples of precoated metal panels for each color selected, 6 x 6 inch in size illustrating color and texture of finish.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of concealed components and utilities.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with AISC S335, AISC S342L, AISC S344L, and MBMA Low Rise Building Systems Manual.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Erector: Company specializing in performing Work of this section with minimum 3 years experience.

1.10 PRE-INSTALLATION MEETINGS

- A. Section 01300 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 WARRANTY

- A. Section 01700 - Execution Requirements: Product warranties and product bonds.
- B. Furnish five year warranty to include coverage for exterior pre-finished surfaces color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 COMPONENTS - WALL AND ROOF SYSTEM

- A. Insulated Steel Panel Manufacturers
 - 1. Metl-Span – Model CF Mesa, Mesa Light (Walls)
 - 2. API – Model R-Span A 200
 - 3. IPS - Model RWP
 - 4. Substitutions: Section 01600 - Product Requirements.
- B. Insulated Steel Panel Requirements
 - 1. Exterior Face 26 Ga. Min. G-90 Galvanized Steel Conforming to ASTM A-653
 - 2. Interior Face 26 Ga. Min. G-90 Galvanized Steel Conforming to ASTM A-653
 - 3. 92% closed cell urethane or polyurethane foam core.
 - 4. Finishes
 - a. Exterior 0.2 mil base primer with 0.7 mil finish coat of Fluoropolymer, Galvalume Plus, or other manufacturer exterior finish.
 - b. Interior 0.2 mil base primer with 0.7 mil siliconized polyester coating.
 - 5. Attachment – Panel must attach to framing without connectivity through the entire wall thickness.

6. Seal – All panel joints and trim connections must be sealed with manufacturer's recommend caulking system to provide an air-tight seal.
 7. Identification – Label ISP panels with certified "R" value.
- C. Joint Seal Gaskets: Manufacturer's standard type.
 - D. Fasteners: Manufacturer's standard type, galvanized high performance organic coating, finish to match adjacent surfaces when exterior exposed.
 - E. Sealant: Manufacturer's standard type, non-staining, elastomeric, skinning.
 - F. Metal Mesh: Galvanized steel wire, woven.
 - G. Trim, Closure Pieces, Caps, Flashings, Rain Water Diverter, Facias Infills, and: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.2 COMPONENTS - WINDOWS

- A. Windows: Specified in Section 08500.
- B. Glass and Glazing: Specified in Section 08800.

2.3 FABRICATION - WALL AND ROOF SYSTEMS

- A. Siding: Minimum 26 Ga Thickness, profile per manufacturer, seams per manufacturer continuously caulked.
- B. Roofing: Minimum 26 Ga Thickness, profile per manufacturer, seams per manufacturer continuously caulked.
- C. Liner: Minimum 26 Ga Thickness, profile per manufacturer, seams per manufacturer continuously caulked.
- D. Soffit Panels: Minimum 26 Ga. metal thickness, V crimped profile, unperforated.
- E. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
- F. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners with 18 Ga. thick sheet.
- G. Expansion Joints: Same material and finish as adjacent material where exposed, 26 Ga. thick, manufacturer's standard brake formed type, of profile to suit system.
- H. Flashings, Closure Pieces, Fascia, Infills, Caps, and: Same material and finish as adjacent material, profile to suit system.

- I. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.

2.4 FACTORY FINISHING

- A. Interior Surfaces of Wall and Roof Components and Accessories: Precoated enamel on steel of modified silicone finish, white color.
- B. Exterior Surfaces of Wall and Roof Components and Accessories: Precoated enamel on steel of fluoropolymer finish, color as selected from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position.

3.2 REMOVAL OF EXISTING PANELS AND INSULATION

- A. Protect existing aquaculture equipment that is in operation from contamination
- B. Remove existing wall panels no damaging base and eave trim.
- C. Protect existing utilities from damage when removing the wall system.
- D. Remove existing bat insulation.
- E. Dispose of materials at an approved landfill or other facility.

3.3 ERECTION - WALL AND ROOFING SYSTEMS

- A. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- B. Fasten cladding system to structural supports, aligned level and plumb.
- C. Locate end laps over supports. End laps as recommended by manufacturer. Place side laps over bearing.
- D. Install expansion joints where indicated on Drawings.
- E. Use exposed fasteners.

- F. Install sealant and gaskets to prevent weather penetration.

3.4 ERECTION - ACCESSORIES

- A. Install door frame, door, overhead door, window and glass, louvers.
- B. Seal wall and roof accessories (including all openings, doors and windows) watertight and weather tight with sealant in accordance with Section 07900.
- C. Reattach existing utility conduits and other accessories to match previous attachment.

3.5 ERECTION TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
- C. Siding and Roofing: 1/8 inch from indicated position.

END OF SECTION

SECTION 07900

JOINT SEALERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes sealants and joint backing, precompressed foam sealers, and accessories.
- B. Related Sections:
 - 1. Section 13121: Sealants required in conjunction with waterproofing of metal building.
 - 2. Section 07840 - Firestopping: Firestopping sealants.
 - 3. Section 08800 - Glazing: Glazing sealants and accessories.
 - 4. Section 09260 - Gypsum Board Assemblies: Acoustic sealant.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 - Standard Specification for Latex Sealants.
 - 2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 - 3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 5. ASTM D1056 - Standard Specification for Flexible Cellular Materials- Sponge or Expanded Rubber.
 - 6. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
 - 7. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.
- D. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight seal and watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Products Requirements.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.6 COORDINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. GE Silicones Model.
 - 3. Mameco International Inc. Model.
 - 4. Pecora Corp. Model.
 - 5. Sika Corp. Model Model.
 - 6. Model.
 - 7. Substitutions: Section 01600 - Products Requirements Not Permitted.
- B. Products Description:
 - 1. High Performance General Purpose Exterior (Nontraffic) Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single or multi- component.
 - a. Type: Sikaflex-1a manufactured by Sika.
 - b. Color: Standard colors matching finished surfaces.
 - c. Applications: Use for:
 - 1) Control, expansion, and soft joints in masonry.
 - 2) Joints between concrete and other materials.
 - 3) Joints between metal frames and other materials.
 - 4) Other exterior non-traffic joints for which no other sealant is indicated.

2. General Purpose Traffic Bearing Sealant: Polyurethane; ASTM C920, Grade P, Class 25, Use T; single or multi- component.
 - a. Type: SikaFlex 1C-SL manufactured by Sika.
 - b. Color: Standard colors matching finished surfaces.
 - c. Applications: Use for exterior and interior pedestrian and vehicular traffic bearing joints.
3. Exterior Foam Expansion Joint Sealer: Precompressed foam sealer; Polyurethane with water-repellent; products recommended by manufacturer for traffic-bearing use.
 - a. Color: Black color.
 - b. Size: As required to provide weathertight seal when installed.
 - c. Applications: Use for exterior wall expansion joints.
4. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
 - a. Color: Standard colors matching finished surfaces.
 - b. Applications: Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated.:
5. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.
 - a. Applications: Use for joints between plumbing fixtures and floor and wall surfaces, and joints between kitchen and bathroom toilet room counter tops and wall surfaces.
6. Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M and A; approved by manufacturer for continuous water immersion; single or multi- component.
 - a. Type: Sikaflex 1a manufactured by Sika.
 - b. Color: Standard colors matching finished surfaces.
 - c. Applications: Use for Pump Sump.

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces and joint openings are ready to receive work.
- C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter impairing adhesion of sealant.
- B. Clean and prime joints.
- C. Perform preparation in accordance with ASTM C1193.
- D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Perform installation in accordance with ASTM C1193.
- B. Perform acoustical sealant application work in accordance with ASTM C919.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING

- A. Section 01700 - Execution Requirements: Final cleaning.
- B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01700 - Execution Requirements: Protecting installed construction.
- B. Protect sealants until cured.

END OF SECTION

SECTION 08500

VINYL WINDOWS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. The work included in this section consists of furnishing and installing vinyl fixed windows, frames for windows as shown on the Drawings and as specified herein.

1.2 SUBMITTALS

- A. Submittals shall conform to the provisions of Section 01300 of these Specifications. Data in the form of drawings, catalog cuts, etc. shall be submitted showing dimensions and design features of windows.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Frame. Polyvinyl chloride (PVC) compound.
- B. Internal Members. PVC compound.
- C. Fasteners and Component Parts. PVC, stainless steel or other non-corrosive material.

2.2 VINYL WINDOW

- A. Frames and sash corners shall be mitered and machine welded. Meeting rails shall interlock and be weather tight. Frame shall weep all moisture to the outside.
- B. Certify as meeting leakage requirements.
- C. Labeled with certified "U-Value".

2.3 GLAZING

- A. Glazing shall meet the requirements of Section 08800 of these Specifications.
- B. Glazing tape shall be used to provide a weather tight seal.
- C. Glazing bead shall be PVC to match frame color.

2.4 FINISH

- A. Finish shall be white vinyl.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install vinyl window frames in accordance with Drawings in a rigid substantial manner, square, plumb and level, utilizing approved installation devices.
- B. Install window in accordance with pre-engineered building recommendations.
- C. Trim windows in office area per construction drawings.

3.2 CAULKING

- A. At junction between frames and adjacent materials, the entire perimeter of the frame shall be sealed on both sides, using materials and methods specified in Section 07900 of the Specifications.

3.3 FINAL CLEANING

- A. Final cleaning of vinyl surfaces shall be done in strict accordance with the manufacturer's instructions. No abrasives shall be used.

END OF SECTION

SECTION 08800

GLAZING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes glass glazing for metal frames, doors, windows.
 - 1. Glass glazing materials and installation requirements are included in this section for other sections referencing this section.
- B. Related Sections:
 - 1. Section 07900 - Joint Sealers: Sealant and back-up material other than glazing sealants.
 - 2. Section 08500 – Vinyl Windows: Glazed windows.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.
- B. American Society of Civil Engineers:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International:
 - 1. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - 2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 3. ASTM C1036 - Standard Specification for Flat Glass.
 - 4. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
 - 5. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 6. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 7. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
 - 8. ASTM E546 - Standard Test Method for Frost Point of Sealed Insulating Glass Units.
 - 9. ASTM E576 - Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position.
 - 10. ASTM E773 - Standard Test Methods for Seal Durability of Sealed Insulating Glass Units.
 - 11. ASTM E774 - Standard Specification for Sealed Insulating Glass Units.
 - 12. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Exterior Windows and Doors.

- D. Glass Association of North America:
 - 1. GANA - FGMA Sealant Manual.
 - 2. GANA - Glazing Manual.
 - 3. GANA - Laminated Glass Design Guide.

- E. National Fire Protection Association:
 - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
 - 3. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies.

- F. Underwriters Laboratories Inc.:
 - 1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
 - 2. UL - Building Materials Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
 - 1. To utilize inner pane of multiple pane sealed units for continuity of air barrier and vapor retarder seal.
 - 2. To maintain continuous air barrier and vapor retarder throughout glazed assembly from glass pane to heel bead of glazing sealant.

- B. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with ASCE 7 - Calculation of Wind Loads.

- C. Limit glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.

1.4 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.

- B. Product Data:
 - 1. Glass: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
 - 2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.

- C. Certificates: Certify products meet or exceed specified requirements.

- D. Manufacturer's Certificate: Certify sealed insulated environmental glass, meets or exceeds specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual, GANA Sealant Manual, GANA Laminated Glass Design Guide for glazing installation methods.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Product Requirements.
- B. Do not install glazing when ambient temperature is less than 50 degrees F.
- C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

- A. Section 01700 - Execution Requirements: Product warranties and product bonds.
- B. Furnish five year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.
- C. Furnish five year warranty to include coverage for delamination of laminated glass and replacement of same.

1.9 EXTRA MATERIALS

- A. Section 01700 - Execution Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 GLAZING

- A. Manufacturers:
 - 1. Arch Aluminum & Glass LC
 - 2. Atohass Americas Inc.
 - 3. Flex-Lite Corp.
 - 4. Glass Unlimited Inc / Ambiance
 - 5. Graham FRP Composites
 - 6. Inkan Ltd.
 - 7. Libbey-Owens-Ford, Inc.
 - 8. Viracon
 - 9. Substitutions: Section 01600 - Product Requirements.

2.2 COMPONENTS

- A. Flat Glass (Type FG): Minimum 1/8 inch unless otherwise indicated.
1. Clear Float Glass (Type FG-CF): ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.
 2. Clear Heat Strengthened Glass (Type FG-CH): ASTM C1048, Kind HS, heat strengthened, Condition A uncoated, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.
 - a. Visible Light Transmittance: 91 percent.
 - b. Shading Coefficient: 1.04.
 - c. Solar Heat Gain Coefficient: 0.90.
 3. Low E Clear Float Glass (Type FG-EC): Clear float glass Type FG-CF, with low emissivity coating on inner surface.
 - a. Visible Light Transmittance: 91 percent.
 - b. Shading Coefficient: 0.59.
 4. Low E Clear Heat Strengthened Glass (Type FG-EHC): Clear heat strengthened glass Type FG-CH, with low emissivity coating on inner surface.
 - a. Visible Light Transmittance: 91 percent.
 - b. Shading Coefficient: 0.59. Safety Glass (Type SG): Conform to ANSI Z97.1, minimum thickness 1/4 inch unless otherwise indicated.
 5. Clear Tempered Glass (Type SG-CT): ASTM C1048, Kind FT Fully tempered, Condition A, uncoated, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select; with horizontal tempering. Insulated Glass Units (Type IG-E): Total unit thickness 1 inch.
 6. Double Pane Insulated Glass Units (Type IG-DP): ASTM E774 Class A and E773; with glass elastomer edge seal; place reflective film within unit; purge interpane space with dry air.
 - a. Outer Pane: Glass Type: FG-EC.
 - b. Inner Pane: FG-CF.
 - c. Solar Heat Gain Coefficient: 0.58
- B. U Factor: 0.38 Maximum Insulated Glass Units (Type IG-O): Total unit thickness 1 inch.
1. Double Pane Insulated Glass Units (Type IG-DP): ASTM E774 Class A and E773; with glass elastomer edge seal; place reflective film within unit; purge interpane space with dry air.
 - a. Outer Pane: Glass Type: FG-EC.
 - b. Inner Pane: SG-CT.
 - c. Solar Heat Gain Coefficient: 0.58
 - d. U Factor: 0.38 Maximum
- C. Insulated Glass Units (Type IG-I): Total unit thickness 1 inch.
1. Double Pane Insulated Glass Units (Type IG-DP): ASTM E774 Class A and E773; with glass elastomer edge seal; place reflective film within unit; purge interpane space with dry air.
 - a. Outer Pane: Glass Type: SG-CT.
 - b. Inner Pane: SG-CT.

- c. U Factor: 0.38 Maximum
 2. Insulated Glass Unit Edge Seal Construction: Aluminum, bent and soldered corners. ACCESSORIES
- D. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, laminated glass core, insulating glass seals, and glazing channels.
1. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component; chemical curing; capable of water immersion without loss of properties; non-bleeding, cured Shore A hardness of 15 to 25.
 - a. Color: As selected.
 - b. Structural Silicone: Furnish high-modulus structural silicone glazing materials where sealant bonds glass to substrate.
 2. Polysulfide Glazing Sealant: ASTM C920, Type M, Grade NS, Class and Use suitable for glazing application indicated; two component; chemical curing, non-sagging type; cured Shore A hardness of 15 to 25.
 - a. Color: As selected.
 3. Polyurethane Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component, chemical curing, non-staining, non-bleeding, Shore A Hardness Range 20 to 35.
 - a. Color: As selected.
 4. Acrylic Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component, solvent curing, non-bleeding; cured Shore A hardness of 15 to 25.
 - a. Color: as selected.
- E. Glazing Gaskets: ASTM C864 Option I, resilient neoprene silicone polyvinyl chloride extruded shape to suit glazing channel retaining slot.
1. Color: Black.
- F. Pre-Formed Glazing Tape: Size to suit application.
1. Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
 - a. Butyl Corner Sealant: ASTM C920 single component non-skinning butyl compatible with glazing tape; color to match tape.
- G. Setting Blocks: ASTM C864 Option I, Neoprene, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- H. Spacer Shims: ASTM C864 Option I, Neoprene, 50 to 60 Shore A durometer hardness, minimum 3 inch long x one half the height of glazing stop x thickness to suit application.
- I. Glazing Clips: Manufacturer's standard type.

- J. Fire-Resistant Glazing Materials: Materials used to obtain required fire-resistant rating.
- K. Smoke Removal Unit Targets: Adhesive targets affixed to glass to identify glass units destined for removal for smoke control.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify openings for glazing are correctly sized and within acceptable tolerance.
- C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

- A. Perform installation in accordance with GANA Glazing Manual.
 - 1. Glazing Sealants: Comply with ASTM C1193.
 - 2. Fire Rated Openings: Comply with NFPA 80.
- B. Exterior Dry Method (Tape and Gasket Spline Glazing):
 - 1. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with compatible butyl sealant.
 - 2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
 - 3. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
 - 4. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
 - 5. Trim protruding tape edge.
- C. Exterior Wet/Dry Method (Preformed Tape and Sealant) Installation:
 - 1. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with compatible butyl sealant.

2. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapor seal.
 3. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
 4. Rest glazing on setting blocks and push against tape with sufficient pressure to attain full contact at perimeter of pane or glass unit.
 5. Install removable stops, with spacer strips inserted between glazing and applied stops, 1/4 inch below sight line. Place glazing tape on glazing pane or unit with tape flush with 1/4 inch below sight line.
 6. Fill gap between glazing and stop with elastomeric glazing sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
 7. Apply cap bead of elastomeric glazing sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- D. Exterior Wet Method (Sealant and Sealant) Installation:
1. Place setting blocks at 1/4 points and install glazing pane or unit.
 2. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inches intervals, 1/4 inch below sight line.
 3. Fill gaps between glazing and stops with elastomeric glazing sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
 4. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- E. Exterior and Interior Butt Glazed Method (Sealant Only) Installation:
1. Temporarily brace glass in position for duration of glazing process. Mask edges of glass at adjoining glass edges and between glass edges and framing members.
 2. Temporarily secure small diameter non-adhering foamed rod on back side of joint.
 3. Apply sealant to open side of joint in continuous operation; thoroughly fill joint without displacing foam rod. Tool sealant surface smooth to concave profile.
 4. Permit sealant to cure then remove foam backer rod. Apply sealant to opposite side, tool smooth to concave profile.
 5. Remove masking tape.
- F. Interior Dry Method (Tape and Tape) Installation:
1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
 2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
 3. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
 4. Place glazing tape on free perimeter of glazing in same manner described above.

5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
 6. Knife trim protruding tape.
- G. Interior Wet/Dry Method (Tape and Sealant) Installation:
1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
 2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
 3. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
 4. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
 5. Fill gaps between pane and applied stop with elastomeric glazing sealant to depth equal to bite on glazing, to uniform and level line.
 6. Trim protruding tape edge.
- H. Interior Wet Method (Compound and Compound) Installation:
1. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.
 2. Locate and secure glazing pane using spring wire clips.
 3. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.
- I. Plastic Film Installation:
1. Install plastic film with adhesive.
 2. Place without air bubbles, creases or visible distortion.
 3. Fit tight to glass perimeter with razor cut edge.
- 3.4 FIELD QUALITY CONTROL
- A. Section 01400 - Quality Requirements: Testing and Inspection Services 01700 - Execution Requirements: Testing, adjusting, and balancing.
 - B. Monitor quality of glazing.
- 3.5 MANUFACTURER'S FIELD SERVICES
- A. Section 01400 - Quality Requirements: Manufacturers' field services.
 - B. Glass product manufacturers to provide field surveillance of installation.
 - C. Monitor and report installation procedures, and unacceptable conditions.
- 3.6 CLEANING
- A. Section 01700 - Execution Requirements: Final cleaning.

- B. Remove glazing materials from finish surfaces.
- C. Remove labels after Work is complete.
- D. Clean glass and adjacent surfaces.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01700 - Execution Requirements: Protecting installed construction.
- B. After installation, mark pane with an 'X' by using removable plastic tape or paste.

3.8 SCHEDULE

- A. Exterior Windows – Hatchery: IG-O

END OF SECTION

SECTION 09900
PAINTING AND COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and field application of paints and coatings.

1.2 RELATED SECTIONS

- A. Section 01300 – Submittals.
- B. Section 01400 – Quality Control.
- C. Section 01700 – Contract Closeout.
- D. Section 03300 – Cast-in-Place Concrete.
- E. Section 05500 – Metal Fabrications: Shop primed items.

1.3 REFERENCES

- A. ASTM D-16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. NPCA (National Paint and Coatings Association) - Guide to U.S. Government Paint Specifications.
- C. PDCA (Painting and Decorating Contractors of America) Painting - Architectural Specifications Manual.
- D. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual

1.4 DEFINITIONS

- A. Conform to ASTM D-16 for interpretation of terms used in this Section.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on all finishing products.
- C. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Store paint materials at minimum ambient temperature of 45°F (7°C) and a maximum of 90°F (32°C), in ventilated area, and as required by manufacturer's instructions.
- E. Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion. Open containers of materials only as needed for use; keep closed when not in use. Keep oily/finish material and soaked rags in tightly closed containers. Dispose of used rags off the site daily; remove empty containers from the site daily.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45°F (7°C) for interiors; 50°F (10°C) for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Alkyd Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.10 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke rating requirements for finish.
- B. Section 01700 - Execution Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers - Paint
 - 1. Columbia Paint
 - 2. Carboline
 - 3. Dupont
 - 4. Tnemec
 - 5. Ameron
 - 6. Sherwin Williams
- B. Paint and coating materials shall be highest quality material Trade names used herein refer to materials manufactured and are used to establish a basis of quality for bidding. The Engineer or Architect is not bound to approve all types of paint from any one manufacturer. Material for each general purpose shall be of the same manufacturer and materials of different manufacturer shall not be used over one another, except for shop prime coats applied under Sections of the Project Manual.
- C. Special systems as specified for surface conditions by the manufacturer specified; substitution only upon affidavit of alternate manufacturer that product will meet conditions and label for surface use.

2.2 MATERIALS

- A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, and of commercial quality.
- B. Patching Materials: Latex filler.
- C. Fastener Head Cover Materials: Latex filler.

2.3 COLORS

- A. Paint colors shall be approved by the owner submit color patches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.

- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. The Painting Contractor shall be responsible for examination and acceptance of all surfaces and conditions affecting proper application of the materials, and shall not proceed until unsatisfactory conditions have been corrected; the application of the first coat a finish system to any surface shall constitute acceptance of that surface.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D-2016.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D-2016.

3.2 PREPARATION

- A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.
- C. Seal with shellac and seal marks which may bleed through surface finishes.
- D. Gypsum Board Surfaces: Fill minor defects with filler compound. Remove spackle drops, mortar, dust, and dirt. Spot prime defects after repair. Surface to be crack free, properly finished and clean.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Wood: Remove grade marks; seal knots with suitable sealer. Hand sand woodwork and trim; dust clean. All nail holes to be filled with suitable interior or exterior grade filler compound.
- G. Concrete and Unit Masonry Surfaces Scheduled to Receive Stain or Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry. Repair surfaces in concrete and masonry in accordance with Section 03300 and

04100, respectively.

- H. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- I. Plastic: Remove grease, oil, and dirt. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing. Lightly sand the surface to allow bonding between primer and plastic.
- J. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- K. Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish. Each coat of paint or finish shall be applied at proper consistency according to the manufacturer's directions; brushed evenly, and free of brush marks, sags, and runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping; paint to be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand metal lightly between coats to achieve required finish.
- F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- G. Allow applied coat to dry before next coat is applied.

3.4 FIELD QUALITY CONTROL

- A. Field testing will be performed under provisions of Section 01400.

3.5 CLEANING

- A. Section 01700 – Contract Closeout: Final Cleaning.
- B. Collect waste material which may constitute a fire hazard, place in closed metal

containers and remove daily from site.

3.6 SCHEDULE - EXTERIOR SURFACES

- A. Steel/Miscellaneous Metals - Shop Primed:
 - 1. Touch-up with compatible primer.
 - 2. Two coats of polyurethane enamel, gloss.
- B. Steel/Miscellaneous Metals – Unprimed:
 - 1. One coat of primer/neutralizer.
 - 2. Two coats of alkyd gloss enamel.
- C. Steel - Galvanized:
 - 1. One coat galvanize primer.
 - 2. Two coats of alkyd gloss enamel.
- D. Roof, Wall and Ground Mounted Electrical/Mechanical Equipment, Duct Work, and Piping:
 - 1. Factory primed or painted - two coats alkyd low gloss enamel, (including electrical transformers and gas meters).
 - 2. Field fabricated / Installed –
 - a. One coat of primer.
 - b. Two coats spray on enamel, satin

3.7 SCHEDULE - INTERIOR SURFACES

- A. Steel/Miscellaneous Metals – Unprimed:
 - 1. One coat of alkyd primer.
 - 2. Two coats of polyurethane enamel, gloss.
- B. Steel/Miscellaneous Metals – Primed:
 - 1. Touch-up with alkyd primer. No. 04-022PP
 - 2. Two coats of polyurethane enamel, gloss.
- C. Steel – Galvanized (excluding catwalk):
 - 1. One coat galvanize primer.
 - 2. Two coats of alkyd enamel, gloss.
- D. Steel/Miscellaneous Metals – Unprimed:
 - 1. One coat of primer/neutralizer.
 - 2. Two coats of alkyd gloss enamel.
- E. Metal Doors and Frames:
 - 1. Touch up abraded prime coat.
 - 2. Two coats of alkyd semi-gloss enamel.
- F. Pumps and Piping
 - 1. One coat of alkyd primer. No. 04-022PP
 - 2. Two coats of alkyd enamel, gloss. No. 04-400WB

- G. Steel Pipe Coating
 - 1. One coat of primer compatible to paint.
 - 2. Two coats of Fuller O'Brien (Enamel #612-33 or approved equivalent). Color by Owner

3.9 CLEANING AND REPAIRING

- A. Painter responsible for all defective work no matter what the cause, including unsuitable and improperly prepared surfaces; refinish at Painter's expense. Painted surfaces shall be free from defects in workmanship or materials. Repair work damaged during construction before time of final project acceptance; touch-up or refinish as necessary abraded, stained or otherwise disfigured surfaces.

3.10 CLEAN UP

- A. During painting, clean up, remove from project, containers and cartoons, rubbish, and rags resulting from work of this section. Maintain premises in clean, orderly condition at all times. Upon completion remove rubbish, tools, equipment, unused products from project.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

SECTION 10440
INTERIOR SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes interior signs.

1.2 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.
- C. Proofs : Submit proofs of sign at actual size and lettering dimensions.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups. Store adhesive attachment tape at ambient room temperatures.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 INTERIOR SIGNS

- A. Manufacturers:
 - 1. APCO Graphics

2. ASI Sign Systems
3. Daktronics, Inc.
4. FFI Group, Inc.
5. Mills Manufacturing
6. Unicor
7. Substitutions: Section 01600 - Product Requirements.

2.2 COMPONENTS

- A. Signs:
1. Aluminum - Aluminum base plate with painted base color and lettering
 2. Decal – Match base color and lettering of aluminum sign

2.3 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.
- B. Stainless Steel Bands: ½” width sufficient length to wrap around 2” guardrail.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01310 - Project Management and Coordination: Verification of existing conditions before starting Work.

3.2 INSTALLATION

- A. Install sign at top of catwalk stairs to top guardrail with stainless steel bands.
- B. Install sign decal at the steel frame member above catwalk, both sides.

3.3 SCHEDULES

- A. “CAUTION: Low Clearance” Sign: Individual letters, 2 inch high, yellow base color with black lettering.
1. Aluminum Groove two openings ¾” wide x 1/8” for stainless steel band attachment.
 2. Decal – Adhesive attachment

END OF SECTION

SECTION 11285

ULTRAVIOLET DISINFECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, equipment and appurtenances required to provide an enclosed vessel, pressurized flow, amalgam lamp based, ultraviolet (UV) system. The UV system to be complete and operational with all control equipment and accessories as shown and specified.
- B. Related Sections:
 - 1. Section 13150 – Aquaculture Systems
 - 2. Section 15100 – Pipe
 - 3. Division 16 - Electrical

1.2 REFERENCES

- A. Commercial Standards.
 - 1. ASTM - American Society for Testing and Materials
 - 2. AWS - American Welding Society
 - 3. AWWA - American Water Works Association
 - 4. MSS - Manufacturers Standardization Society of the Valve and Fitting Industry.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Submit for review, engineering drawings showing the following:
 - 1. Complete description in sufficient detail to permit an item comparison with the specifications.
 - 2. Dimensions and installation requirements.
 - 3. Descriptive information including catalogue cuts and manufacturers' specifications for all components.
 - 4. Electrical schematics and layouts.

1.4 QUALITY ASSURANCE

- A. To be acceptable, the manufacturer must be able to demonstrate to the satisfaction of the engineer successful performance with amalgam UV lamp systems in similar applications.
- B. The manufacturer must be able to demonstrate at least ten (10) permanent installations of this equipment type in similar applications.

- C. The CONTRACTOR is responsible for determining any changes to the mechanical, civil and electrical design as necessitated by the use of other manufacturer or suppliers. Any design changes are the CONTRACTOR's responsibility, and both design and construction costs associated with any design changes necessitated shall be borne by the CONTRACTOR. All changes shall be subject to review and approval by the ENGINEER.

PART 2 PRODUCTS

2.1 GENERAL

- A. Warranties for materials and workmanship for all equipment and accessories as specified in this section are to be valid for a period of not less than one (1) year, starting from final acceptance by the OWNER.
1. Equipment: The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage and installation for a period of one (1) year from date of start up or one and one half (1.5) years from date of shipment.
 2. UV Lamps: The UV lamps are to be warranted for a minimum of 9000 hours.
- B. The physical layout of the system shown on the Engineering Drawings and the equipment specified herein are based solely upon the Amalgam Lamp UV System, as manufactured by Aquafine Corporation (Trojan Technologies, Inc).
- C. Design Criteria:
1. Provide UV equipment which shall disinfect municipal water with the following characteristics:
 - a. Peak Flow (usGpm): 600 usGpm (--)
 - b. Water Temperature (degrees C) 25° C (77° F)
 - c. Ultraviolet Transmittance at 253.7 nm 90%: (assumed minimum)
 - d. UV dose at end of lamp life: >60.0 mJ/cm²
 2. The UV system is to be installed into the existing pipework having a footprint with the following dimensions:
 - a. Length (ft): 6: feet
 - b. Width (mm): 305 mm (12: inches)
 - c. Pipe Diameter (mm): 254 mm (10: inches)
 3. The total headloss across the UV system at peak flow will not exceed 0.15 psi.
 4.
 - a. The UV reactor shall be supplied pre-assembled and ready for installation.
 - b. The UV system will consist of one (1) UV reactor, one (1) System Control Center.
 - c. The UV system must fit within the piping footprint as stated without modification.

- D. To be acceptable, the UV system must operate in an enclosed vessel having a “boot” reactor design and use amalgam UV lamps.
- E. The UV system must be designed to fit within the piping footprint described, without modification.
- F. The Amalgam lamp system is to be furnished with the latest components and equipment available at the time of shipment.
- G. Provide a UV system complete with UV reactor, control panel, manual wiping system, UV intensity monitoring system, as herein specified.
- H. Each system shall be designed to allow for complete system shut down or by-pass.
- I. Flow through the system shall not be disrupted while changing of UV lamps is being carried out.

2.2 MANUFACTURERS

- A. The physical layout of the system shown on the Engineering Drawings and the equipment specified herein are based solely upon the Amalgam Lamp UV System
- B. Approved Manufacturers:
 - 1. Aquafine Corporation (Trojan Technologies, Inc).

2.3 MATERIALS

- A. All metal components in contact with the feed water shall be Type 316L stainless steel; which has been passivated and electro-polished.
 - 1. All material exposed to UV light shall be Type 316L stainless steel, Type 219 quartz or a suitably UV resistant material.

2.4 EQUIPMENT

- A. The system shall be designed for complete immersion of the UV lamps including electrodes and the full length of the lamp in the water. All lamp electrical connections shall be at one end of the UV lamp. The major axis of the UV lamps shall be parallel to flow.
- B. UV system(s) is/are to be delivered to site completely assembled, such that fitting into the pipework and termination of electrical and communications wiring is all that is required by the installation contractor.

2.5 COMPONENTS

- A. UV Reactor
 - 1. Each UV reactor shall be manufactured using stainless steel tubing, which is closed on one end and open on the other.

2. All wetted materials shall be Type 316L stainless steel which has been passivated and electro-polished.
3. Each UV reactor shall have a drain port fixed to its outer wall.
4. Each UV reactor shall be designed to fit into the existing pipe work.
5. Each UV reactor shall accept its respective UV lamps and quartz sleeves through only one end of the vessel. This end of the UV reactor shall allow for complete reactor entry so internal inspection and/or service can be accomplished.
6. The service side of the UV reactor and the UV lamp sleeve seals shall be made using suitable o-ring materials.
7. UV reactors shall be able to operate at a maximum inlet pressure of 150 PSI and be furnished with a factory certified pressure test report detailing a minimum hydrostatic pressure test of 225 PSI for at least 10 minutes.
8. Each UV reactor shall have its inlet flange fitted to the open end of the pipe and the outlet flange fitted to the side, wall of the vessel so as to ensure a minimum hydraulic efficiency of 80%.
9. Factory certified computational fluid dynamic calculations are to be furnished as proof of this hydraulic efficiency.
10. UV reactors shall possess the ability of being mounted horizontally or vertically.

B. UV Lamps

1. The filament shall be significantly rugged to withstand shock and vibration.
2. Lamp bases to be resistant to UV and ozone.
3. All electrical connections to the UV lamp shall be terminated at one end.
4. UV lamps shall have a lamp base design which prevents arcing between electrical pins.
5. UV lamps shall have a monochromatic spectral output, with the emissions peaking at 254 nanometers.
6. The mercury contained in the lamps shall be mixed with a base metal and fixed to the inside wall of the UV lamp quartz.

C. Lamp End Seal and Lamp Holder

1. The open end of the UV lamp sleeves shall be sealed to the sleeve guide by a suitable compression o-ring.
2. O-ring compression is made by a sleeve nut, which shall require no special tools for installation or removal.
3. Each UV lamp electrical connection shall incorporate a sealing boot which is held firmly in place by the sleeve nut to prevent emission of ultraviolet rays

D. UV Lamp Sleeves

1. Clear fused quartz tubing, closed at one end shall be used. Type 219 quartz shall be used for disinfection applications.

E. Electronic Power Supplies

1. A pair of UV lamps shall be powered by one electronic power supply; which can be enabled to automatically adjust lamp output.

2. Electronic power supplies shall possess the ability of varying the output electrical power to the lamps.
 3. The electronic power supply shall operate in a voltage range of 208-240 volts and not be frequency dependant.
 4. Each lamp within the pair shall operate on its own circuit within the power supply so as to prevent consecutive lamp failures should one lamp fail.
- F. Electrical
1. Each UV system shall be powered from a remote mountable System Control Center (SCC) by means of a waterproof cable interfacing with a watertight strain relief.
 2. The System Control Center shall be of stainless steel construction.
 3. System Control Center electrical rating shall be a minimum of NEMA type 3R.
 4. Maximum total power consumption shall be no greater than 1.65 kW.
 5. Electrical supply to each System Control Center shall be 208-240 Volts, 1 phase, 50 or 60 Hz, 1.73 kVa.
 6. Signal wiring interfacing the UV system and the System Control Center, shall be as shown on the Engineering Drawings.
- G. Quartz Sleeve Cleaning System
1. The UV System shall be capable of having its quartz sleeves cleaned. The manually actuated wiping system consists of a push-pull mechanism.
- H. Control and Instrumentation
1. System Control:
 - a. To be microprocessor based. Operator interface is to be a configurable, display type and be located indoors.
 2. Alarm Conditions:
 - a. Individual lamp failure - failed lamps shall be indicated by specific address (i.e. lamp #). Position in the reactor shall be indicated via lamp numbers fixed to the lamp wiring at the service end of the UV reactor.
 - b. UV Intensity & Low UV Alarm – Intensity to be monitored by a silicon carbide diode with UV intensity displayed in \square watts/cm². A low UV alarm will occur once minimum design UV intensity has been exceeded.
 - c. A 4-20mA out signal shall be available for remote monitoring of UV intensity.
 - d. Lamp life status - at the end of UV lamp(s) lifetime the elapsed time meter will flash continually for the next 240 hours to alert the operator that all lamps in the reactor require change out.
 - e. Remote ON/OFF capabilities are to be provided.
 - f. Up to 7 discreet alarms shall be available for discreet alarm enunciation.
 - g. An alarm history registry of minimally the last 18 alarms shall be part of the control scheme provided.
- I. Spare Parts
1. No spare parts will be supplied as part of this contract

- J. Model: Aquafine UVLogic model 06AL30 or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. The LHO unit and related equipment must be fabricated, erected, assembled, and placed in proper operating condition in full conformity with the Contract Documents, engineering data, instructions, and recommendations of the equipment Manufacturer as approved by the ENGINEER.
- B. Furnish and install each item of equipment complete with all supports, structural work, and appurtenances required to ensure that equipment is ready for operation.
- C. All units and parts must be amply proportioned for the stresses that may occur during fabrication, erection, installation and operation.
- D. Individual parts furnished that are alike and installed as units are to be alike in workmanship, design, and materials, and are to be interchangeable.
- E. Supply and install all shim systems necessary to ensure that orifice plate(s) are level and all anchors needed to ensure stability of the equipment.

3.2 INSTALLATION

- A. All equipment shall be installed in accordance with the manufacturer's engineering drawings, manufacturer's written instructions, and with the Contract Drawings.
- B. The CONTRACTOR shall provide all supervision, labor, tools, construction equipment, incidental materials, and the necessary services required to complete the installation and testing of the equipment.

3.3 SYSTEM START-UP AND COMMISSIONING

- A. Upon completion of the installation, each piece of equipment and each system must be tested for satisfactory operation without leaking, excessive noise, vibration, overheating, or other operative malfunction. All equipment is to be adjusted and checked for alignment, clearances, supports, and adherence to safety standards until found satisfactory.

END OF SECTION

SECTION 13135

FLUIDIZED SAND BIOFILTER

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the Fluidized Sand Biofilter for Phase II of the June Sucker Hatchery. The total number of Fluidized Sand Biofilters specified in this section is 1.
- B. Related Sections:
 - 1. Division 1
 - 2. Section 13210 – CO2 Stripper
 - 3. Section 15101 – General Piping Requirements

1.2 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data: Provide product data for each item in Part 2 - Products. Indicate dimensions, capacities, performance characteristics, finishes for materials, and installation instructions for each type of product indicated.
- C. Shop Drawings: Detail piping and equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Schematic flow diagrams showing piping and equipment.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For systems to include in maintenance manuals specified in Division 1.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- G. Project Record Documents: Record actual locations of piping and equipment. Revise shop drawings to reflect actual installation.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in fluidized sand biofilter design and construction similar to that indicated for this project and with a record of successful in-service performance in similar applications. Minimum experience of at least 10 installations with an installed service record of 5 years or greater is required.

- B. Installer Qualifications: Engage personnel experienced in FRP vessel installations similar to that required by this project who are acceptable to the FRP vessel manufacturers.
- C. Provide listing/approval stamp, label, or other marking on the equipment indicating that it is made to specified standards.
- D. Technology which bears a US Patent or US Patent Pending status must be purchased from a licensed supplier.

1.4 MATERIAL RESTRICTIONS

- A. The Contractor shall not install any material containing cadmium, brass, bronze, copper, zinc, or their alloys, which could come in contact with fish rearing water. These heavy metal materials have been shown to be toxic to fish.
- B. All pumps, valves, piping, wetted components, etc. that may come in contact with water shall be a material specified and approved by the Contracting Officer or the Contracting Officers Technical Representative (COTR).

PART 2 PRODUCTS

2.1 GENERAL

- A. The Fluidized Sand Biofilter shall be a custom FRP vessels manufactured according to the specifications in this section and as detailed in the aquaculture drawing set.
- B. ACCEPTABLE PRODUCTS AND MANUFACTURERS
 - 1. The CycloBio, patent pending, provided by Aquatic Habitats, 877-900-2422
 - 2. Approved equal
- C. MANUFACTURER
 - 1. Any changes to the Contract Documents required to suit the Manufacturer shall be made at no cost to the Government. Any changes in the design shall be submitted to the Contracting Officer for approval.
- D. The Fluidized Sand Biofilter shall each have a 304.8 mm (12 inch) wide effluent launder at the top with a 360 degree V-notch weir.
- E. The Fluidized Sand Biofilter shall each be supplied with ample hold down flanges that the manufacturer has determined sufficient for securing the vessel to the concrete floor according to the seismic requirements of the location.
- F. The sand used to fill the biofilter vessel shall be a finely graded silica sand with an effective size of 0.18 mm and a uniformity coefficient of less than 1.7, with at least 50% (by weight) of the sand retained on a USA standard sieve size of 70 and approximately 25% (by weight) retained on a USA standard sieve size of 50.

The effective size (D10) is defined as the opening size that will pass only the smallest 10% (by weight), of the granular sample. The D10 can be taken from a log-probability plot of the particle size distribution. The UC for a given granular media equals the D60 divided by the D10 values which are determined after plotting the results of a sieve analysis on log-probability paper. The silica sand shall be U.S. Silica Company #1 dry unground silica sand from their Mapleton, Pennsylvania, quarry. Prior experience with this sand indicates that it will expand approximately 60% at a superficial velocity of 0.76 cm/s (a hydraulic loading rate of 11 gpm/ft²). Sand Contact – U.S. Silica Company, (304) 258-2500. Media alternates or substitutions are not permissible.

2.2 FLUIDIZED SAND BIOFILTER

- A. Identification
- | | | |
|----|-----------------|--------------------------|
| 1. | Equipment Name: | Fluidized Sand Biofilter |
| 2. | Quantity | 1 |
- B. Operating Conditions: The Fluidized Sand Biofilter shall be suitable for long term operation under the following conditions:
- | | | |
|----|-------------------------------|-------------|
| 1. | Duty | Continuous |
| 2. | Fluid service | Fresh Water |
| 3. | Fluid temperature (degrees C) | 25°C (77°F) |
- C. Dimensions: Vessel height and orientation and elevations of all penetrations must match those shown on the aquaculture drawings. Alternate dimensions are not permissible. Major vessel dimensions are as follows:
- | | | |
|-----|---------------------------------------|--|
| 1. | Nominal Inner Diameter (mm) | 1,828.8 (72 in) |
| 2. | Outer Diameter at the Top(mm) | 2,032.0 (80 in) |
| 3. | Outer Diameter at the Base (mm) | 2,032.0 (80 in) |
| 4. | Overall Height (mm) | 4,572.0 (180 in) |
| 5. | Inlet Port (mm) | 1,52.4 (6 in) ANSI Flange |
| 6. | Effluent Channel with end Flange (mm) | 914.4 (36 in) W x 304.8 (12 in) H x 152.4 (6 in) L with 76.2 (3 in) Flange |
| 7. | Floc Siphon Port Diameter (mm) | 76.2 (3 in) Sch. 40 PVC Coupling |
| 8. | Inspection Port Diameter (mm) | 152.4 (6 in) ANSI Flange with blind |
| 9. | Sand Delivery Port Diameter (mm) | 152.4 (6 in) ANSI Flange with blind |
| 10. | Manway | 609.6 (24 in) ANSI Flange with blind |
- D. Description of Operation:
1. In normal operation the Fluidized Sand Filter shall receive 1,070-1,270 L/min (283-336 gpm) of process water from the reuse system pump sump. The process water shall enter the Fluidized Sand Filter tangentially through the inlet at the base of the vessel, pass through the annular space and inlet slot about the inside perimeter of the vessel, and flow upward through the void spaces of the expanded fluidized sand biofilter media.
 2. Process water flows upward through the vessel and out through a V-notch weir at the top to the effluent launder where it then exits the biofilter vessel through a 914.4 mm (36 in) wide x 304.8 mm (12 in) tall x 152.4

mm (6 in) long channel. The outlet channel flange connects to the flange of the inlet channel of the CO₂ Stripper.

3. Bacteria grow on the expanded sand in biofilter; these bacteria remove dissolved wastes (i.e., ammonia, nitrite, and organic carbon) from the reuse process water. As the bacteria grow, excess biosolids flocs are controlled within the filter as needed by siphoning the biofilm from the top of the fluidized sand bed. A 76.2 mm (3 inch) PVC socket will be used to connect to floc siphon plumbing.

E. Sand:

1. The Fluidized Sand Filter Vessel shall be filled with finely graded silica sand as specified above. The required static depth of sand is 2133.6 mm (7 ft), which will require approximately 5.6 m³ (198 ft³) of sand.

2.3 NUTS, BOLTS, WASHERS, AND HANGERS

- A. Nuts, bolts, washers and threaded rod shall be 316 stainless steel. Hanger and pipe supports shall be 316 stainless steel.

2.4 SPARE PARTS

- A. None required.

PART 3 EXECUTION

3.1 GENERAL

- A. All FRP vessels shall be properly designed and built for stresses that may occur during fabrication, shipping, installation, and intermittent or continuous operation. Workmanship shall be of high industrial standard in all respects.
- B. The Fluidized Sand Biofilter shall come with a Manufacturer's warranty covering both parts and labor for a period of at least two years.

3.2 FLUIDIZED SAND BIOFILTER INSTALLATION

A. General:

1. Movement of large aquaculture equipment into the treatment rooms must be coordinated with building construction.
2. All components must be furnished in such a way that they may be moved into the facility through a door opening that is 10 ft wide and 10 ft in height. The biofilter vessel shall be provided in two segments that may be moved into the building separately and assembled in place. Each section shall not exceed 9.5 ft in height. All fasteners and sealant required for field assembly shall be provided with the equipment.
3. The Fluidized Sand Filter installation shall be coordinated with the process piping, UV Reactor, CO₂ Stripper, LHO, and LHO Head Tank installation.

4. Each of the Fluidized Sand Biofilter shall be installed on a level surface and possibly a felt, rubber, or plastic membrane in accordance with requirements stated by the filter manufacturer. The Fluidized Sand Biofilter must rest on a level floor in order to assure proper water flow distribution across the outlet weir.
5. The biofilter vessel shall be amply secured to the floor using their hold down flange connections after all other process connections have been made. The contractor is responsible for determining the size, number, type, and method of bolt installation within the concrete to amply secure the vessels according to the seismic requirements of the location.
6. The Fluidized Sand Filter shall be bolted to the CO₂ Stripper using the connecting vessel flanges and an EPDM gasket. The bolt holes in the connecting flanges shall be drilled in the field once temporary connections have been made between the Biofilter and the CO₂ Stripper.
7. The biofilter vessel shall be amply secured to the floor after all other process connections have been made.
8. The biofilter vessel shall have a blind flange cover plate and an EPDM gasket bolted over each sand delivery port and each inspection port.
9. The Contractor shall fill the biofilter vessel with sand after the installation of the vessel has been completed and water flow and leak tests have been completed.
 - a. The biofilter vessel shall be filled with sand to the design static depth as indicated by the Fluidized Sand Biofilter manufacturer.
 - b. Sand can be manually loaded into the vessel through the 609.6 mm (24 in) manway or pneumatically blown into the vessel through the 152.4 mm (6 in) diameter Sand Delivery Port.
 - c. Human exposure to silica dust must be avoided. The escapement of silica dust into the room during the pneumatic delivery of sand must be prevented by the use of an appropriate water misting system and a vented cover placed over the top of the vessel.

3.3 FIELD QUALITY CONTROL

- A. Inspection:
 1. Do not put the Fluidized Sand Biofilter into operation unless they are inspected and approved by the Engineer and the Owner.
 2. During installation, notify the Engineer at least 24 hours before inspection must be made. Perform tests specified below in presence of the Owner's representative.
- B. Functional testing:
 1. Test for leaks and defects in the Fluidized Sand Biofilter and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate reports for each test, complete with diagram of portion of the Fluidized Sand Biofilter tested.
 2. Perform initial hydrostatic testing in accordance with Manufacturer's instructions and test to design flow conditions.
 3. Repair leaks and defects with new materials and retest the Fluidized Sand Biofilter or portion thereof until satisfactory results are obtained.

3.4 CLEANING

- A. Clean and disinfect the Fluidized Sand Biofilter as follows:
1. Purge the Fluidized Sand Biofilter and parts of existing water piping that have been altered, extended, or repaired before using.
 2. Clean the Fluidized Sand Biofilter before sand is added at the end of Filter installation. Remove dirt and debris as work progresses.
 3. Refer to Section 13150 Aquaculture System for cleaning and disinfection requirements as part of facility commissioning process.

3.5 COMMISSIONING

- A. Field Testing:
1. Upon completion of the installation, the Fluidized Sand Biofilter shall be tested for satisfactory operation. All equipment shall be adjusted and checked for alignment, levelness, clearances, supports, and adherence to safety standards, until found satisfactory. This work will be performed by the Contractor.

END OF SECTION

SECTION 13150
AQUACULTURE SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. The work necessary to furnish, install, calibrate, adjust, test, start up and operate the Aquaculture System.
2. The work described in this Specification includes all labor, materials, equipment and services necessary to install and test the complete Aquaculture System.
3. Record Shop Drawings: Provide a copy of corrected, approved shop drawings for the Aquaculture System, updated as-built conditions.

B. Related Sections:

1. Section 11285 – UV Disinfection System
2. Section 13135 – Fluidized Sand Biofilter
3. Section 13209 – FRP Tanks
4. Section 13211 – Low Head Oxygenator
5. Section 15100 – Pipe
6. Section 15101 – Pumps
7. Section 15102 – Valves
8. Section 15131 – Oxygen Distribution

1.2 REFERENCES

- A. Not Used

1.3 SUBMITTALS

- A. Section 01330 - Submittals.

1.4 MATERIAL RESTRICTIONS

- A. The CONTRACTOR shall not install any material containing cadmium, brass, bronze, copper, zinc, or their alloys which could come in contact with fish rearing water. These heavy metal materials have been shown to be toxic to fish.
- B. All pumps, valves, piping, or other wetted components that may come in contact with water shall be of a material specified or approved by the ENGINEER.
- C. Only metals deemed safe for aquaculture facilities may be used such as marine grade aluminum (5000 or 6000 series), stainless steel, or titanium. The use of Cast iron and steel may be allowable on written approval by the DEPARTMENT

and by the Aquaculture System Manufacturer prior to installation. Any other variation from these recommended metals must be approved in writing by the DEPARTMENT and by the Aquaculture System Manufacturer prior to installation. Where dissimilar metals could come into contact, insulating materials such as nylon washers or gaskets must be used to minimize the possibility of galvanic reactions.

- D. Acceptable nonmetallic materials that may come into contact with fish rearing water include:
 - 1. Polyvinyl chloride (PVC).
 - 2. Polyethylene.
 - 3. Polypropylene.
 - 4. Fiber reinforced plastic (FRP) with NSF food grade polyester gelcoats
 - 5. Natural rubber.
 - 6. Neoprene.

- E. The CONTRACTOR shall not use any materials which are toxic to aquatic organisms or materials which could leach toxic chemicals or organic chemicals into culture waters or in areas where condensates could drip into culture waters.

- F. The CONTRACTOR shall not supply any lubricants which are not biodegradable and food safe H1 lubricants or supply any products which require non-biodegradable, non-food safe lubricants.

- G. Any adhesives/sealants, paint or coatings in direct contact with the process water must be food grade, and shall be certified by the manufacturer as being safe for use in potable water systems.

- H. The CONTRACTOR shall use only NSF-certified glues and solvents including all solvents and glues for PVC pipe.

PART 2 PRODUCTS

2.1 AQUACULTURE EQUIPMENT

- A. The following Table 1 lists the equipment which makes up the Aquaculture System.

Table 1: Aquaculture System Equipment

Equipment	Manufacturer/Supplier
Existing Drum Filter	PRAqua/Existing
New Drum Filter	PRAqua/State of Utah
Pump Sump	Existing

Existing Recirculation Pumps	Goulds G&L/Existing
New Recirculation Pumps	Goulds G&L/Contractor supplied
Fluidized Sand Biofilter	Aquatic Habitats or equal/State of Utah
CO2 Stripper	Aquatic Habitats or equal/State of Utah
UV Reactor	Aquafine/Contractor Supplied
LHO and Header Tank Assembly	Aquatic Habitats or equal/State of Utah
Circular FRP Culture Tank Assembly	Tendered/Contractor Supplied
Oxygen Distribution Equipment	Assorted/Contractor supplied
Monitoring Equipment including O2 Panel	Point Four/Contractor Supplied

PART 3 EXECUTION

3.1 GENERAL

- A. System components are described in the Contract Documents.
- B. The CONTRACTOR is responsible for installing all components of the aquaculture system in compliance with the quality and workmanship standards as described in the Contract Documents and as recommended by the equipment manufacturers.

3.2 WARRANTY FOR AQUACULTURE EQUIPMENT

- A. Warranty shall commence in accordance with the substantial completion date and shall not be a function of equipment delivery dates.

3.3 INSTALLATION

- A. Aquaculture systems and equipment shall be installed in accordance with the manufacturer’s written instructions and with the Contract Drawings.
- B. The CONTRACTOR shall provide all supervision, labor, tools, construction equipment, incidental materials, and the necessary services required to complete the installation and testing of the equipment.
- C. The Fish Culture tank installation shall be coordinated with the process piping and other aquaculture equipment. Elevation of equipment should conform to the requirements of the engineer responsible for system hydraulics.

- D. Mount all equipment level and plumb. For FRP culture tanks, top flange of tank shall be level to within a tolerance of 0.15% of the tank diameter (0.15" on 8 ft diameter tank).
- E. Install all piping with minimum 0.5% slope down to low point drains as identified on plans. Slopes greater than 0.5% will be permitted where appropriate.
- F. Equipment Support and Restraints: Supply and Install equipment anchors as required by local seismic requirements.
- G. When backfilling or pouring concrete around buried fiberglass tanks, the CONTRACTOR shall ensure that the tank is filled with process water and shall provide additional shoring and bracing as necessary to prevent distortion or damage. Care shall be taken in placement and vibration of fill or concrete to avoid damaging equipment. Deflection of the tank wall inward due to backfilling, compaction, or concrete placement shall be limited to 0.25% of the tank wall height.
- H. Where concrete is to be in contact with fiberglass components, the CONTRACTOR shall coat fiberglass component with an emulsion foundation coating prior to concrete placement. Coating is only required and shall be limited to the points of contact with the concrete.
- I. For tanks (or equipment) with bases located at finished floor level or on housekeeping pads, a uniform and level surface shall be made between the tank bottoms and the support foundations by means of grouting. Tanks shall be set in wet grout tapered from a point 1 inch higher at tank center to the foundation edges. Initially, grouting shall be finished to leave no voids. Tanks shall be settled down squeezing out excess grout in such a manner as to leave no voids in the tank bottom/foundation interface. The grout shall not be used to support any load, only to fill irregularities in the tank bottoms and foundations. Once installed, the tanks shall not be exposed to any loads until the grout has hardened.
- J. For equipment on metal stands or base plates, level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than ¼ inch per foot. Use double wedges to provide a level bearing surface for pump and driver base. Accomplish wedging so there is no change of level or springing of base-plate when anchor bolts are tightened. Once set in position, aligned, and shimmed to proper elevation, grout the space between the bottom of the base-plate and the concrete foundation with an appropriate poured, non-shrinking grout. Remove wedges after grout is set and pack void with grout.
- K. Equipment shall be installed in such a manner that no stresses shall be applied to the equipment by the connected plumbing.
- L. The aquaculture equipment shall be coordinated with other instrumentation, piping, and equipment.

3.4 HYDROSTATIC TESTING OF EQUIPMENT AND PIPING

- A. Perform testing on all installed equipment and piping prior to and after backfilling or encasement with concrete. Ensure that all pipes are supported sufficiently for tests to prevent sagging or deformation due to weight of water.
- B. Filling:
 - 1. Fill all piping and equipment with clean water.
 - 2. Maximum Pipe Filling Velocity: 0.25 foot per second, applied over the full area of the pipe.
 - 3. Vent Piping During Filling: Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
- C. Hydrostatic Testing for Piping:
 - 1. Maximum Allowable Leakage: There shall be no leakage over the test period.
 - 2. Test Period: Maintain hydrostatic test pressure for 60 minute minimum, and for such additional time as necessary to conduct examination for leakage.
 - 3. Testing Head: test to maximum free water surface.
- D. Hydrostatic Testing for Tankage:
 - 1. Maximum Allowable Leakage: There shall be no leakage, no signs of weeping, and no signs of capillary action over a period of 48 hours.
 - 2. Test Period: Maintain hydrostatic test pressure for 48 hours, and for such additional time as necessary to conduct examination for leakage.
 - 3. Testing Head: Test at the maximum free water surface or to such point that the highest overflow begins to take water.
- E. Examine joints and connections for leakage.
- F. Correct visible leakage and retest as specified.
- G. Empty equipment or piping of water prior to final cleaning and disinfection.
- H. Refer to Section 15131 Oxygen Distribution, for additional testing standards, and for pneumatic testing of gas piping systems.

3.5 CLEANING

- A. Prior to biofilter media placement, pump operation, flushing or disinfection, clean all interior surfaces of culture tanks and treatment equipment using pressurized water and tools suitable for adequate scrubbing and cleaning. Cleaning shall:
 - 1. Remove all debris and deposits of foreign nature.
 - 2. Remove all biological growths.
 - 3. Clean the slopes, walls, top and bottom.
 - 4. Avoid damage to the structure.
 - 5. Avoid pollution or oil deposits by workers and equipment.

- B. Flush all piping of foreign matter and construction materials. Operate valves during flushing process at least twice during each flush.
- C. Where possible, isolate the equipment or pipes being cleaned to prevent contaminating materials from entering downstream treatment processes or culture tanks.
- D. Pump or drain scrub water from structures. Dispose of water used in cleaning in accordance with applicable regulations.
- E. Refer to Section 15131 Oxygen Distribution, for cleaning of gas plumbing.

3.6 RECIRCULATION SYSTEM FLUSHING

- A. All recirculation systems which include the biofiltration unit process shall undergo a flushing procedure to clean the biofilter sand media and purge any released organic matter and sand fines from the system. Prior to initiation of flushing:
 - 1. Hydrostatic testing of all piping and equipment is to be completed.
 - 2. All Aquaculture System unit processes are to be commissioned to the satisfaction of the DEPARTMENT and the User Agency.
 - 3. Influent treatment systems are to be functioning and performing as designed. Only treated process water is to be introduced to the culture systems.
 - 4. The biofilter shall be filled to the designed media depth with the supplied sand media.
 - 5. All equipment and piping is to be cleaned and free of debris.
- B. An owner's representative is to be present throughout the flushing procedure.
- C. The system is to be filled with process water such that all tanks are at their operating water level, and all pipes are full and free of air pockets.
 - 1. Maximum Filling Velocity: 0.25 foot per second, applied over the full area of the pipe.
 - 2. Vent Piping During Filling: Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
- D. Initial Flushing Procedure:
 - 1. Block the holes on the LHO.
 - 2. Open the CO2 stripper tank drains.
 - 3. Initiate flow to the biofilter by starting the recirculation pumps. Slowly increase flow until the design flow of the biofilter is reached. Water will recirculate within the treatment system by returning to the pump sump through the header tank overflow.
 - 4. The water will become cloudy as the biofilter sand media is washed.
 - 5. Water will discharge to waste through the header tank drain. Add cold influent water to the pump sump through the float valve on a demand basis. Add additional influent water as required to maintain sump water level through the use of one of the manual addition points.

6. Operate in this manner for a minimum period of 5 days, or longer if required, until water runs visibly clear to the satisfaction of the OWNER. During this period, cycle the biofilter by starting and stopping flow a minimum of five times.
- E. Drain system and reclean to ensure that all deposits of sand or other debris resulting from the flushing procedure are eliminated from the culture system.

3.7 DISINFECTION

- A. Refer to Section 01500, Construction Facilities and Temporary Controls, for site disinfection and disposal requirements.
- B. Disinfect using chlorine solution of a volume and strength so that a concentration of at least 50 ppm of free chlorine is contained in the culture system.
- C. Inject the disinfecting solution into culture system and recirculate for a minimum 3 hour period of time. It is critical that:
 1. The disinfecting solution be pumped through all culture equipment, treatment equipment, and plumbing such that it contacts all wetted surfaces.
 2. All equipment with movable parts, such as drum filters, are cycled or operated during the disinfecting procedure to ensure that all surfaces are contacted.
 3. Biofilter sand is fluidized during the disinfecting procedure.
- D. For culture systems that can not be recirculated, fill all tanks and treatment equipment, as possible, with disinfecting solution and allow to stand for the contact period.
- E. Parts of structures that cannot be immersed shall be spray or brush disinfected.
- F. At end of 3 hour period, solution shall have a strength of at least 25 ppm free chlorine. If disinfecting solution contained in pump has a residual free chlorine concentration less than 25 ppm after the 3 hour retention period, reclean system, reapply disinfecting solution, and retest until satisfactory test period is obtained.
- G. Operate valves and pump appurtenances during disinfection to ensure that disinfecting solution is dispersed into all parts of pump and lines.
- H. After disinfection, de-chlorinate the system water using sodium thiosulfate until chlorine is below detectable limits, then dilute and flush water from system.
- I. Dilute and dispose in accordance with applicable standards and regulations.
- J. Disinfection may occur simultaneously with recirculation system flushing procedure on submittal and approval of a work plan detailing the procedure to be used.

- K. After disinfection is completed:
 - 1. Care is to be taken to prevent the further introduction of contaminants to the system.
 - 2. Only process water is to be introduced to the culture systems thereafter.

3.8 COMMISSIONING

- A. Commissioning of aquaculture systems and equipment shall be performed by the CONTRACTOR in accordance with Section 01700, Execution Requirements.
- B. Prior to execution of commissioning of aquaculture systems and equipment, and prior to vendor representatives arriving on site, the CONTRACTOR is required to complete pre-commissioning checklists as provided in the aquaculture system submittal.
- C. An authorized representative of the owner shall be present during commissioning and startup of all aquaculture systems and equipment.
- D. Commissioning requirements for unit processes within the aquaculture system are provided in the aquaculture system submittal.
- E. Further to the unit process commissioning requirements, the CONTRACTOR is responsible for functional testing of the aquaculture system as a whole as described hereinafter.

3.9 FUNCTIONAL TESTING

- A. Functional testing of aquaculture equipment and for aquaculture systems as a whole shall be performed by the CONTRACTOR.
- B. An authorized representative of the OWNER shall be present during functional testing of all aquaculture systems and equipment as per Section 01700, Execution Requirements.
- C. If any deficiencies are revealed during the tests, such deficiencies shall be corrected and the tests shall be re-conducted.
- D. Flow Testing: Confirm that pumps are capable of achieving the design flow rate and that the system piping is capable of carrying the flow between system components without an overflow condition occurring. The CONTRACTOR shall be responsible for providing an accurate and acceptable method of measuring the flow but may calibrate and use installed process flow meters where applicable. All maximum flow parameters to be confirmed are described below. Unless otherwise noted, test parameters listed for a given system are required to occur simultaneously and are not to be achieved independently.
- E. Flow Test Parameters:
 - 1. Flow through one circular Culture Tank:
 - a. Bottom Drain: 10.5 gpm

- b. Side Drain: 43 gpm
 2. Flow through Drum Filter: 600 gpm
 3. Flow into Biofilter: 367 gpm
 4. Flow into CO2 stripper: 1200 gpm
 5. Flow into LHO: 600 gpm
- F. Biofilter Fluidization Testing: Confirm that biofilter media fluidizes as designed when flow is initiated. The testing procedure is to be performed only after completion of flushing and disinfection procedures are completed. Testing procedure shall be as follows:
1. With the pumps turned off, measure the static sand bed depth in the biofilter and record. The design static bed depth for each size of filter is 7 feet.
 2. Turn the pumps on and adjust flows to achieve the maximum design flow through the biofilter. Record the flow rate.
 3. Confirm that there is proper fluidization by probing the bottom of the filter for accumulations of sand.
 4. When the biofilter has reached steady state operation and a consistent expanded sand level is achieved, measure the expanded sand depth and record.
 5. If sufficient pumping capacity exists, measure the expanded sand bed depth at a flow rate of 25 percent greater than and 25 percent less than the design flow to identify how flow fluctuations affect the bed expansion. At each measurement, record bed depth and associated flow.
- G. Backflow Prevention Testing: Check valves installed on recirculation system pumping stations shall be tested for integrity of backflow prevention. Testing shall be performed a minimum of three times per system. In systems with multiple operating pumps, each pump shall be tested. Testing procedure shall be as follows:
1. From a full flow operating condition, pumps should be stopped suddenly and shall remain stopped for a period of 30 minutes.
 2. After each stoppage of flow, confirm that there is no loss of water level from upstream process vessels for the duration of the stoppage.
 3. On resumption of flow, media within biofilter vessels shall be confirmed to re-fluidize as per the biofilter fluidization test.
- H. Culture Tank Hydrodynamics Testing: The purpose of this test is to ensure adequate tank rotation is achievable and that the division of flow between culture tank dual drains is set appropriately for optimal tank hydrodynamics. Testing procedure shall be as follows:
1. Each culture tank system shall be running at maximum design flow and under normal operating conditions at the time of testing. Each culture system may be tested and adjusted independently.
 2. Set the flow to each culture tank at the maximum design flow
 3. Rotate spray bars such that injection nozzles are oriented tangential to the tank wall and in the appropriate direction of rotation as indicated in the Contract Drawings.

4. Using a flow measurement device or using standpipe stand-over heights as reference, determine the relative flow rates through each of the culture tank drains.
 5. Incrementally adjust relative heights of tank outlet standpipes to achieve the design tank water level and the design split of flows between drains as specified in the aquaculture submittal package.
 6. Once all adjustments are made, measure and record the rotational period of the culture tank at its perimeter through the use of a small floating object, such as a rubber ball, which has been placed on the water surface. Ensure object is disinfected prior to use.
- I. Overflow Capacity Testing: All process vessel overflows shall be tested to confirm that design flow capacity may be achieved. Testing procedure shall be as follows:
1. Under normal operating conditions, confirm that pumps are flowing at design flow rates.
 2. For vessel to be tested, throttle vessel outlets until design overflow rate is achieved. Design overflow rates are given in the table of flow rates above. To test the CO2 stripper overflow will require temporarily blocking the LHO orifice plate openings.
 3. Confirm that overflow plumbing is capable of handling maximum design flow without discharge over the top of the process vessel.
- J. Gas Distribution Systems Testing: The gas distribution system shall be tested to ensure that design flows and pressures are achievable at all distribution points. The following conditions shall be tested:
1. On oxygen control panels, turn off all oxygen flow to low head oxygenator. Direct all oxygen to the oxygen diffuser flow meters. The oxygen supply and distribution system shall be capable of providing sufficient flow to cause all oxygen diffuser flow meters to simultaneously read at a minimum of half of the indicated scale while maintaining a supply pressure of greater than 25 psi.

3.10 TRAINING

- A. Training is not required.
- B. Operating and Maintenance Manuals for aquaculture systems and equipment will be provided by the aquaculture systems manufacturers. Manuals shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representative for each item of equipment. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of the appendix. The final copies delivered after commissioning and testing period shall include all modifications made during installation, checkout and testing.

3.11 RUN-IN PERIOD

- A. Once all chemicals and contaminants are flushed from the system, and commissioning and testing have been completed, the culture systems shall be

operated for a minimum run-in period of 3 weeks prior to the introduction of fish into the facility. This period is in addition to flushing, functional testing, and performance testing periods specified elsewhere.

- B. During the run-in period, both phase 1 and phase 2 systems shall be operated simultaneously at the design flow rate. Operation of all modules shall be continuous through out the run-in period with the exception of short duration outages of 8 hours or less as required to make adjustments to equipment or system function, or to simulate culture operations during training of operators.
- C. On completion of the run-in period, and on completion of the training to the mutual satisfaction of both the aquaculture systems manufacturer and the User Agency, a Certificate of Aquaculture System Acceptance shall be signed by all parties, indicating readiness for the introduction of fish to the system.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

SECTION 13208

DRUM FILTER

PART 1 GENERAL

1.1 SUMMARY

- A. The drum filter to be used on this project is an existing drum filter owned by the State of Utah. The contractor will be required to install this drum filter.
- B. As part of this contract, the drum filter is to be modified so that it is suitable for use in the Aquaculture Systems. The modifications include replacing the microscreens and the drum seal.
- C. Related Sections:
 - 1. Division 16 - Electrical
 - 2. Section 13150 – Aquaculture Systems
 - 3. Section 15100 - Pipe

1.2 REFERENCES

- A. Commercial Standards.
 - 1. ASTM - American Society for Testing and Materials
 - 2. AWS - American Welding Society
 - 3. AWWA - American Water Works Association

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. A. Product Data and Shop Drawings: Submit complete assembly and installation drawings and product data for the drum filter equipment as a complete system, in accordance with SECTION 01300 - SUBMITTAL PROCEDURES. The following are to be included in the submittal:
 - 1. Product data and shop drawings for approval. The product data and drawings must certify that the equipment meets the required specifications. Drawings are to show key dimensions.
 - 2. Equipment name and applicable specification number
 - 3. Dimensional information.
 - 4. Assembly and Installation Drawings: Complete assembly and installation drawings.
 - 5. Installation instructions as defined by the original equipment manufacturer
 - 6. Procedure and parts required for refurbishing the existing filter.

1.4 QUALITY ASSURANCE

- A. The CONTRACTOR is responsible for determining any changes to the mechanical, civil and electrical design as necessitated by the use of other

manufacturer or suppliers. Any design changes are the CONTRACTOR's responsibility, and both design and construction costs associated with any design changes necessitated shall be borne by the CONTRACTOR. All changes shall be subject to review and approval by the ENGINEER

1.5 DELIVERY, STORAGE, AND HANDLING

- A. The drum filter and associated equipment is to be provided to the site by the State of Utah.
- B. The Contractor is required to provide to the site any parts and equipment needed to refurbish and install the drum filter. The ENGINEER reserves the right to reject delivery of the parts and equipment, if found upon inspection, to have any cracks, foreign matter, surface porosity, sharp discontinuity, defects of workmanship or other damage as per SECTION 01400 – QUALITY REQUIREMENTS

PART 2 PRODUCTS

2.1 GENERAL

- A. Warranties for materials and workmanship for the refurbishment and installation as specified in this section are to be valid for a period of not less than one (1) year, starting from final acceptance by the OWNER. The contractor is not responsible for warranty of the drum filter and associated equipment provided by the State.

2.2 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. PRAqua Supplies Ltd, 250-754-4844.

2.3 MATERIALS

- A. Materials of Construction: Except where approved by the OWNER, materials or components provided by the CONTRACTOR shall be fabricated out of materials that are food safe, suitable for use in an aquaculture environment. To minimize galvanic reactions, insulating gaskets and washers must be used to prevent direct contact between dissimilar metals.
 - 1. Install no materials containing cadmium, brass, bronze, copper, zinc, or their alloys that may come in contact with contact with fish rearing water, as these heavy metal materials are proven to be toxic to fish.
 - 2. All wetted components that may come in contact with water are to be a material specified and approved by the ENGINEER

2.4 EQUIPMENT

- A. Description of Operation: The drum filter associated equipment provided herein is to be utilized for the removal of solids from the culture water. The solids intercepted by the microscreens are removed and discharged to waste during the backwash process. During the backwash process, the drum rotates to lift the dirty screens to above the waste trough where they are washed off the screens. The waste solids flow by gravity out of the drum filter for discharge to the septic system. A dedicated backwash pump is used to provide the water for washing the screens.
- B. The only equipment required to be supplied by the CONTRACTOR are those components required for refurbishing the drum filter including replacement microscreens and a drum filter seal kit and installing the drum filter including plumbing, backwash pump, control panel, conduit and wiring and anchors.

2.5 COMPONENTS

- A. Microscreens
 1. 24 screen panels suitable for installation on a PRAqua RFM 4872 drum filter manufactured in 2001.
 2. Pore size: 60 micron
 3. Materials: polypropylene screens embedded in a polyester mesh.
- B. Seal Kit for PRAqua rotofilter model RFM 4872 manufactured in 2001.
 1. Seal: EPDM drum seal material.
 2. Accessories: All hardware and fasteners required to allow for installation of the new seal material within the existing filter

PART 3 EXECUTION

3.1 GENERAL

- A. The drum filter seal kit and the microscreens are to be installed by a PRAqua technician or by personnel trained by PRAqua Supplies Ltd. All other parts of the installation process can be performed under the supervision of plumbing and electrical contractors.
- B. The CONTRACTOR is responsible for installation of the filter, backwash system, control panel and all related equipment
- C. Refer to manufacturer's instructions for installation procedures.
- D. Refer to aquaculture drawings for location, orientation and elevation information.
- E. Drum filter must be installed on a flat housekeeping pad as shown on aquaculture drawings.

- F. Refer to electrical drawings for control panel conduit and wiring requirements.
- G. Provide an empty 1/2 inch conduit (including pull wire) between the existing drum filter control panel and the control panel for this drum filter for future cross connections.

3.2 CLEANING

- A. The existing drum filter is a piece of equipment which has already been used in another application. To minimize the risk of introducing disease into the facility, the drum filter should be cleaned before it is transported into the facility. Remove the existing screens and drum seal. Remove all debris and flush to ensure that there are no particulates remaining within the enclosure. All surfaces should then be soaked or brushed with a chlorine solution of minimum concentration of 50 ppm for a minimum contact time of 15 minutes. Rinse with potable water until no residual chlorine concentration is detectable, then flush with un-chlorinated water from the Logan FES well supply.
- B. After installation, clean and disinfect the drum filter as follows:
 - 1. Remove dirt and debris as work progresses.
 - 2. Refer to Aquaculture System Specification for module cleaning and disinfection requirements as part of facility commissioning

3.3 SYSTEM START-UP AND COMMISSIONING

- A. Upon completion of the installation, each piece of equipment and each system must be tested for satisfactory operation without leaking, excessive noise, vibration, overheating, or other operative malfunction. All equipment is to be adjusted and checked for alignment, clearances, supports, and adherence to safety standards until found satisfactory.

END OF SECTION

SECTION 13209

FIBER-REINFORCED PLASTIC TANKS WITH FRP BOTTOMS

PART 1 GENERAL

1.1 SUMMARY

- A. Supply 10 circular Fish Culture Tanks in accordance with the requirements of Division 1. The Fish Culture Tanks includes fish exclusion screens, sumps, side and bottom drains including standpipes for water level control, and all appurtenances and components necessary to provide a complete and fully functional Fish Culture Tank system.
- B. The rectangular research tanks are existing tanks which are to be reused. Only, reuse supply, reuse return and effluent plumbing will be required as part of this contract. The rectangular tanks will be supported on the existing cinder blocks and raised to the finished design elevation using composite wood boards between the cinder blocks and the bottom of the tanks.
- C. Related Sections:
 - 1. Section 13150 – Aquaculture Systems
 - 2. Section 15101 – General Piping Requirements
 - 3. Section 15131 – Oxygen Distribution
 - 4. Section 17225 – Instrumentation and Control System

1.2 REFERENCES

- A. Commercial Standards.
 - 1. ASTM - American Society for Testing and Materials
 - 2. AWS - American Welding Society
 - 3. AWWA - American Water Works Association
 - 4. MSS - Manufacturers Standardization Society of the Valve and Fitting Industry.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data and Shop Drawings: Submit complete assembly and installation drawings and product data for the Fish Culture Tank equipment as a complete system. The following are to be included in the submittal:
 - 1. Product data and shop drawings for approval. Drawings are to show locations and connections of water inlet and outlet.
 - 2. Equipment name and applicable specification number
 - 3. Product data including:
 - a. Dimensions and capacity
 - b. Components including resin and reinforcement
 - c. Tank construction materials,

- d. Exact pipe connection sizes, types and locations
 - e. Schematic flow diagrams showing piping and equipment
 - f. Floor and wall slopes,
 - g. Tank interior and exterior color
 - h. Finishes including UV absorbers, pigments and gelcoats
 - i. Weights and thicknesses
 - j. Specifications for accessory items.
4. Assembly and Installation Drawings: Complete assembly and installation drawings and instructions including piping, equipment assemblies, required clearances, method of field assembly, location and size of each field assembly, mounting, and anchoring.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in FRP vessel manufacture similar to that indicated for this project and with a record of successful in-service performance in similar applications. Minimum experience of at least 10 installations with an installed service record of 5 years or greater is required.
- B. Installer Qualifications: Engage personnel experienced in FRP vessel installations similar to that required by this project who are acceptable to the FRP vessel manufacturers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading: Manufacturer shall provide shipping of all items specified to the project location. The Owner shall make the Manufacturer fully responsible to adequately crate and protect all fibreglass items from damage during shipping. Damaged units may be rejected by Engineer and returned to the manufacturer for replacement or repair.
- B. Storage and Protection: Stored units shall be kept fully crated and protected from damage at all times prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers:
 1. Red Ewald Inc., 1-800-242-3524
 2. D&T Fiberglass Inc., 1-916-383-9012
 3. Dolphin Fiberglass Products Inc., 1-350-247-1748
 4. Or Approved Equal

2.2 MATERIALS

- A. Material Restrictions:

1. Install no materials containing cadmium, brass, bronze, copper, zinc, or their alloys that may come in contact with contact with fish rearing water, as these heavy metal materials are proven to be toxic to fish.
2. All vessels, pumps, valves, piping, and wetted components that may come in contact with water are to be a material specified and approved by the ENGINEER

B. Resin

1. The resin shall be US FDA-approved for use with foods and potable water. The resin, unless otherwise specified shall be as produced by Reichhold, Dow, Ashland or approved equal. The same resin shall be used throughout the laminate unless otherwise specified.
2. An isophthalic polyester resin, rated for use in fresh water applications at temperatures up to 65.6°C (150°F), shall be used for all FRP vessels.
3. The resin used shall not contain fillers, unless specified. When specified up to 2% by weight thixotropic agent, Cab-O-Sil, or equal, may be used for viscosity control in the paraffinated top coat on vertical surfaces, provided it will not interfere with visual inspection.
4. Unless otherwise agreed upon by the Manufacturer and the Engineer, the cure system used for the resin shall be in accordance with the resin manufacturer's current recommendations. Proper curing of the resin is the FRP vessel Manufacturer's responsibility. All products fabricated to this specification shall be cured to at least 90% of the minimum Barcol Hardness specified by the resin manufacturer. This requirement applies to both interior and exterior surfaces. (Note: The use of paraffin in the resin or the use of synthetic veil may lower the Barcols below the resin manufacturer's specifications, this is acceptable.)
5. No chemical-resistant surface, interior or exterior, shall be acetone sensitive.

C. Reinforcement

1. Woven roving shall be Type E (electrical borosilicate) glass, nominal 24 oz./sq. yd., 4 by 5 weave, with a silane-type finish and a binder compatible with the lay-up resin.
2. Chopped strand mat shall be Type E glass, 1-1/2 oz. per sq. ft., with a silane finish and a styrene-soluble reactive binder.
3. Continuous roving used in chopper gun for spray-up shall be Type E.

D. Laminate Construction

1. The vessel shall be constructed using a multi-layered system consisting of, at minimum, the following layers:
 - a. Polyester gel coat
 - b. Chop strand fibreglass
 - c. Woven roving
 - d. Chop strand fibreglass
 - e. Polyester gel coat
2. The minimum thickness shall be 3/16 inches (4.763 mm).
3. The inner surface of each tank shall be smooth from a molded surface and consist of a polyester gel coat 15 to 18 mil thick and light blue in

- color. The exterior of each tank shall be finished with a polyester gel coat a minimum of 10 mil thick and light blue in color.
4. All factory perforations must be sealed with resin and gel coat. Field cut perforations may be sealed with epoxy or polyester resin and gel coat or with marine grade sealant.
 5. A visual inspection of the laminate shall be made by the manufacturer. ASTM D2563 shall be used for quality control of construction. Laminate defects and the permissible limits shall be in accordance with the following table:

Defect	Process Surface	None Process Surface
Blisters	None	Max ¼ inch diameter, 0.0625 inch high
Burned Areas	None	None
Chips	None	Max ¼ inch with max thickness 20% of wall
Cracks	None	None
Crazing	None	Slight
Dry Spots	None	Max 2 sq. in./sq. ft.
Entrapped Air	None at surface	0.125 inch diameter max; no more than 3% laminate, 0.0625 inch diameter of area, max 10/sq. in.
Exposed Glass	None	None
Exposed Cut Edges	None	None
Foreign Mater	None	None if it effects the properties of the laminate
Pits	Max 0.125 inch by 0.03125 inch deep, max 10/sq. ft.	Max 0.125 inch diameter by 0.0625 inch deep
Scratches	None (Coated)	None (Coated)
Surface Porosity	None	None
Wrinkles	Max deviation 20% of wall thickness	Max deviation 20% of wall thickness
Sharp Discontinuity	None	None

- E. Pipe connections
 1. Schedule 40 PVC socket fittings or FRP flanges may be used to connect piping to tanks and tank accessories. If PVC fittings are used, then the length of FRP encapsulation must equal or exceed the diameter of the pipe fitting. Pipe fittings must not intrude into the tank or tank accessory volume unless specified (i.e. attach fittings to outside of tank walls with nothing visible on the inside of the tank). FRP flanged connections must equal or exceed Class 150.

- F. Metals
 1. Marine grade aluminum or type 304 or type 316 stainless steel.

2. Use type 304 or type 316 stainless steel fasteners where required to assemble component pieces unless noted otherwise. Provide galvanic protection if aluminum and stainless contact.

2.3 EQUIPMENT

A. Tank numbers and dimensional information will be required as noted below:

Number Required	Diameter (ft)	Depth (ft)	Features required
10	8	4	<ul style="list-style-type: none"> • One piece • side drain including two removable standpipes 4" diameter (may be bolted onto tank), • Integral bottom center drain sump, • bottom drain standpipe assembly including two removable standpipes minimum 2" diameter.

B. Dimensional Requirements:

1. Max Height Top Flange to Centerline of Bottom Drain Outlet: 4'3.75"
2. Max Outside Diameter (including flange): 8' 10"

2.4 COMPONENTS

A. Fish Exclusion Screen

1. Fish exclusion screen must be provided for all tank outlets. They may be manufactured out of semi-rigid PVC, aluminium or stainless steel. Opening slots shall be staggered with a maximum opening of 1/8 inches by 1/2 inches.

B. Side Drain

1. Sidewall drain box (skimmer box) may be constructed of FRP and must be positioned as shown on drawings. Box dimensions shall be as shown on the drawings. The fish exclusion screen or any fasteners should not have sharp edges which could damage the fish. The screen assembly shall be firmly secured to the tank or sidewall drain box all around the edges. The side box and fish exclusion screen may be bolted in position by the contractor during assembly. Total open area of fish escapement screen shall not be less than 74.1 sq. inches. Sidewall drain boxes are to be equipped with two outlet drains. Two identical, 4 inch diameter, vertical, removable level control standpipes shall be provided for sidewall box flows (one for reuse flows and one for effluent flows). Side drain level control standpipes will be field trimmed for length to set tank water levels and balance flows. Provide handles to facilitate easy removal of the level control standpipes.

C. Drain Sump

1. Tank bottom center drain sump may be constructed of FRP or PVC. It must include a fish exclusion screen with total open area not less than 16.5 sq. inches. The screen must be removable and securely fit into a recess around the interior of the Center Sump. The outlet sump shall be

equipped with a 2 inch diameter side exit fitting as shown on the drawings.

- D. Standpipe
 - 1. Bottom drain standpipe assembly shall have one 2 inch diameter inlet and two identical, 2 inch diameter, vertical, removable level control standpipes to control outlet flows. The left outlet (when looking from the inlet side) will require an elbow transition to a horizontal outlet, while the right side outlet should discharge vertically. The maximum vertical displacement between the inlet centerline and the left outlet centerline must not exceed 5 inches. Provide handles to facilitate easy removal of the level control standpipes.
- E. Inlet
 - 1. Provide one inlet spraybar assembly per tank. Spraybar must be sized to deliver water evenly from the design water surface as shown on the construction drawings to within 6 inches of the bottom of the tank.
 - 2. Tank inlet assembly to be provided 0.375 inch diameter orifices located along one side of the inlet spraybar assembly. Each spraybar to have 26 orifices. All orifices to be distributed evenly along the spraybar.
 - 3. Operators must be able to rotate the spray bar assembly 360° in order to control tank rotation velocity.
- F. Bottom drain standpipe assemblies and sidewall drain boxes may be supplied as separate components for field assembly.
- G. All fish culture tanks shall be properly designed and built for stresses that may occur during fabrication, shipping, installation, and intermittent or continuous operation. Workmanship shall be of high industrial standards in all respects.

PART 3 EXECUTION

3.1 GENERAL

- A. Culture tank components and related equipment are to be assembled and installed in proper operating condition and in full conformity with the Contract Documents, Drawings, engineering data, instructions, and recommendations of the equipment Manufacturer as approved by the ENGINEER
- B. Tank manufacturer must identify minimum acceptable installation requirements. Refer to installation requirements as defined in Specification section 13150- Aquaculture systems. Installation contractor must satisfy both sets of requirements.

END OF SECTION

SECTION 13210

CARBON DIOXIDE STRIPPER (CO2 STRIPPER)

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the Carbon Dioxide Stripper (CO2 Stripper) unit. The CO2 Stripper equipment includes water/air contact chamber, header tank, blower(s), water distribution plate(s), mist eliminator, lifting lugs, bracket supports and guides, and all appurtenances and components necessary to provide a complete and fully functional CO2 Stripper system.
- B. Related Sections:
 - 1. Division 16 - Electrical
 - 2. Section 13050 – Aquaculture Systems
 - 3. Section 13209 – FRP tanks.
 - 4. Section 13135 –Fluidized Sand Biofilter
 - 5. Section 13211 – Low Head Oxygenator

1.2 REFERENCES

- A. Commercial Standards.
 - 1. ASTM - American Society for Testing and Materials
 - 2. AWS - American Welding Society
 - 3. AWWA - American Water Works Association
 - 4. MSS - Manufacturers Standardization Society of the Valve and Fitting Industry.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data and Shop Drawings: Submit complete assembly and installation drawings and product data for the CO2 Stripper equipment as a complete system. The following are to be included in the submittal:
 - 1. Product data and shop drawings for approval. The product data and drawings must certify that the stripper unit meets the required specifications. Drawings are to show locations and connections of water inlet and outlets, blower(s), and mist eliminator.
 - 2. Dimensional information including:
 - a. Surface area
 - b. Plan dimensions
 - c. Hydraulic loading rates
 - d. Fall heights within the CO2 Stripper
 - e. Standing water depth on the orifice plate
 - f. Blower size, electrical requirements and control requirements
 - g. Ducting requirements including mist control equipment

- h. Location and dimensions of overflow equipment
 - 3. Assembly and Installation Drawings: Complete assembly and installation drawings including CO2 Stripper size, plate thicknesses, support stands, lifting lugs, distribution plate, and location of blower and mist eliminator.
 - 4. Installation Instructions: Including mounting, anchoring, and plumbing.
- C. Upon completion of the work, submit the following before final acceptance and payment:
- 1. Operation and Maintenance Manuals including instructions for operation of blowers, and maintenance of all components.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing CO2 Stripper units similar to that indicated for this project and with a record of successful in-service performance at this flow rate or greater. Minimum experience of at least two (2) installations with an installed service record of two (2) years or greater is required.
- B. The CONTRACTOR is responsible for determining any changes to the mechanical, civil and electrical design as necessitated by the use of other manufacturer or suppliers. Any design changes are the CONTRACTOR's responsibility, and both design and construction costs associated with any design changes necessitated shall be borne by the CONTRACTOR. All changes shall be subject to review and approval by the ENGINEER.

1.5 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The ENGINEER reserves the right to reject delivery of the equipment, if found upon inspection, to have any cracks, foreign matter, surface porosity, sharp discontinuity, defects of workmanship or other damage.

PART 2 PRODUCTS

2.1 GENERAL

- A. Warranties for materials and workmanship for all equipment and accessories as specified in this section are to be valid for a period of not less than one (1) year, starting from final acceptance by the OWNER.
- B. Process Description: The CO2 Stripper unit and equipment provided herein are to be utilized for the removal of dissolved carbon dioxide and for the aeration of culture water. Water pumped to the top of the unit flows by gravity through the CO2 Stripper. Water falls through the CO2 Stripper vessel's air/water contact chamber, where air is blown counter to the direction of falling water. The equipment is to be designed for installation on a concrete floor elevated three feet, zero inches (3'0") above the floor that the Biofilter is mounted on.

- C. Provide complete CO2 Stripper unit, including blower, distribution plate, mist eliminator, lifting lugs, support brackets and all appurtenances or components necessary to provide a complete and fully functional system. Furnish the CO2 Stripper units and equipment as a package to achieve standardization for operation, maintenance, and service.
- D. Unit Manufacturer is responsible for the design and fabrication of required support legs and restraints.
- E. Each CO2 Stripper unit must be capable of decreasing the CO2 concentration by 50% under the following conditions:
- | | |
|---|--------------|
| 1. Maximum Flow Rate(gpm) | 1,200 |
| 2. Water temperature (degrees C) | 25°C (77°F) |
| 3. Water pH (--) | 7.4 |
| 4. Alkalinity (mg/L) | 200 as CaCO3 |
| 5. Elevation (ft) | 4,500 MSL |
| 6. Inflow dissolved carbon dioxide Concentration (mg/L) | 15 |
- F. Layout of facilities indicated on the Drawings are based on equipment specified herein and elsewhere in the specifications. CO2 Stripper to be manufactured to match the plumbing shown on the aquaculture drawings. All vessel dimensions, orientations, and elevations must match those shown on the aquaculture drawings. Alternate dimensions are not permissible.
- G. Bypass: Provide a plumbing system to bypass the CO2 Stripper unit sized to the total capacity of the system
- H. Connections: The CO2 stripper vessel Manufacturer is responsible for design and supply of connections to the Biofilter vessel and the LHO. Co-ordinate with the manufacturer's of these components as required.
- I. All components must be furnished in such a way that they may be moved into the facility through a door opening that is 10 ft wide and 10 ft in height. If so required, the equipment may be provided in two segments that may be moved into the building separately and assembled in place. All fasteners and sealant required for field assembly shall be provided with the equipment.

2.2 MANUFACTURERS

- A. Approved Manufacturers:
1. Aquatic Habitats, 877-900-2422.
 2. Approve Equal.

2.3 MATERIALS

- A. Materials of Construction:
1. The CO2 Stripper shall be fabricated out of materials that are food safe, suitable for use in an aquaculture environment, and ozone resistant. All

materials, including supports, fasteners, etc. must also be suitable for installation in a corrosive (brackish/marine) environment.

2. The vessel body of the CO₂ Stripper shall be fabricated from fiberglass-reinforced plastic (FRP). Internal components and accessories may be fabricated of 5000-series or 6000-series aluminum, stainless steel, HDPE, FRP or equal as approved by the ENGINEER.
3. To minimize galvanic reactions, insulating gaskets and washers must be used to prevent direct contact between dissimilar metals.

B. Material Restrictions:

1. Install no materials containing cadmium, brass, bronze, copper, zinc, or their alloys that may come in contact with contact with fish rearing water, as these heavy metal materials are proven to be toxic to fish.
2. All vessels, pumps, valves, piping, and wetted components that may come in contact with water are to be a material specified and approved by the ENGINEER.

C. Resin

1. The resin shall be US FDA-approved for use with foods and potable water. The resin, unless otherwise specified shall be as produced by Reichhold, Dow, Ashland or approved equal. The same resin shall be used throughout the laminate unless otherwise specified.
2. An isophthalic polyester resin, rated for use in fresh water applications at temperatures up to 65.6°C (150°F), shall be used for all FRP vessels.
3. The resin used shall not contain fillers, unless specified. When specified up to 2% by weight thixotropic agent, Cab-O-Sil, or equal, may be used for viscosity control in the paraffinated top coat on vertical surfaces, provided it will not interfere with visual inspection.
4. Unless otherwise agreed upon by the Manufacturer and the Engineer, the cure system used for the resin shall be in accordance with the resin manufacturer's current recommendations. Proper curing of the resin is the FRP vessel Manufacturer's responsibility. All products fabricated to this specification shall be cured to at least 90% of the minimum Barcol Hardness specified by the resin manufacturer. This requirement applies to both interior and exterior surfaces. (Note: The use of paraffin in the resin or the use of synthetic veil may lower the Barcols below the resin manufacturer's specifications, this is acceptable.)
5. No chemical-resistant surface, interior or exterior, shall be acetone sensitive.

D. Reinforcement

1. Woven roving shall be Type E (electrical borosilicate) glass, nominal 24 oz./sq. yd., 4 by 5 weave, with a silane-type finish and a binder compatible with the lay-up resin.
2. Chopped strand mat shall be Type E glass, 1-1/2 oz. per sq. ft., with a silane finish and a styrene-soluble reactive binder.
3. Continuous roving used in chopper gun for spray-up shall be Type E.

E. Laminate Construction

1. The minimum thickness shall be 3/16 inches (4.763 mm).

2. The inner surface of each tank shall be smooth from a molded surface.
3. All factory perforations must be sealed with resin and gel coat. Field cut perforations may be sealed with epoxy or polyester resin and gel coat or with marine grade sealant.
4. A visual inspection of the laminate shall be made by the manufacturer. ASTM D2563 shall be used for quality control of construction. Laminate defects and the permissible limits shall be in accordance with the following table:

Defect	Process Surface	None Process Surface
Blisters	None	Max ¼ inch diameter, 0.0625 inch high
Burned Areas	None	None
Chips	None	Max ¼ inch with max thickness 20% of wall
Cracks	None	None
Crazing	None	Slight
Dry Spots	None	Max 2 sq. in./sq. ft.
Entrapped Air	None at surface	0.125 inch diameter max; no more than 3% laminate, 0.0625 inch diameter of area, max 10/sq. in.
Exposed Glass	None	None
Exposed Cut Edges	None	None
Foreign Mater	None	None if it effects the properties of the laminate
Pits	Max 0.125 inch by 0.03125 inch deep, max 10/sq. ft.	Max 0.125 inch diameter by 0.0625 inch deep
Scratches	None (Coated)	None (Coated)
Surface Porosity	None	None
Wrinkles	Max deviation 20% of wall thickness	Max deviation 20% of wall thickness
Sharp Discontinuity	None	None

- F. Pipe connections
 1. Schedule 40 PVC socket fittings or FRP flanges may be used to connect piping to tanks and tank accessories. If PVC fittings are used, then the length of FRP encapsulation must equal or exceed the diameter of the pipe fitting. Pipe fittings must not intrude into the tank or tank accessory volume unless specified (i.e. attach fittings to outside of tank walls with nothing visible on the inside of the tank). FRP flanged connections must equal or exceed Class 150.

- G. Metals
 1. Marine grade aluminum or type 304 or type 316 stainless steel.

2. Use type 304 or type 316 stainless steel fasteners where required to assemble component pieces unless noted otherwise. Provide galvanic protection if aluminum and stainless contact.

2.4 COMPONENTS

A. CO2 Stripper

1. Each CO2 Stripper must conform to the criteria as specified in this Section and as shown on the Drawings. The CO2 Stripper unit and all appurtenances and components are to be provided by a single supplier.
2. Fabrication: Material thicknesses must be adequate to achieve structural integrity for each unit.
3. Structural Design: CO2 Stripper unit Manufacturer is assigned full responsibility for the complete structural design of each unit.
4. The CO2 stripper vessel inside diameter must be 6 feet. Vessel height and orientation and elevations of all penetrations must match those shown on the aquaculture drawings. Alternate dimensions are not permissible.
5. Inlet: The vessel will be provided with four inlets. One inlet will be a trough 36 inches wide by 12 inches deep which connects directly to the biofilter vessel. This trough must be complete with a 10 inch diameter CO2 stripper bypass connection as shown in the drawings. The second inlet is the penetration where this bypassed flow enters the header tank portion of the vessel below the CO2 stripper. The third inlet delivers pumped flows onto the CO2 stripper distribution plate. The fourth inlet introduces pumped flows into the lower portion of the vessel, bypassing the CO2 stripper.
6. Outlet: The header tank portion of the vessel will have an outlet trough 36 inches wide by 16 inches deep. The outlet trough must be designed to connect to pass over the UV reactor to connect to the LHO in a leak free connection.
7. Distribution Plate System: The distribution plate for each unit is to consist of a removable plate system with a series of orifices evenly punched into the plate and Crown nozzles to break up the water flow. Design the distribution plate with a minimum freeboard of 4 inches at the maximum design flow rate of 1200 gpm
8. Overflow: The header tank portion of this vessel must be supplied with an overflow. The weir length should be sized to handle the full flow with no more than 2 inches of standover height at the maximum anticipated flow rate (12 foot long weir length). Prevent entrance of normal stripper flows into the overflow by providing a full length cover. Discharge vertically through a 12 inch PVC socket connection as shown on the aquaculture drawings.
9. Drain: Provide an integral cone shaped header tank complete with a 2 inch diameter drain. Include internal piping necessary to route the to the vessel exterior as shown on the drawings. Sweep elbows must be used. Provide complete with a 2 inch PVC socket connection as shown on the aquaculture drawings.
10. Support Systems: Include support legs and anchors of adequate size to hold the equipment in position against the weight and thrust force of the

water and to satisfy local seismic requirements. The contractor is responsible for determining the size, number, type, and method of bolt installation within the concrete to amply secure the vessels according to the seismic requirements of the location.

- B. Blower
1. The blower(s), blower motor(s), electrical controls and disconnects, supporting elements and piping connections must be designed to work with the CO2 Stripper.
 2. The blower motor(s) to be fully enclosed, and to include all guards and covers required for safe operation.
 3. Supply and install electrical motor equipment complete with motor, starter and controls. Provide motor starters and all appurtenances necessary for motor control, complete with thermal overload protection in each phase. The motor must be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. All motor controls, equipment and wiring must be in accordance with NFPA 70.
 4. Supply a nameplate for each blower. The nameplate shall show:
 - a. Manufacturer's name
 - b. Manufacturer's address
 - c. Equipment type or style
 - d. Model
 - e. Serial number
 - f. Catalog number
 - g. Rated capacity
 5. Supply all necessary mounting hardware, piping and fittings required to provide adequate support of the blower(s), blower motor(s), electrical equipment and piping.
- C. Mist Eliminator
1. For each CO2 Stripper, supply an exhaust duct connection complete with a mist eliminator designed to intercept suspended droplets. The intercepted water is to be encouraged to flow back into the stripper vessel. Refer to design drawings for additional ducting requirements.

PART 3 EXECUTION

3.1 GENERAL

- A. CO2 stripper components and related equipment are to be assembled and installed in proper operating condition and in full conformity with the Contract Documents, Drawings, engineering data, instructions, and recommendations of the equipment Manufacturer as approved by the ENGINEER.
- B. Refer to manufacturer for installation, levelling and anchoring instructions. The vessel must be installed vertically and at the elevation shown on the aquaculture

drawings. If the floor slope prevents the vessel from being installed vertically, refer to manufacturer for instructions on how to grout or otherwise install the vessel to ensure that the vessel is correctly installed.

- C. Furnish and install each item of equipment complete with all supports, structural, mechanical and electrical work, expansion joints, guides, anchors and all appurtenances required for the CO₂ stripper to be ready for operation. All vessels and parts must be amply proportioned for the stresses that may occur during fabrication, installation and operation. There must be no undue forces and moments on the equipment flanges.
- D. Individual parts furnished that are alike and installed as units are to be alike in workmanship, design, and materials, and are to be interchangeable.

3.2 CLEANING

- A. Clean and disinfect the CO₂ Stripper as follows:
 - 1. Remove dirt and debris as work progresses.
 - 2. Refer to Aquaculture System Specification for module cleaning and disinfection requirements as part of facility commissioning

3.3 SYSTEM START-UP AND COMMISSIONING

- A. Upon completion of the installation, each piece of equipment and each system must be tested for satisfactory operation without leaking, excessive noise, vibration, overheating, or other operative malfunction. All equipment is to be adjusted and checked for alignment, clearances, supports, and adherence to safety standards until found satisfactory.

END OF SECTION

SECTION 13211

LOW HEAD OXYGENATOR (LHO)

PART 1 GENERAL

1.1 SUMMARY

- A. The LHO equipment includes water/air-oxygen mixing chambers, water distribution plates, burp tubes, lifting lugs, bracket supports and guides, gas inlet/outlet fittings, and all appurtenances and components necessary to provide a complete and fully functional LHO system. It also includes the header tank including an outlet and overflow outlet. The LHO equipment does not include oxygen supply or oxygen distribution equipment.
- B. Related Sections:
 - 1. Section 13050 – Aquaculture Systems
 - 2. Section 13210 – CO2 Stripper.
 - 3. Section 15131 – Oxygen Distribution
 - 4. Section 17225 – Control Panels

1.2 REFERENCES

- A. Commercial Standards.
 - 1. ASTM - American Society for Testing and Materials
 - 2. AWS - American Welding Society
 - 3. AWWA - American Water Works Association
 - 4. MSS - Manufacturers Standardization Society of the Valve and Fitting Industry.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. A. Product Data and Shop Drawings: Submit complete assembly and installation drawings and product data for the LHO equipment as a complete system, in accordance with SECTION 01300 - SUBMITTAL PROCEDURES. The following are to be included in the submittal:
 - 1. 1. Product data and shop drawings for approval. The product data and drawings must certify that the equipment meets the required specifications. Drawings are to show locations and connections of water inlet, water outlet, burp tube, and gas injection system.
 - 2. Equipment name and applicable specification number
 - 3. Dimensional information including:
 - a. Surface area
 - b. Plan dimensions
 - c. Hydraulic loading rates
 - d. Fall heights within the LHO
 - e. Standing water depth on the orifice plate(s)

- f. Number of LHO chambers
 - g. Submergence depth
 - h. Clearance from bottom of installation tank
 - i. Location and dimension of overflow equipment
 4. Assembly and Installation Drawings: Complete assembly and installation drawings including LHO unit sizes and chamber designs, plate thicknesses, support stands, lifting lugs, distribution plates, burp tube, and gas inlet/outlet fittings.
 5. Installation instructions: Including mounting, anchoring, and plumbing.
 6. Calculations showing that overflow is designed to pass 100% of the maximum flow from the top of the distribution plate down to the installation tank as if the LHO orifice plate is totally blocked without loss of water from the system.
 7. Certification: Written certification from the LHO unit Manufacturer, addressed to the OWNER, stating that the equipment will efficiently and thoroughly perform the required functions.
- C. Upon completion of the work, submit the following before final acceptance and payment:
1. Warranties for all equipment and accessories as specified in SECTION 01400 – QUALITY REQUIREMENTS.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing Low Head Oxygenator (LHO) units similar to that indicated for this project and with a record of successful in-service performance at this flow rate or greater. Minimum experience of at least two (2) installations with an installed service record of two (2) years or greater is required.
- B. The CONTRACTOR is responsible for determining any changes to the mechanical, civil and electrical design as necessitated by the use of other manufacturer or suppliers. Any design changes are the CONTRACTOR's responsibility, and both design and construction costs associated with any design changes necessitated shall be borne by the CONTRACTOR. All changes shall be subject to review and approval by the ENGINEER.

1.5 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The ENGINEER reserves the right to reject delivery of the equipment, if found upon inspection, to have any cracks, foreign matter, surface porosity, sharp discontinuity, defects of workmanship or other damage as per SECTION 01400 – QUALITY REQUIREMENTS

PART 2 PRODUCTS

2.1 GENERAL

- A. Warranties for materials and workmanship for all equipment and accessories as specified in this section are to be valid for a period of not less than one (1) year, starting from final acceptance by the OWNER.
- B. The LHO unit and all appurtenances and components are to be provided by a single manufacturer.
- C. The LHO and related header tank must conform to the criteria as specified in this Section and as shown on the Drawings. All vessel dimensions, orientations, and elevations must match those shown on the aquaculture drawings. Alternate dimensions are not permissible.

2.2 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Aquatic Habitats, 877-900-2422.
 - 2. Approved Equal.

2.3 MATERIALS

- A. Materials of Construction:
 - 1. The LHO, header tank, and related components shall be fabricated out of materials that are food safe, suitable for use in an aquaculture environment, and ozone resistant. All materials, including supports, fasteners, etc. must also be suitable for installation in a corrosive (brackish/marine) environment.
 - 2. The header tank must be fabricated from fiberglass-reinforced plastic (FRP). All nozzles or connections on the header tank must be PVC plumbing.
 - 3. The LHO Unit may be fabricated of 5000-series or 6000-series aluminum, stainless steel, HDPE, FRP or equal as approved by the ENGINEER.
 - 4. To minimize galvanic reactions, insulating gaskets and washers must be used to prevent direct contact between dissimilar metals.
- B. All oxygen (O₂) hardware and fittings shall be of stainless steel, copper, bronze or brass. Make final connections to the LHO with flexible tubing suitable for use with oxygen.
- C. Material Restrictions:
 - 1. Install no materials containing cadmium, brass, bronze, copper, zinc, or their alloys that may come in contact with contact with fish rearing water, as these heavy metal materials are proven to be toxic to fish.
 - 2. All vessels, pumps, valves, piping, and wetted components that may come in contact with water are to be a material specified and approved by the ENGINEER

D. Resin

1. The resin shall be US FDA-approved for use with foods and potable water. The resin, unless otherwise specified shall be as produced by Reichhold, Dow, Ashland or approved equal. The same resin shall be used throughout the laminate unless otherwise specified.
2. An isophthalic polyester resin, rated for use in fresh water applications at temperatures up to 65.6°C (150°F), shall be used for all FRP vessels.
3. The resin used shall not contain fillers, unless specified. When specified up to 2% by weight thixotropic agent, Cab-O-Sil, or equal, may be used for viscosity control in the paraffinated top coat on vertical surfaces, provided it will not interfere with visual inspection.
4. Unless otherwise agreed upon by the Manufacturer and the Engineer, the cure system used for the resin shall be in accordance with the resin manufacturer's current recommendations. Proper curing of the resin is the FRP vessel Manufacturer's responsibility. All products fabricated to this specification shall be cured to at least 90% of the minimum Barcol Hardness specified by the resin manufacturer. This requirement applies to both interior and exterior surfaces. (Note: The use of paraffin in the resin or the use of synthetic veil may lower the Barcols below the resin manufacturer's specifications, this is acceptable.)
5. No chemical-resistant surface, interior or exterior, shall be acetone sensitive

E. Reinforcement

1. Woven roving shall be Type E (electrical borosilicate) glass, nominal 24 oz./sq. yd., 4 by 5 weave, with a silane-type finish and a binder compatible with the lay-up resin.
2. Chopped strand mat shall be Type E glass, 1-1/2 oz. per sq. ft., with a silane finish and a styrene-soluble reactive binder.
3. Continuous roving used in chopper gun for spray-up shall be Type E.

F. Laminate Construction

1. The minimum thickness shall be 3/16 inches (4.763 mm).
2. The inner surface of each vessel shall be smooth from a molded surface.
3. All factory perforations must be sealed with resin and gel coat. Field cut perforations may be sealed with epoxy or polyester resin and gel coat or with marine grade sealant.
4. A visual inspection of the laminate shall be made by the manufacturer. ASTM D2563 shall be used for quality control of construction. Laminate defects and the permissible limits shall be in accordance with the following table:

Defect	Process Surface	None Process Surface
Blisters	None	Max ¼ inch diameter, 0.0625 inch high
Burned Areas	None	None
Chips	None	Max ¼ inch with max thickness 20% of wall

Cracks	None	None
Crazing	None	Slight
Dry Spots	None	Max 2 sq. in./sq. ft.
Entrapped Air	None at surface	0.125 inch diameter max; no more than 3% laminate, 0.0625 inch diameter of area, max 10/sq. in.
Exposed Glass	None	None
Exposed Cut Edges	None	None
Foreign Mater	None	None if it effects the properties of the laminate
Pits	Max 0.125 inch by 0.03125 inch deep, max 10/sq. ft.	Max 0.125 inch diameter by 0.0625 inch deep
Scratches	None (Coated)	None (Coated)
Surface Porosity	None	None
Wrinkles	Max deviation 20% of wall thickness	Max deviation 20% of wall thickness
Sharp Discontinuity	None	None

- G. Pipe connections
1. Schedule 40 PVC socket fittings or FRP flanges may be used to connect piping to tanks and tank accessories. If PVC fittings are used, then the length of FRP encapsulation must equal or exceed the diameter of the pipe fitting. Pipe fittings must not intrude into the tank or tank accessory volume unless specified (i.e. attach fittings to outside of tank walls with nothing visible on the inside of the tank). FRP flanged connections must equal or exceed Class 150.
- H. Metals
1. Marine grade aluminum or type 304 or type 316 stainless steel.
 2. Use type 304 or type 316 stainless steel fasteners where required to assemble component pieces unless noted otherwise. Provide galvanic protection if aluminum and stainless contact.

2.4 EQUIPMENT

- A. Description of Operation: The LHO unit and associated equipment provided herein is to be utilized for the addition of oxygen and carbon dioxide into the culture water. Water delivered to the top of the unit flows by gravity through the LHO. The water is distributed evenly over the LHO orifice plate, and then falls through into the water/oxygen contact chambers. Oxygen is metered into one side of the LHO and flows horizontally through each chamber where it interfaces with the water to achieve the necessary oxygen transfer. A second inlet complete with a cap is to be provided so that operators can add carbon dioxide to the water as needed for pH control. The LHO units shall be supplied with and installed in a header tank that will provide the required submergence of the LHO

and a reservoir from which oxygenated water will be supplied to the culture systems. The LHO units shall have an open bottom and will discharge into the header tank. A burp tube or similar gas flow and pressure control device is required to allow off-gas to vent from the final LHO chamber.

- B. Provide complete LHO unit, including header tank, distribution plate, gas and water inlet and outlet fittings, lifting lugs, support brackets and all appurtenances or components necessary to provide a complete and fully functional system. Furnish the LHO units and equipment as a package to achieve standardization for operation, maintenance, and service.
- C. Each LHO unit must be capable of increasing the dissolved oxygen concentration in the water by a minimum of 160% over saturation under the following conditions:
- | | | |
|----|-------------------------------|-------------|
| 1. | Maximum Flow Rate(gpm) | 1,200 |
| 2. | Minimum Flow Rate (gpm) | 500 |
| 3. | Water temperature (degrees C) | 25°C (77°F) |
| 4. | Water pH (--) | 7.4 |
| 5. | Elevation (ft) | 4,500 MSL |
| 6. | Source oxygen purity | >99% purity |
| 7. | Inflow dissolved oxygen | 6.8 mg/L |
| 8. | Inflow TGP | 100% |
- D. Structural Design: LHO unit Manufacturer is assigned full responsibility for the complete structural design of each unit and the structural design of all supports and restraints.
- E. All components must be furnished in such a way that they may be moved into the facility through a door opening that is 10 ft wide and 10 ft in height. If so required, the equipment may be provided in two segments that may be moved into the building separately and assembled in place. All fasteners and sealant required for field assembly shall be provided with the equipment.

2.5 COMPONENTS

- A. LHO Unit
1. Fabrication: Provide for a completely gas-tight LHO design when a water seal is maintained over the distribution plate. Sheet thicknesses must be adequate to achieve structural integrity for each unit. The LHO must be fabricated as one unit.
 2. The inlet to the LHO is a trough connection from the CO₂ stripper. This trough must pass over the UV reactor vessel without leaking. Co-ordinate the LHO inlet design with the CO₂ stripper manufacturer.
 3. Distribution Plate System: The distribution plate for each unit is to consist of a removable plate system with a series of orifices evenly punched into the plate. The distribution plate is to provide even distribution of water into the LHO chambers at the indicated range of flow rates. The plate systems must be designed such that a water seal is maintained for the design flow rate.

4. Support Systems: Include support legs and anchors for each unit that are of adequate size to hold the equipment in position against the weight and thrust force of the water.
- B. Header Tank
1. Provide for a conical bottomed header tank designed to support and anchor the LHO as shown on the aquaculture drawings.
 2. The normal outlet is a 10 inch diameter PVC.
 3. Distribution Plate System: The distribution plate for each unit is to consist of a removable plate system with a series of orifices evenly punched into the plate. The distribution plate is to provide even distribution of water into the LHO chambers at the indicated range of flow rates. The plate systems must be designed such that a water seal is maintained for the design flow rate.
 4. Support Systems: Include support legs and anchors for each unit that are of adequate size to hold the equipment in position against the weight and thrust force of the water. The contractor is responsible for determining the size, number, type, and method of bolt installation within the concrete to amply secure the vessels according to the seismic requirements of the location.

2.6 OXYGEN METERING AND DISTRIBUTION

- A. Supply all LHO hardware necessary to provide a sealed connection of the oxygen distribution equipment and of portable carbon dioxide bottles to the LHO, including but not limited to poppet style check valves on each gas inlet to prevent backflow of gases. The oxygen supply and distribution are covered under another specification.
- B. All gas hardware and fittings shall be of stainless steel, copper or brass. Make final connections to the LHO with flexible tubing suitable for use with oxygen.

PART 3 EXECUTION

3.1 GENERAL

- A. The LHO unit and related equipment must be fabricated, erected, assembled, and placed in proper operating condition in full conformity with the Contract Documents, engineering data, instructions, and recommendations of the equipment Manufacturer as approved by the ENGINEER.
- B. Furnish and install each item of equipment complete with all supports, structural work, and appurtenances required to ensure that equipment is ready for operation.
- C. All units and parts must be amply proportioned for the stresses that may occur during fabrication, erection, installation and operation.

- D. Individual parts furnished that are alike and installed as units are to be alike in workmanship, design, and materials, and are to be interchangeable.
- E. Supply and install all shim systems necessary to ensure that orifice plate(s) are level and all anchors needed to ensure stability of the equipment.

3.2 CLEANING

- A. Clean and disinfect the LHO and Header Tank as follows:
 - 1. Remove dirt and debris as work progresses.
 - 2. Refer to Aquaculture System Specification for module cleaning and disinfection requirements as part of facility commissioning

3.3 SYSTEM START-UP AND COMMISSIONING

- A. Upon completion of the installation, each piece of equipment and each system must be tested for satisfactory operation without leaking, excessive noise, vibration, overheating, or other operative malfunction. All equipment is to be adjusted and checked for alignment, clearances, supports, and adherence to safety standards until found satisfactory.

END OF SECTION

SECTION 15100

PIPE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe
 - 2. Pipe supports
 - 3. Pipe fittings

- B. Related Sections:
 - 1. Section 2205 – Soil Materials
 - 2. Section 2207 - Aggregate Materials
 - 3. Section 2225 – Trenching and Backfilling for Pipelines
 - 4. Section 13135 - CycloBio Fluidized Sand Filter
 - 5. Section 13150 - Aquaculture System
 - 6. Section 13209 - FRP Culture Tanks
 - 7. Section 13210 - CO2 Degasser
 - 8. Section 13211 - Low Head Oxygenator
 - 9. Section 15101 – Pumps and Motors
 - 10. Section 15102 – Valves

1.2 REFERENCES

- A. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- B. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- C. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- D. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- E. ANSI/AWWA - C151/A21.51: Ductile Iron Pipe.
- F. ANSI/AWWA C115/A21.15: Flanged Ductile Iron Pipe with Threaded Flanges
- G. ANSI/AWWA C153/A21.53: Ductile Iron Compact Fittings
- H. Carbon Steel Pipe A106/A53 Grade B; welded or seamless

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings and accessories.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Installers documented experience.
- E. Proof that pipe is manufactured in America.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Manufacturer's name and pressure rating marked on pipe.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store pipe per manufacture's recommendations and in a manner which prevent shock, damage or excessive exposure to sunlight and weather.
- B. Protect gasket material from sunlight and contamination.

PART 2 PRODUCTS

2.1 PIPE

- A. Schedule 40, 80 PVC Pipe
 - 1. Material- PVC Type 1 cell classification 12454, conforming to ASTM D 1784, and Certified for potable water service by NSF International.
 - 2. Joints – Solvent Weld
 - 3. Fittings – All fittings shall be injection molded and manufactured in strict compliance to ASTM D 2466
 - a. Solvent Weld,
 - b. Flange - CL150 bolt pattern per ANSI Standard B16.5 for a maximum internal pressure of 150 psi, non-shock at 73°F.

Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207.

- c. Threaded - Threaded connections to be AMNS (NPT) tapered pipe thread

- B. PVC Sewer Pipe
 - 1. Material -SDR 35 PVC; ASTM D3034
 - 2. Joints – Bell and Spigot ASTM D3212
 - a. Gaskets – F679
 - 3. Fittings – Bell and Spigot, Solvent Weld

- C. Carbon Steel Pipe
 - 1. Material - A106 /A53 Grade B welded or seamless steel
 - A. Joints –Butt-welded. Field welding shall be performed per AWWA C206. Shop welding and fabrication shall conform to AWWA C207.
 - 2. Fittings – Class 150 Steel Flanges 150 lb Flanges with ANSI B16.5 Bolt Pattern.
 - 3. Coating – Epoxy coated interior and exterior.

- D. Copper Pipe
 - 1. Material - ASTM B819, Type L drawn. Furnish piping identified with manufacturer's markings.
 - 2. Fittings: ASME B16.22, wrought copper and bronze or MSS SP 73 wrought and cast copper.
 - 3. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

2.2 UNDERGROUND PIPE MARKERS – EXTERNAL PIPES

- A. Magnetic Locator Tape: Identification tape shall be furnished with white or black printing on an appropriate color field having the words CAUTION: Name of Utility - BELOW. All pipe in exterior locations shall include a 3-inch magnetic locator tape installed in the pipeline trench approximately 12 inches below ground surface.

2.3 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type A2, A4, B1, B2 as specified in Section 02207, 02225.
- B. Cover: Fill Type A2, A4, A6, as specified in Section 02207.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1, as specified in Section 02205.

2.4 ACCESSORIES

- A. Link Seal or equal
- B. Insulation – ½" Closed cell w/ single slit. Adhesive R-320

2.5 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Creative Systems Inc.
 - 3. Flex-Weld, Inc.
 - 4. Glope Pipe Hanger Products Inc.
 - 5. Michigan Hanger Co.
 - 6. Superior Valve Co.
 - 7. Substitutions: Section 01600 - Product Requirements.

- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

- C. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

- D. Hangers for Hot Pipe, Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.

- E. Hangers for Hot Pipe, Sizes 6 inches and Larger: Adjustable steel yoke, cast iron pipe roll and double hanger.

- F. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

- G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded supports or spacers and hanger rods, cast iron roll.

- H. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.

- I. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamps.

- J. Vertical Support: Steel riser clamp.

- K. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

- L. Copper Pipe Support: Carbon steel ring, adjustable, copper plate.

- M. PVC Flange Adaptors
 - 1. Material – Ductile Iron ASTM A536 Gr. 65-45-12.
 - 2. Flanges
 - a. Steel ANSI 16.5 150 lb
 - b. Ductile Iron ANSI 16.1 125 lb
 - 3. Testing Requirements – AWWA C-900, ASTM D 2241
 - 4. Gasket – Dual Seal

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify that alignments and elevations of pipe and structures confer with plans.
- C. Examine pipe and fittings for defects or damage
- D. Verify utility location, existing piping location an structure where connections are to be made prior to beginning work.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 02225 for Work of this Section.
- B. Backfill around sides and to top of pipe in accordance with Section 02225.
- C. Maintain optimum moisture content of fill material to attain required compaction density.
- D. Place fill material in accordance with Section 02225.

3.4 INSTALLATION - PIPE

- A. Route pipe in straight line.
- B. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- C. Recommended bolt torques for all PVC flanges:

Flange Size (inches)	Bolt Diameter (inches)	Bolt Torque (ft-lb)
0.5 to 1.5	0.5	15
2 to 4	0.625	25
6 to 8	0.75	45
10 to 12	0.875	50

- D. Backfill trench in accordance with Section 02225.
- E. Install closed cell insulation around all copper pipe beneath grade.
- F. Concrete Penetrations:
 - 1. PVC Pipe – Wrap PVC Pipe with Sill Seal or approved equal to a thickness of 1/4". Secure with Duct Tape
 - 2. Copper Pipe – Wrap with closed-cell insulation.

3.5 PIPE SUPPORTS

- A. Where pipe is within 4 inches of the floor, install wood bearing plates with construction adhesive to concrete bearing locations.
- B. Maximum Support Spacing for PVC Pipe

Pipe Size (inches)	Max Span (feet)
1/2	3.25
3/4	3.5
1	4.0
1 1/4	4.5
1 1/2	5.5
2	5.5
3	7.5
4	8.0
6	10.0
8	11.5
10	12.5
12	13.0
14	13.5

- C. Install lateral restraints to prevent hammer and horizontal movement.
- D. Support piping at all bends regardless of spacing.

3.6 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Pressure test supply system to 20 psi for 30 minutes. Repair leaks and re-test. No visible leakage will be permitted.
- C. Compaction Testing for Bedding: In accordance with ASTM D1557. ASTM D2922. ASTM D3017.

- D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- E. Frequency of Compaction Tests: One test per trench at midpoint and top of backfill. Spacing 50 feet.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

SECTION 15101
PUMPS AND MOTORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pumps
 - 2. Motors
- B. Related Sections:
 - 1. Section 15100 –Piping
 - 2. Section 15101 – General Piping Requirements
 - 3. Division 16 - Electrical

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- D. Installers documented experience.
- E. Proof of "Buy American" requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Closeout procedures.

- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.
- C. Maintain one copy of each document on site.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

1.6 WARRANTY

- A. Section 01700 - Execution Requirements: Product warranties and product bonds.
- B. Furnish 1-year manufacturer warranty for pumps.

PART 2 PRODUCTS

2.1 PUMPS AND MOTOR

- A. Recirculation Pump Motor
 1. SPEC: 37M031Y660G1
 2. HP: 10
 3. VOLTS: 208-230/460
 4. AMPS: 28.5-28.4 / 14.2
 5. RPM: 1760
 6. FRAME: 215JM
 7. HZ: 60
 8. PH: 3
 9. EFF: 89.5%
 10. P.F. 73%
 11. RATING: 56C AMB-CONT
 12. USABLE AT 208V: 28.5 A
 13. BEARINGS: DE: 6309
 14. ODE: 6206
 15. ENCL: TEFC
 16. SN: F0510312525
 17. LSM-2914
- B. Recirculation Pump

1. G&L PUMPS: L0500125
2. SIZE: 3X4-8
3. IMP. DIA: 9.06
4. CAT #: 23SH2L5A0

2.2 ACCESSORIES

- A. Pressure Gauges: All gauges shall be 3-1/2 inch, glycerin filled, with an accuracy of ANSI Class B or better. Gauge shall operate within a range of 1 to 20 psi.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify all pumps, motors, and materials are present and meet the requirements of these Specifications.

3.2 INSTALLATION

- A. Install pumps and motors in accordance with shop drawings and manufacturer's recommendations.
- B. Interface with suction and discharge piping to provide a complete waterproof seal.
- C. Install electrical and pump controls in accordance with the manufacturer's recommendations and the electrical specifications.
- D. Perform final alignment of pumps after the bolts have been tightened, the grout on the pump base is set, and the pumps and piping are filled with water. Align pumps to comply with manufacturer's requirements. Pump vibration shall comply with Hydraulic Institute requirements.
- E. Provide a pressure gauge on the intake and discharge side of each pump.
- F. Supply manual on/off switches for each pump complete with motor starters, overload protection, fusible disconnects and a pilot light. Provide local area disconnects.
- G. Pumps shall be installed on existing concrete housekeeping pad.
- H. After the pumps have operated at least 2 weeks during normal operating conditions, recheck the alignment of the pumps and realign to comply with manufacturer's requirements, if necessary.

3.3 START-UP SERVICES

- A. Provide a factory-trained representative to oversee, inspect and to certify the installation of each type of pump. Prior to operator training, demonstrate to the Engineer that the equipment is ready for operation.
- B. Provide a factory-trained representative to demonstrate operation and maintenance of each of the pumps and motors for a minimum of four (4) hours.

END OF SECTION

SECTION 15102

VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Valves
 - 2. Valve Actuators

- B. Related Sections:
 - 1. Section 13135 - CycloBio Fluidized Sand Filter
 - 2. Section 13150 - Aquaculture System
 - 3. Section 13209 - FRP Culture Tanks
 - 4. Section 13210 - CO₂ Degasser
 - 5. Section 13211 - Low Head Oxygenator
 - 6. Section 15100 –Pipe
 - 7. Section 15101 – General Piping Requirements

1.2 REFERENCES

- 1. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- 2. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- 3. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- 4. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Installers documented experience.
- E. Proof of meeting “Buy American” requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Manufacturer's name and pressure rating marked on valve body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 VALVES

- A. Ball Valves
 1. PVC Type I Cell Classification 12454.
 2. EPDM O Rings.
 3. Double stop polypropylene handle.
 4. NSF approved.
 5. 150 P.S.I. pressure rating @ 73° F.
 6. True Union Type
- B. Butterfly Valves – PVC
 1. PVC Type I Cell Classification 12454.
 2. Lug Style to control flow with piping on one side of valve.
 3. Valve seats – Buna-N, EPDM, Viton.
 4. Bolt Pattern – ANSI ASME B-16.5 CL150.
 5. Disc – Offset, 316 stainless steel stem, 2 O-ring seals.
 6. Operator - Poly Propylene Handle, or operating wheel
 7. Lugs stainless steel or zinc plated steel.
 8. 150 P.S.I. pressure rating @73° F.
- C. Butterfly Valves – Cast Iron
 1. Body – Cast Iron A-126 Class B with 304 Stainless Steel Seat
 2. Lug Style to control flow with piping on one side of valve.
 3. Stem – 316 Stainless Steel
 4. Disc – 316 Stainless Steel
 5. Seat – EPDM, Buna N
 6. O-Ring Seals – EPDM, Buna N

7. Operator – Cast Iron, Steel Handle, or operating wheel
8. 150 P.S.I. pressure rating @73° F.
9. Excluded Manufacturers: Bray International

D. Check Valves

1. Body and Cover – Ductile Iron ASTM A 536
2. Rubber Flapper – Buna N internally reinforced with Steel
3. Removable without removing valve.
4. Bolt Pattern – ANSI ASME B-16.5 CL150.

E. Gate Valves

1. Type - Resilient wedge gate valve, open arrow indicator cast on body.
2. Stem – Non-rising type
 - a. Assembly – Cast Bronze per AWWA
 - b. Stuffing Box – O-Ring seal type with 2 rings above thrust collar, replaceable under full working pressure with valve open.
 - c. Stem nut – Solid Bronze, independent of wedge.
3. Actuator - Hand wheel activator - above ground installations; two (2) inch square AWWA operating nut for underground installations.
4. Coating – Epoxy for above ground gate valves, supply a 2” AWWA nut adapted hand wheel. Fusion coating of body and bonnet interior and exterior per C550.
5. Wedge - Cast iron completely encapsulated with rubber permanently bonded per ASTM D429.
Testing - hydrostatic pressure equal to twice the specified working pressure.

F. Pinch Valves

1. Type - Manually Operated Pinch Valve, cast iron fully enclosed body, epoxy lined and coated, ASME B16.1 Class 125, with flanged ends.
2. Minimum working pressure - 90 psi.
3. Sleeve – Elastomer one piece molded Buna-N, EPDM, or Viton construction with integral flanges drilled to be retained by the flange bolts. All internal valve metal parts are to be completely isolated from the process fluid by the sleeve trim.
4. Port area - 100% of the full pipe area at the valve ends.
5. Mechanism - steel mechanism that shall be double acting with pinching of the sleeve trim occurring equally from two sides. ACME threads shall be used on all valve mechanisms. There shall be no cast parts in the operating mechanism.
6. Stem - non-rising and have a non-rising hand wheel. The hand wheel shall be fitted with a lubrication fitting to allow lubrication of the stem. A valve position indicator rod shall pass through the center of the stem, retaining bolt, and hand wheel to provide visual position indication.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify elevations of pipe and structures confer with plans.
- C. Examine valves and appurtenances for defects or damage.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION - VALVES

- A. Review installation location and access for operation after installation.
- B. Install in orientation noted on the plans, or as necessary for operation.
- C. Position for full actuation of the handle or operating mechanism.
- D. Support valves as detailed on plans to ensure stress is not placed on the adjacent pipe.
- E. Install valves so a water tight seal is provided at all joints.

END OF SECTION

SECTION 15131
OXYGEN DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Design, supply and install Oxygen distribution piping as required to connect the existing bulk oxygen supply at the Oxygen Control Panel to the Low Head Oxygenator™ (LHO) unit and to the culture tank oxygen diffusers. Included in this specification are the two oxygen diffusers, and associated rotometers and tubing at each fish culture tank
- B. Related Sections:
 - 1. Section 03300 - Piping: General
 - 2. Section 13209 - FRP Culture Tanks
 - 3. Section 13211 - Low Head Oxygenator
 - 4. Section 17225 – Control Panels.

1.2 REFERENCES

- A. Commercial Standards.
 - 1. ASME American Society of Mechanical Engineers
 - a. B16.22 - Wrought Copper and Bronze Solder – Joint Pressure Fittings
 - b. B.16.23 - Cast Bronze Solder Joint Drainage Fittings - DWV
 - c. B16.24 - Bronze Flanges and Flanged Fittings, 150 and 300 lb.
 - d. B.16.26 - Cast Bronze Alloy Fittings for Flared Copper Tubes
 - 2. ASTM American Society for Testing and Materials
 - a. B32 - Standard Specification for Solder Metal
 - b. B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes
 - c. B306 - Standard Specification for Copper Drainage Tube -DWV
 - 3. AWS American Welding Society
 - a. A5.8 - Specification for Filler metals for Brazing and Braze Welding

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Products to be supplied by the Contractor shall be approved by the purchasing agent prior to procurement. Approval will be by return of stamped approved product data sheets as described below.
- C. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalog information. Indicate relevant data and ratings.

- D. Shop Drawings
 - 1. Provide layout drawings of all underground piping systems. Indicate all fittings, valves, supports, interceptors, clean outs, low point drains and piping material.
 - 2. Provide layout of all above ground piping systems. Indicate all valves, fittings, supports and invert elevations.
- E. A minimum of two (2) copies of special tools and operating keys shall be furnished to the owner. Supply any spare parts provided by the manufacturers at the time of equipment purchase.
- F. Maintain one (1) record set of the construction documents in good condition at the site. Mark on them the exact "as-built" arrangement including locations of all valves and other equipment. On or before the date of the final inspection, deliver one (1) set of "as-built" documents to the Owner. The delivery of the documents shall not relieve the Contractor of the responsibility of furnishing required information that may have been omitted from the documents.
- G. Upon completion of the work, submit the following before final acceptance and payment:
 - 1. Certification of pressure testing signed by contractor's representative and owner's representative indentifying that oxygen distribution equipment has successfully passed testing requirments in the presence of witnesses acceptable to the owner.

1.4 QUALITY ASSURANCE

- A. Materials and workmanship shall be in accordance with the local codes and ordinances of legally constituted authorities; where provisions of these specifications exceed such requirements, these specifications shall govern.
- B. Contractor furnished materials and equipment shall comply with industry standards, at a minimum, except when the materials and equipment specified herein require more restrictive tolerances, more rigid standards or a more precise workmanship.
- C. All work shall be performed by personnel qualified to produce workmanship of the specified quality. Contractor must demonstrate experience installing oxygen distribution plumbing.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. The ENGINEER reserves the right to reject delivery of the equipment, if found upon inspection, to have any cracks, foreign matter, surface porosity, sharp discontinuity, defects of workmanship or other damage as per SECTION 01400 – QUALITY REQUIREMENTS

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturer(s) or Suppliers are as follows:
 - 1. Aquatic Ecosystems
 - 2. Air Liquide
 - 3. Praxair
 - 4. Or approved equal

2.2 MATERIALS

- A. All tubing shall comply with ASTM B 819 standards, Type K or L. Type K shall be used for systems having an operating pressure of 200 psig or greater. Distribution is to be as per the configuration shown on the drawings. Each length of tube shall be suitable for oxygen service, be permanently labeled and delivered plugged, capped or otherwise sealed to prevent contamination of internal surfaces. Plugs, caps or other seals shall remain in place until final assembly. Mechanical connections must not be used on any tubing located below grade.
- B. Install condensation blow-off ports at all low points along distribution piping.
- C. All fittings and valves to be of all-brass construction and comply with ASME B16.22 standards, cleaned for oxygen service. Fittings shall be delivered plugged, capped, bagged or otherwise sealed to prevent contamination of internal surfaces. Plugs, caps, bags or other seals shall remain in place until final assembly.
- D. Where two or more valves or other fittings of the same type or size are required, the fittings shall be furnished by the same Manufacturer.
- E. All brazed joints shall be brazed using an AWS A5.8 BCuP Series filler metal, except joints between dissimilar metals, which shall be fabricated using BAg series brazing filler metals and brazing flux.
- F. All hose shall be green in color, smooth, EPDM rubber. Hose to meet RMA specifications for Grade R, Type S.

2.3 EQUIPMENT

- A. Oxygen diffusers for Circular Tanks
 - 1. Fine or Ultra-finepore Diffusers not less than 12 inches long and with a minimum rated capacity of 1 cfm.
 - 2. Two diffusers per tank
 - 3. Sweetwater AS300 or equivalent.
 - 4. Approved manufacturers or suppliers:
 - a. Aquatic Ecosystems
- B. Oxygen diffusers for Rectangular Tanks

1. Fine or Ultra-finepore Diffusers not less than 3 inches long and with a minimum rated capacity of 1 cfm.
 2. Two diffusers per tank
 3. Sweetwater AS80 or equivalent.
 4. Approved manufacturers or suppliers:
 - a. Aquatic Ecosystems
- C. Rotometer for Circular Tanks
1. Suitable for Oxygen at atmospheric pressure.
 2. One per tank, installed complete with a "Y" fitting to two isolation valves and two barb fittings (refer to Phase 1 tank installation for preferred configuration).
 3. Flow range 3 to 30 lpm.
 4. Approved manufacturers or suppliers:
 - a. Key Instruments
 - b. Western Medical
- D. Rotometer for Rectangular Tanks
1. Suitable for Oxygen at atmospheric pressure.
 2. One per tank, installed complete with a "Y" fitting to two isolation valves and two barb fittings (refer to Phase 1 tank installation for preferred configuration).
 3. Flow range 2 to 20 lpm.
 4. Approved manufacturers or suppliers:
 - a. Key Instruments
 - b. Western Medical

PART 3 EXECUTION

3.1 GENERAL

- A. Warranties for materials and workmanship for all equipment and accessories as specified in this section are to be valid for a period of not less than one (1) year, starting from the final acceptance by the OWNER.
- B. Brazing and installation:
1. Brazers shall be qualified in accordance with the requirements of NFPA 99
 2. Brazing flux shall not be used in joints between copper tube and ASME B16.22 fittings.
 3. During installation care shall be taken to avoid contamination of interior "cleaned for oxygen service" surfaces of piping system components. Joints shall be brazed within one hour of being cleaned.
 4. In applications where copper tube must be joined to brass or bronze system components brazing flux shall be applied sparingly to the exterior surface of the tube. Brazing flux shall not be applied to the interior surfaces of the fitting.

5. While being brazed, joints shall be continuously purged with a positive flow of oil-free dry nitrogen to prevent the formation of copper oxide on the interior surface of the joint. The flow of purge gas shall be maintained until the joint is cool to the touch.
6. During and after installation, openings in the piping system shall be kept capped, plugged or sealed to avoid unnecessary loss of purge gas while brazing and to prevent contamination of the system. During brazing, a discharge opening shall be provided on the opposite side of the joint from where the purge gas is being introduced. After brazing, this discharge opening shall be capped, plugged or sealed to prevent contamination of the system.
7. Field fabricated, mechanically formed tees/outlets and couplings shall not be used.
8. Brazed joints shall be allowed to cool to the touch naturally and shall not be shock cooled. After cooling, all joints shall be cleaned with water and a stainless steel wire brush to remove any residue and permit clear visual inspection of the joint. Where flux has been permitted, hot water shall be used.
9. Mechanical joints shall not be used in below ground applications. All joints and connections below ground level must be brazed
10. Mechanical connections may be used in above grade applications where joints can be accessed for inspection and repair
11. Local low point drains are required throughout the distribution system. Low point drains shall be a tight sealing, repairable or replaceable plug or ball valve which is easily accessible to operators. Where topography prevents installation of low point drains in above grade locations, a valve vault shall be provided complete with a tight sealing lid and with provision for draining of any accumulations of water.
12. Anti-siphon loops are to prevent backflow of water from equipment into oxygen distribution plumbing and are to exceed the normal water level at equipment by 2 feet.

C. Material cleaning requirements:

1. Fittings, tube, valves, and piping system components shall be cleaned for oxygen service in accordance with Compressed Gas Association (CGA) Pamphlet G-4.1. Cleaning shall be performed by the manufacturer or a facility equipped to clean, rinse, and purge the material in accordance with CGA Pamphlet G-4.1.
2. Immediately before final assembly, fittings, tube, valves, and piping system components shall be visually examined internally for contamination. Material that has become contaminated shall not be installed.
3. On-site cleaning of the interior surfaces of fittings, tube, valves, and piping system components shall be limited to recleaning surfaces in the immediate vicinity of the joints that have become contaminated prior to brazing. These surfaces shall be cleaned by washing in a clean, hot water/alkaline solution such as sodium carbonate or trisodium phosphate (1 lb. to 3 gal. of potable water). Interior surfaces shall be thoroughly scrubbed and rinsed with clean, hot, potable water.

4. Cleaning materials must not be allowed into the acrylic oxygen flow meters unless the contractor confirms prior to use that no damage could be sustained in the cleaning process.

3.2 PERFORMANCE

- A. Design
 1. The minimum inside diameter of all oxygen distribution piping, tubing and associated fittings shall be 1/4 inches.
 2. Net losses through the oxygen distribution system from the bulk oxygen distribution panel to the LHO control panel shall not exceed 2 psi when the LHO is operating at design capacity. The maximum net losses through the oxygen distribution system from the bulk oxygen distribution panel to the oxygen diffusers shall not exceed 20 psi. Pipe and fittings must be sized appropriately.
 3. The maximum operating pressure in the oxygen distribution system is 50 psi.
 4. Isolation valves shall be provided at the inlet to all oxygen control panels and immediately preceding any transition from copper tubing to hose.

3.3 SYSTEM START-UP AND COMMISSIONING

- A. The contractor shall make arrangements to have the owner's representative present when the oxygen distribution system is pressure tested.
- B. The Oxygen distribution system shall be pressure tested (using compressed gas (oil and grease free) with the tubing to equipment closed off) to 100 psi for not less than 1 hour. Pressure drop shall not exceed 2 psi. System must be cleaned after pressure testing.

END OF SECTION

DIVISION 16 - ELECTRICAL

16050	Common Work Results For Electrical
16060	Grounding And Bonding For Electrical Systems
16071	Hangers And Supports For Electrical Systems
16072	Vibration And Seismic Controls For Electrical Systems
16075	Identification For Electrical Systems
16120	Low-voltage Electrical Power Conductors And Cables
16130	Raceway And Boxes For Electrical Systems
16140	Wiring Devices
16145	Lighting Control Devices
16410	Enclosed Switches And Circuit Breakers
16420	Enclosed Controllers
16443	Motor-starter Panel
16511	Interior Lighting

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SECTION 16050

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Electrical equipment coordination and installation.
 2. Sleeves for raceways and cables.
 3. Sleeve seals.
 4. Grout.
 5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 16050

SECTION 16060

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid or stranded conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

- E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- F. Correct deficiencies of grounding system.

END OF SECTION 16060

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SECTION 16071

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
- B. Related Sections include the following:
 - 1. Division 16 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 2. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for

steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt or single-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION 16071

SECTION 16072

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Channel support systems.
- B. Related Sections include the following:
 - 1. Division 16 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
 - a. Component Importance Factor:
 - 1) General: 1.0.
 - 2) Life Safety (EM): 1.5
 - b. Component Response Modification Factor:
 - 1) Fixtures: 1.0
 - 2) Equipment: 2.5
 - 3) Conduit and Cables: 5.0.
 - c. Component Amplification Factor: 2.5.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 173%.
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: 76%.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. Loos & Co.; Seismic Earthquake Division.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
 - 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining

cable service; and with a minimum of two clamping bolts for cable engagement.

- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- F. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Verify snubber minimum clearances.
 - 7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 16072

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SECTION 16075

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Identification for conductors.
 2. Instruction signs.
 3. Equipment identification labels.
 4. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.2 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White
 - 5) Ground: Green
 - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

- C. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
- E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Enclosures and electrical cabinets.
 - b. Access doors and panels for concealed electrical items.
 - c. Motor-starter panels.
 - d. Enclosed switches.
 - e. Enclosed circuit breakers.
 - f. Enclosed controllers.
 - g. Contactors.

END OF SECTION 16075

SECTION 16120

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
- D. Multiconductor Cable: Comply with NEMA WC 70 for Type SOW with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders: Type THHN-THWN, single conductors in raceway.
- B. Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- C. Cord Drops and Portable Appliance Connections: Type SOW, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- D. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- E. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips,

that will not damage cables or raceway.

- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 16 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

END OF SECTION 16120

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SECTION 16130

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
- C. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces

specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For professional engineer and testing agency.

E. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel Aluminum Zinc-coated steel or aluminum.

- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Fittings for EMT: Steel or die-cast, compression type.
 - 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 3R, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with

wireways as required for complete system.

- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum or galvanized, cast iron with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 4, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Stainless steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass or Plastic.
- G. Cabinets:
 - 1. NEMA 250, Type 4, fiberglass or stainless-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid steel conduit.
 - 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Dry Locations, Not Subject to Physical Damage: EMT.
 - 2. Exposed and Subject to Physical Damage: Rigid steel conduit
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 5. Damp or Wet Locations: Rigid steel conduit.
 - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel or nonmetallic in damp or wet locations.

- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- C. Complete raceway installation before starting conductor installation.

- D. Support raceways as specified in Division 16 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from RNC, Type EPC-40-PVC to rigid steel conduit before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit forequipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations.
- N. Set metal floor boxes level and flush with finished floor surface.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

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SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches and wall-box dimmers.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.4 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following

manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Hubbell
 - c. Leviton
 - d. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

2.5 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.8 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and

listed and labeled for use in "wet locations."

- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.9 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 16140

SECTION 16145

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches.
 - 3. Lighting contactors.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls; a Genlyte Company.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).

- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
4. Astronomic Time: All channels.
5. Battery Backup: For schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Novitas, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.

8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. GE Industrial Systems; Total Lighting Control.
5. Square D; Schneider Electric.

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Division 16 Section "Low-

Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 16 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 16 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 16 Section "Network Lighting Controls."

END OF SECTION 16145

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SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonfusible switches.
 - 2. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual

- overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- 1.6 QUALITY ASSURANCE
- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- 1.7 PROJECT CONDITIONS
- A. Environmental Limitations: Rate equipment for continuous operation under the

following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, rotator handle with capability to accept padlocks, and interlocked with cover in closed position.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 16 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION 16410

SECTION 16420
ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage magnetic.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
- F. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers;.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.9 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers:

1. Comply with NEMA ICS 2, general purpose, Class A.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.

B. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Configuration: Nonreversing.
2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic or melting alloy type.
3. Surface mounting.
4. Green pilot light.
5. Two, reversible N.O./N.C. auxiliary contacts.

C. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Configuration: Nonreversing.
2. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

4. Control Circuits: 24 120-V ac; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 50 VA.
 5. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 20 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 6. External overload reset push button.
- D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R.
 3. Other Wet or Damp Indoor Locations: Type 4.
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.

- a. Push Buttons: Unguarded types; momentary as indicated.
 - b. Pilot Lights: LED types; colors as indicated.
 - c. Selector Switches: Rotary type.
- B. Reversible N.C./N.O. auxiliary contact(s) (2 minimum per unit).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."
- B. Seismic Bracing: Comply with requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Division 16 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Test continuity of each circuit.
 3. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Owner before starting the motor(s).
 4. Test each motor for proper phase rotation.
 5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies

detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Owner before increasing settings.

3.7 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 16420

SECTION 16443

MOTOR-STARTER PANEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes motor-starter panels for use on ac circuits rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of controller and each type of motor-starter panel. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each motor-starter panel.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current ratings of buses and installed units.
 - d. Vertical and horizontal bus capacities.
 - e. UL listing for series rating of overcurrent protective devices in combination controllers.
 - f. Features, characteristics, ratings, and factory settings of each motor-starter panel unit.
 - 2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-starter panel. Provide schematic wiring diagram for each type of controller.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around motor-starter panels where pipe and ducts are prohibited. Show motor-starter panel layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

- D. Manufacturer Seismic Qualification Certification: Submit certification that motor-starter panels, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For manufacturer.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For motor-starter panels, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for motor-starter panels and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain motor-starter panels and controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-starter panels, including clearances between motor-starter panels, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver motor-starter panels in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

1.6 COORDINATION

- A. Coordinate layout and installation of motor-starter panels with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate features of motor-starter panels, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each motor-starter panel, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - 2. Danfoss Inc.; Danfoss Electronic Drives Div.
 - 3. Eaton Corporation; Cutler-Hammer Products.
 - 4. General Electric Company; GE Industrial Systems.
 - 5. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.

6. Siemens/Furnas Controls.
7. Square D.

2.2 MOTOR-STARTER PANELS

- A. Enclosures: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 1. Indoor Wet or Damp Locations: NEMA 250, Type 4.
- B. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-starter panel location.

2.3 BUSES

- A. Material: Plated hard-drawn copper, 98 percent conductivity or Tin-plated aluminum.
- B. Ampacity Ratings: As indicated for horizontal and vertical main buses.
- C. Neutral Buses: Full size.
- D. Equipment Ground Bus: Noninsulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure.
- E. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.4 FUNCTIONAL FEATURES

- A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-starter panel.
- B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.
 1. Controller Disconnecting Means: Factory-assembled combination disconnect and controller.
 - a. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- C. Transient Voltage Surge Suppressors: Connect to motor-starter panel bus.

2.5 ACROSS-THE-LINE CONTROLLERS

- A. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-

button action; marked to show whether unit is off, on, or tripped.

1. Configuration: Nonreversing.
 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic or melting alloy type.
 3. Surface mounting.
 4. Green pilot light.
 5. Two, reversible N.O./N.C. auxiliary contacts.
- B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
1. Control Circuit: 120 V; obtained from integral control power transformer with a control power source of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
 2. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

2.6 FEEDER OVERCURRENT PROTECTION

- A. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

2.7 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

- C. Control Relays: programmable relays.

2.8 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested, motor-starter panels before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive motor-starter panels for compliance with requirements, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each motor-starter panel assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor-starter panel mounting surface.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

3.4 IDENTIFICATION

- A. Identify motor-starter panel, motor-starter panel components, and control wiring according to Division 16 Section "Identification for Electrical Systems."
- B. Operating Instructions: Frame printed operating instructions for motor-starter panels, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of motor-starter panels.

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 16 Section "Grounding and Bonding for Electrical Systems."

3.7 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain components of motor-starter panels including solid-state controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 16443

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SECTION 16511
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. Ballast.
 - 4. Energy-efficiency data.
 - 5. Life, output, and energy-efficiency data for lamps.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate

dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power wiring.

- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- D. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
 4. Laminated Silver Metallized Film: 90 percent.
- F. Plastic Diffusers, Covers, and Globes:
 1. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 BALLASTS FOR HID LAMPS

- A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
 1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: .90 or higher.
 7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 8. Protection: Class P thermal cutout.

2.4 HID LAMPS

- A. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Adjust aimable lighting fixtures to provide required light intensities.
- C. Connect wiring according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16511

SECTION 17225
CONTROL PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. This section states minimum requirements modification of the existing facility instrumentation and control equipment to accommodate the requirements of the phase 2 module. This includes the following:
 - 1. Remove the existing phase 1 early rearing conductivity probe
 - 2. Remove the existing phase 1 grow out conductivity probe
 - 3. Relocate the existing phase 1 dissolved oxygen probe
 - 4. Add a phase 2 dissolved oxygen probe
 - 5. Add a phase 2 low flow sensor
 - 6. Add a phase 2 oxygen control panel
 - 7. Reprogram the existing monitoring and alarm panel to accommodate the revised instrumentation.

- B. Related Sections:
 - 1. Division 16 - Electrical
 - 2. Section 13150 – Aquaculture Systems
 - 3. Section 15131 – Oxygen Distribution

1.2 REFERENCES

- A. JIC - Joint Industrial Council Std. EGP-1-1967
- B. NEMA - Standard IC-15
- C. UL - Standard UL 508
- D. NFPA - National Fire Prevention Association
- E. ISA - Standard RP 7.2

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.

- B. All documentation shall be submitted in accordance with the Instrument General Provisions. This shall include:
 - 1. One reproducible set of electrical materials list. List shall contain manufacturer's nameplate date, catalog number, operating voltage or current, or other information required to completely specify each component. This list shall be submitted to Engineer prior to purchase for approval.
 - 2. Shop Drawings:

- a. detailed shop drawings shall be submitted to Engineer before obtaining any materials.
- b. shop drawings shall include:
 - assembly outline drawings (structural steel)
 - panel cut-out locations and sizes
 - back panel instrument location
 - electrical point to point wiring diagrams to show detailed internal wiring and outgoing wiring to field devices..

1.4 QUALITY ASSURANCE

- A. Codes and Standards
 1. All material and installation shall be in accordance with this section and the latest revisions of the following:
 - a. NEC - National Electric Code
 - b. NEMA - National Electrical Manufacturer's Assoc.
 - c. U.L. - Underwriters Laboratories, Inc.
 - d. JIC - Joint Industrial Council.

1.5 INSPECTION AND TESTING

- A. At 100 percent completion, the panel and control instruments will undergo a complete inspection and functional test. Tests shall include, but not be limited to the following:
 1. Each instrument component and each instrument system shall be tested for proper functional operation.
 2. All electrical components shall be tested for proper operation at design voltage and frequency.
 3. Functional system check of all interlock and sequencing control systems.
 4. Other test normally performed by the panel manufacturer
- B. The manufacturer shall provide all test equipment and manpower required for testing and inspection. The Engineer shall notify the manufacturer of any special equipment required.
- C. Vendor shall submit to Engineer three copies of all inspection and test reports

1.6 SERVICE ARRANGEMENT

- A. Manufacturer's services specified and required for contractor purchased equipment, shall be arranged for, contracted by, and paid for by the Contractor

1.7 EQUIPMENT PROTECTION

- A. Contractor shall be responsible for all damage and defacement, whether functional or non functional, to all items of contractor purchased equipment from the time it is unloaded, during installation, and during period of beneficial use, and until installation is accepted by the Owner; and Contractor, shall, at Contractor's own expense, repair or replace, or cause to be repaired or replaced, any and all such damage and/or defacement.

- B. Contractor is responsible for ensuring no interruption to the phase 1 monitoring and control functions of the equipment during the installation of the phase 2 facility other than those permitted by the facility owner.

1.8 COORDINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.

PART 2 PRODUCTS

2.1 GENERAL

- A. All equipment must match in materials and components the existing instrumentation and control equipment.
 - 1. Approved suppliers or manufacturers
 - a. Point Four Systems Inc, 1-800-267-9936
- B. System Performance:
 - 1. Supplied equipment shall be capable of providing real-time monitoring and data-logging of dissolved oxygen (DO), Temperature, Electrical Conductivity (EC) and pH as well as provide alarm relays low system flow and low level water conditions in the sump.

2.2 MONITORING AND ALARM PANEL AND ASSOCIATED PROBES

- A. The existing monitoring and alarm panel must be modified as follows:
 - 1. Remove the two existing conductivity probes (as needed to provide room for new DO probe and flow switch).
 - 2. Relocate one dissolved oxygen probe
 - 3. Add one dissolved oxygen probe
 - 4. Add one low flow switch
 - 5. Connect alarm panel to oxygen control panel.
 - 6. Revise internal programming as required to accommodate the changes to the probes and signals
- B. Existing Oxygen probe
 - 1. To be relocated to the existing drum filter inlet chamber.
- C. Oxygen probe
 - 1. Operating range 0-60 mg/L
 - 2. Suitable for installation in a pipe.
 - a. Installed in the discharge pipe from the new drum filter
 - 3. Oxyguard Type III Oxygen Probe.
- D. Low flow switch
 - 1. Paddle style switch which detects when flow rates are greater than or less than 0.5 feet per second

2. Stainless steel
3. Suitable for installation in a pipe.
 - a. Installed in the discharge pipe from the new drum filter
4. Gem Sensors model F-550 series.

2.3 OXYGEN CONTROL PANEL

- A. The oxygen control panel shall include two solenoid valves and one 3 to 30 lpm variable area rotometer calibrated for oxygen plus all associated valves and fittings mounted on a single PVC panel to match the existing oxygen control panel.
- B. Provide an isolation valve on the supply from the bulk oxygen system.
- C. Program the solenoid valve controls so that the oxygen supply to the phase 2 module LHO should stop if the flow of water in the phase 2 module is not detected.
- D. Program the solenoid valve controls so that the oxygen supply to the phase 2 module culture tank diffusers should start in the event of a low oxygen signal from the phase 2 dissolved oxygen probe, if the phase 2 module flow stops, or if there is a power outage.
- E. Provide a piped bypass around the solenoid valve to the culture tank diffusers including isolation valves so that oxygen can be supplied in the event that the solenoid valve fails. Include isolation valves on either side of this solenoid valve so that a flow of oxygen can be supplied to the culture tanks during repair or replacement of the solenoid valve. The pipe and fitting assembly must be designed so that the solenoid valve can be repaired or replaced without jeopardizing the supply of oxygen to the culture tank diffusers.
- F. Provide an isolation valve before the solenoid valve on the oxygen supply to the LHO and design the piping so that the solenoid valve can be repaired or replaced without interrupting oxygen flow to the phase 2 culture tank diffusers.
- G. Provide nameplates on each oxygen service.

PART 3 EXECUTION

3.1 OXYGEN CONTROL PANEL

- A. The oxygen panel board shall be installed adjacent to the existing oxygen control panel.

3.2 PREPARATION

- A. The oxygen control panel must be cleaned for oxygen service as described in section 15131 before activation.

END OF SECTION

LOGAN FES WARM WATER
HATCHERY FACILITY PHASE II
DFCM PROJECT # 09167520