SECTION 13065

PREFABRICATED WALK-IN FREEZER

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The work includes furnishing all labor, materials, and equipment for the installation of the prefabricated walk-in freezers as shown on the Drawings and as specified herein.

1.2 SUBMITTALS

A. Make all submittals in accordance with SECTION 01340.

B. Submittals shall contain complete dimensions and interface requirements including piping and electrical requirements.

C. Shop drawings shall cover all details of doors, frames, refrigeration components, wall sections, ceiling and all other manufactured items.

D. Supply five (5) separately bound copies of operating, maintenance and lubrication instruction manual including complete parts lists of the refrigeration system in accordance with the requirements of SECTION 01730.

E. A complete set of installation instructions shall be included with the walk-in. These instructions shall cover the erection and assembly of the walk-in and the installation of refrigeration systems. A floor plan print shall be included.

1.3 GUARANTEES

A. Manufacturer shall warrant that any part of installed walk-in freezer, including the refrigeration system and its related accessories, is free from defects in material or workmanship under normal use and service. Manufacturer shall be obligated to repair or replace any part of this equipment which proves to be defective within the period of five (5) years from the date of acceptance of the Certificate of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver walk-in freezer and refrigeration system to the job-site as close to time of installation as possible.

B. Store walk-in freezer and refrigeration system in an enclosed space adequately protected from weather, condensation and damage.

C. Any damage occurring to walk-in freezer and refrigeration system prior to acceptance shall be repaired or replaced at no additional cost to the Owner.

1.5 ABBREVIATIONS

A. N.S.F.: National Sanitation Foundation.

PART 2 PRODUCTS

2.1 WALK-IN FREEZER

A. General: Freezer size and configuration shall be designed to fit into the space indicated on the Drawings and in the specific product section of this spec. The Contractor shall verify all dimensions and interferences prior to fabrication.

B. Panel construction: Wall and ceiling panels shall consist of interior and exterior metal pans insulated with 4 inch thick minimum rigid urethane foam with a minimum R value of 32. Panels shall be made without internal wood or metal structural members and shall maintain a complete break in metal to metal continuity across the internal and external surfaces after freezer is installed. Panel edge must have tongues and grooves "foamed in place" to assure tight joints. A flexible vinyl gasket shall be fitted on the interior and the exterior of each panel along every tongue edge to provide gasketing at each joint. Ninety-degree angled panels shall be provided for each corner.

C. Wall and ceiling panels as indicated in Drawings and as specified herein.

D. Interior and exposed exterior walls shall have 22 gauge Type 304 stainless steel, #4 finish.

E. Exterior walls and ceilings that are not exposed shall have 26 gauge Galvanized steel finish.

F. Freezer floor will be an insulated concrete slab provided by the Contractor as shown on the Drawings.

G. Panel locking assemblies. Assembly of walk-in shall be accomplished by Posi-Locs. Posi-Locs shall be foamed-in-place and activated by a hex wrench provided by the manufacturer. Access ports to locking devices shall be covered by snap caps. Access ports shall be on interior to allow assembly of walk-in from the inside.

H. Section gaskets. N.S.F. listed gaskets shall be foamed-in-place to the male side of all panels, on both interior and exterior. Gaskets shall be impervious to stains, greases, oils, mildew, etc.

I. Door shall be equipped with flexible rubberized gasket, door closure and latch. Hardware has provisions for locking and a safety release which prevents entrapment of personnel with the box.

J. Door jamb shall be made of metal clad wood.

K. Each entrance door section shall be provided with an incandescent type vapor-proof light, pilot light switch and conduit between switch box and outlet box. Concealed wiring shall be standard on each entrance door section.

L. A threshold with non-skid striping shall be provided with each door section. Heater wire shall continue beneath the threshold.

M. A single 2" dial thermometer shall be attached to the building's interior entrance door jamb to indicate the temperature inside the freezer box. The thermometer shall be flush mounted of a field replaceable design with a temperature range of -60˚F to 80˚F.

N. N.S.F.: All walk-ins shall be fabricated to comply with National Sanitation Foundation No. 7. The N.S.F. label shall be affixed to the interior door pan. All interior corners, including floor shall be covered.

O. Air vent: A Tri-Action air vent shall be provided to equalize pressure between the interior and exterior, caused by sudden temperature changes due to door openings and evaporator defrosting. The vent shall be heated to prevent moisture and/or frost accumulation.

P. Drain lines: Installing contractor shall provide suitable drain lines from all evaporators. Drains shall be trapped outside the walk-in. Freezer drains shall be copper tubing and shall be heated and insulated to prevent freeze-up. All plumbing to be in accordance with local codes.

Q. Entrance door shall be located as shown on the Drawings. The door shall be a 60”x84” single, manually operated sliding door with finish to match wall. Door and door section shall be listed by Underwriters Laboratories (UL).

R. Operating electrical power: 460 V/3/60 provided by a single electrical service. The box lighting, drain and door heaters, and ETC can be connected to 120 volt power. See section 2.3.C for evaporator fan power.

S. Provide all structural supports required for ceiling panel intermediate supports. Structural design must be stamped by Engineer registered in the State of Oregon.

T. Freezer manufacturer to provide fluorescent lighting approved for freezer applications, to be installed on site by Contractor.

2.2 ACCEPTABLE MANUFACTURERS

A. Imperial Manufacturing
2271 NE 194th
Portland, OR 97230

B. Kalt Manufacturing Co., Inc.
Portland, OR 97217

C. Wilderman Refrigeration Co.
Seattle, WA 98109

2.3 REFRIGERATION SYSTEM

A. All refrigeration equipment shall be essentially the standard products of a reputable manufacturer and shall be of the best quality used for the purpose in commercial practice. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the system need not be of the same manufacturer. Each major component shall have the manufacturer's name, address, and catalog number on a metal plate securely affixed in a conspicuous place.

1. All components shall be guaranteed by the manufacturer to be suitable for use as indicated in the Drawings and as specified herein.

2. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other moving parts located where any person may come in close proximity to shall be fully enclosed or properly protected per OSHA standards.

B. Freezer condensing unit: Freezer condensing unit shall be a stand alone, frame mounted, air cooled preassembled remote condensing unit sized to provide a minus 10˚F box temperature with 120˚F condensing temperature. This condensing unit shall operate on 460 volt 3 phase power, and is to be installed on the ground outside of the freezer box in a weather proof enclosure, and shall be supplied with a “low ambient” operation option suitable to -30˚F ambient.

1. Compressor: Compressor shall be semi-hermetic low temperature design and have a maximum rating of 8 HP or less. The compressor shall be supplied with oil pressure safety switches, motor winding safeties and crank case heater with controls. Compressor starter overload shall have double lugs to provide a connection point for field connected power factor correction capacitors.

2. Condensing coil and fan: The condensing unit shall have an integral air cooled condensing coil sized for 115% design capacity and a "head-pressure" controlled electric fan sized for the coil (115% of condensing unit capacity).

3. Refrigerant receiver: The condensing unit shall have a refrigerant receiver tank sized to hold 100% or greater of the system's calculated refrigerant volume. The receiver tank shall be valved to isolate and store the complete refrigerant charge for system maintenance.

4. Refrigerant accumulator: The condensing unit shall have a suction-line accumulator with a liquid refrigerant subcooling coil to subcool the refrigerant going to the evaporator and to also provide a heat source to evaporate any liquid refrigerant in the suction line.

5. Filter/dryers: The condensing unit shall have replaceable cartridge type refrigerant filter/Dryer in the liquid line with a moisture sensing sight glass. A separate suction line cartridge filter element. Both filter cartridges shall be supplied with isolation valves.

6. Condensing unit operational controls: The condensing unit shall have a dual pressure control to operate the compressor. A separate "head-pressure" control to operate the condenser fan.

7. Condensing unit safeties: The condensing unit shall have as a minimum (but not limited to) the following safety switch controls:

    a. High refrigerant "Head-Pressure" shut-off with manual reset.

    b. Low compressor oil pressure switch with manual reset.

    c. Both switches shall have an indicator light to aid in trouble shooting a system shutdown.

8. Over pressure devices: The compressor's "Hot Gas" circuit shall have a relief valve and the receiver shall have a burst disk. Both devices shall discharge outside the condenser unit housing.

9. Vibration isolation: The compressor shall be mounted on vibration isolator mounts as recommended by the manufacturer and the condensing unit frame shall be mounted on vibration isolation pads. All piping and wiring conduit connecting to the compressor shall be installed with vibration isolation flexible connections.

C. Freezer evaporator unit: Freezer evaporator shall have inner fin coil, copper sheathed electric defrost heating elements, propeller fans, heavy-duty motor designed for low temperatures, bonderized sturdy metal base with finished paint coat, galvanized mounting channels and hanger bolts, electric drain pan, heating pad, super heater, timer, motor starter, and contractor. Evaporator unit shall operate on 460 volt, single phase power.

D. Thermostats: One remote bulb thermostat shall be provided and installed for the freezer room. Thermostats shall be line voltage type for 120-volt, 1-phase service, range -50°F to +50°F. Thermostats shall be Minneapolis-Honeywell, White-Rogers, Barber-Coleman or Johnson.

E. Gauges and gauge board: Gauges for suction and liquid lines shall be for refrigeration service 3-1/2 inch diameter, surface mounted with 5 lb. major graduations and 1 lb. minor graduations. Gauges shall be Ashcroft, Marsh, or U.S. Gauge Company. Gauges and thermometers shall be mounted on a 5/8 inch marine plyboard, gauge board painted to match equipment. All instruments and gauges shall be provided with plastic nameplates identifying unit and function. Gauge board to be mounted on the inside of the condensing unit's cover.

F. Piping: Suction, liquid line and drain line shall be copper tube of the sizes determined by the manufacturer with solder fittings. All piping shall be cleaned and firmly supported free from leaks, and installed in a neat workmanlike manner and in all respects in keeping with the best trade practice. Drain lines in refrigerated spaces shall have electrical heat tape wrapped thereon of sufficient capacity to prevent freezing and insulated. A manufacturer approved filter/drier and a sight glass shall be installed on the liquid line as a part of paragraph 2.2.B.6 of this section.

F. Pipe insulation: Suction lines outside cold spaces shall be insulated in accordance with SECTION 15250 after testing.

H. Provide a relay for a freezer warm alarm, with battery backup. Set to alarm at +30°F.

PART 3 EXECUTION

3.1 INSTALLATION OF EQUIPMENT AND ACCESSORIES, AND TESTING

A. Installation: A complete set of instructions covering both assembly of the walk-in freezer and installation of the refrigeration equipment shall be supplied by the manufacturer and shall be strictly followed. Installation shall be complete and ready for use.

B. Refrigerant piping:

1. Evacuation and testing equipment: Provide a 2-stage high-vacuum pump with clean oil, capable of pumping down to 0.08 millimeters of mercury (95 microns), and a closed-end mercury manometer, thermocouple, or thermistor vacuum, gauges.

2. Install refrigerant piping in accordance with the recommendations of the manufacturer.

3. Install refrigerant circuit piping with accessories and to configuration as shown on the drawings.

4. Support and anchor piping to adequately prevent sagging and vibration.

5. Evacuate refrigerant piping, condenser, and evaporator coil: Do not evacuate compressor. Evacuate system to 500-micron absolute pressure. Pressurize with dry nitrogen to 425 psi gauge, maximum allowable pressure drop is 4 psi gauge in 48 hours. Check for leaks. Re-evacuate system to 100 microns and hold vacuum for a minimum of 6 hours. Remake all leaking joints and repeat system evaluation procedure, including leak testing.

C. Freezer room draw-down: Initial and subsequent pull-downs of low temperature room should be slow. Draw-down freezer room to -10°F. For proper pulldown schedule proceed as follows to avoid insulation damages:

1. Schedule:

24 Hour Days	Freezer Room Temperature
1st	75°F
2nd	60°F
3rd	45°F
4th	35°F
5th	30°F
6th	20°F
7th	10°F
8th	0°F
9th	-10°F

2. Note: Period between 35°F and 30°F very critical.

D. Testing and operation:

1. Refrigerating units shall be fully charged with their proper refrigerant and oil ready for insulated rooms drawdown test.

2. At the completion of the test, the systems shall be fully charged and free of leaks. Any deficiency shall be corrected at no additional cost to the Owner.

END OF SECTION

SECTION 13120

PRE-ENGINEERED STAIRS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The work includes designing furnishing and installing prefabricated stairs, concrete abutments, and anchoring systems as shown on the Drawings and as specified herein.

1.2 SUBMITTALS

A. Submit the following in accordance with SECTION 01340

1. Schematic drawings and diagrams shall be submitted for review and acceptance. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the work to be done. All relative design information such as member sizes, reactions, and general notes shall be clearly specified on the drawings. Drawings shall have cross referenced details and sheet numbers. All drawings shall be signed and sealed by a Professional Engineer who is licensed in State of Oregon.

2. Welder certifications in compliance with AWS standard qualification tests.

3. Welding procedures in compliance with SECTION 2.2

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel

1. Unpainted Weathering Steel

a. Stairs which are not to be painted shall be fabricated from high strength, low alloy, atmospheric corrosion resistant ASTM A847 cold-formed welded square and rectangular tubing and/or ASTM A588, or ASTM A242, ASTM A606 plate and structural steel shapes (Fy = 50,000 psi). The minimum corrosion index of atmospheric corrosion resistant steel, as determined in accordance with ASTM G101, shall be 5.8.

2.2 FABRICATION

A. Welding

1. Welding and weld procedure qualification tests shall conform to the provisions of ANSI/AWS D1.1 “Structural Welding Code”, 2000 Edition. Filler metal shall be in accordance with the applicable AWS Filler Metal Specification (i.e. AWS A 5.28 for the GMAW Process). For exposed, bare, unpainted applications of corrosion resistant steels (i.e. ASTM A588 and A847), the filler metal shall be in accordance with AWS D1.1, Section 3.7.3.

B. Welders

1. Welders shall be properly accredited operators, each of whom shall submit certification of satisfactorily passing AWS standard qualifications tests for all positions with unlimited thickness of base metal, have a minimum of 6 months experience in welding tubular structures and have demonstrated the ability to make uniform sound welds of the type required.

PART 3 EXECUTION

3.1 DELIVERY AND ERECTION

A. Delivery is to be made to a location nearest the site which is accessible to normal over-the-road tractor/trailer equipment. All trucks delivering stair materials will need to be unloaded at the time of arrival.

B. The manufacturer will provide detailed, written instruction in the proper lifting procedures and splicing procedures (if required). The method and sequence of erection shall be the responsibility of others.

C. The stair manufacturer shall provide written inspection and maintenance procedures to be followed after installation.

END OF SECTION

SECTION 13121

PRE-ENGINEERED CHEMICAL STORAGE BUILDING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The work includes furnishing all labor, materials, equipment and appliances required to complete the Pre-Engineered Chemical Storage Building work as indicated on the Drawings and as specified herein.

1.2 SUBMITTALS

A. Submit information for approval on all materials to be provided under this Section in accordance with SECTION 01340. Provide sufficient data to indicate conformance to all specified requirements.

1. Erection Instructions and Diagrams: Submit instructions and diagrams as necessary to erect the building and install all components for approval containing, but not limited to, the following:

    a. Anchor bolt layouts, embedment and sizes;

    b. Structural connections;

    c. Roofing and siding connections;

    d. Joint sealing and caulking;

    e. Flashings;

    f. Accessory installation details;

    g. All details and instructions necessary for complete assembly;

    h. Shop drawings necessary to supplement the instructions and drawings as required for the proper erection and installation of the building and components.

2. Certificates of Conformance or Compliance: Submit certificates from the manufacturer attesting that materials conform to requirements of this specification and of reference documents.

3. Colors: Submit samples of manufacturer's standard colors for selection by Owner.

1.3 DELIVERY AND STORAGE

A. Deliver, store, and handle prefabricated components, panels, and other manufactured items in such a manner that they will not be damaged or deformed. Stack materials stored on the site before erection on platforms or pallets and cover with tarpaulins or other suitable weathertight covering. Store all metal sheets or panels so that water which might have accumulated during transit or storage will drain off; do not store the sheets or panels in contact with materials that might cause staining. Upon arrival on the job site, inspect the sheets or panels; if found wet, remove the moisture and re-stack the sheets or panels and protect them until used.

PART 2 PRODUCTS

2.1 CHEMICAL STORAGE BUILDING

A. GENERAL: Provide one chemical storage building with 19’-4” x 7’-4” x 9’-0” exterior dimensions and 18’-0” x 6’-0” x 7’-6” interior dimensions. The building shall be designed for storage of up to twenty seven 55-gallon drums, and have 54,000 pounds storage capacity, a 40 PSF snow load rating, a 25 PSF door load rating, a 500 SPF floor load rating, be suitable for up to 130 MPH exposure wind load, and shall be rated for seismic zone 4.

B. WALL STRUCTURAL FRAMEWORK: Two (2) hour fire rated noncombustible weatherproof construction that meets or exceeds UL 263 and ASTM E 119, with multiple layers of UL Classified fire-resistant gypsum wallboard encased between exterior 12 gauge steel and interior heavy gauge Galvanneal sheet steel. Gypsum wallboard layers shall be offset with overlapping joints for maximum fire resistance. Walls shall conform to NFPA 30 standards and be fabricated from 3” x 2” x 1/8” steel structural or mechanical tubing members placed on 24” on center. Building perimeter shall have 6” x 3” x 3/16” steel tubing below and above wall studs. The corner studs and door frame opening studs shall be 3” x 3” x 3/16”. Framework shall be connected by welding. Exterior sheets shall be connected to wall framework at each seam with a continuous weld. All framing members shall be mechanical or structural tubing; formed channels or studs are not acceptable. Building walls shall have R-11 insulation protected by a steel lining.

C. ROOF SYSTEM: Roof shall have a two (2) hour fire rated Class A flame spread rating; wind uplift rating exceeding UL Rating I-60 and construction of fire rated weather proof noncombustible construction same as building walls. Roof Structural System shall be fabricated from 3.5” x 3.5” x 1/8” structural steel or mechanical tubing. Roof supports shall be installed 24” on center. Exterior roof sheets shall be continuously welded to roof supports at each seam. All framing members shall be mechanical or structural tubing; formed channels or studs are

not acceptable. Steel roof shall be 12 gauge with multiple layers of UL Classified fire resistant gypsum wallboard and equipped with rain shield over door. Building ceiling shall have R-11 insulation protected by a steel lining.

D. FLOOR SYSTEM: Floor shall be constructed with grating and a leak proof spill-containment sump assembly having a 6" high assembly consisting of 1" deep welded steel floor grating over 6" deep leak proof secondary containment sump. Steel floor grating shall be continuous throughout building, fabricated from welded steel grating with 1' x 3/16" bearing bars at 1" x 3/16" on center and crossbars at 4" on center. Grating material shall be galvanized steel. Sump shall be fabricated utilizing continuously welded 10 gauge steel sheets for maximum spill containment. Chemical-resistant epoxy coating shall be applied to secondary containment sump. Floor System shall be fabricated to comply with NAAMM MBG 531, Metal Bar Grating Manual for Steel, Stainless Steel, and Aluminum Gratings and Stair Treads.

E. BUILDING BASE: Base shall have open channel construction, with underside coated with chemical resistant epoxy for maximum corrosion resistance. Forklift pockets and hold-down brackets for each of off-loading and relocation shall be provided. Building base framing shall be capable of withstanding 1000 PSF minimum. The building base shall be constructed in this manner to ensure the fork lifting, loading, transporting, offloading, and relocation shall not affect this chemical storage building. This is to ensure the door openings remain square after lifting the building multiple times with a crane or fork trucks. The building base assembly shall consist of the following materials: 6" x 4" x 3/16" rectangular tubing, Hold Down Brackets welded to building that are ½" thick plate steel angles, C 4x5.4 and C 6x8.2 Floor Channels, and 4" x 2" x 1/8" rectangular tubing.

F. STATIC GROUNDING SYSTEM: Building shall have one exterior grounding connection, one 10 foot long 5/8" diameter copper-clad steel grounding rod, one No. 4AWG copper conductor, and grounding lugs.

G. GRAVITY AIR FLOW VENTS: Vents shall be UL listed with 1-1/2 hour rated fire dampers provided with UL listed 165 degree fusible links. Dampers include louvers and screens to provide airflow and have a galvanized steel frame and curtain type galvanized steel blades.

H. BUILDING FINISH: After an extensive cleaning process, the interior and exterior surfaces shall be protected with a high performance 2-part epoxy base coat (primer) and a high finish polyurethane top coat providing proven interior chemical resistance as well as exterior abrasion, corrosion, UV resistance and exceptional durability. Color shall be selected by the Owner.

I. SIGNAGE: Signage shall be permanent D.O.T. metal flip placard signage with rust proof aluminum holders and stainless steel clips on each door. One (1) pressure sensitive NFPA 704 Hazard Rating sign shall be provided on each door.

J. APPROVALS: This unit shall have Factory Mutual (FM Global) Approval and Warnock Hersey Approval. Third party and/or state approvals shall be provided if required by local codes.

K. BUILDING HEATER: Heater shall be UL Listed conforming to Class 1, Div 1 & 2, Group B. Heater shall be a 1.8KW (6,143 BTU/HR) Convection Heater operating with 208V Single Phase power. Heater shall include a temperature thermostat with a range from 36 deg F to 82 deg F.

L. ELECTRICAL LOAD CENTER: Load center shall be a UL Listed, Single-Phase, 3 Wire, 120/240V 100A Load Center (NEMA 3R). Unit shall have rainproof and sleet- (ice-) resistant-outdoor enclosures that are intended for use outdoors to protect the enclosed equipment against rain and meet the requirements of Underwriters' Laboratories, Inc., Publication No. UL 508, applying to "Rainproof Enclosures."

M. LIGHT FIXTURE: Provide one (1) incandescent light fixture that is UL listed and conforms to Class 1, Div 1 & 2 Group B.

N. DOOR: Provide one (1) double door where shown on the Drawings that is UL classified and labeled, three hour (3) fire-rated. Door shall be a 60" double leaf steel door and located on front of building where shown on the Drawings. Door shall be equipped with a UL listed self-closer, steel latch guard, surface slide bolt, positive pressure threshold and an exterior UL listed keyed lock.

O. DRY CHEMICAL FIRE SUPPRESSION SYSTEM: Provide one (1) 21 lb tank system that is UL, ULC Listed and FM Approved Pre-Engineered Dry Chemical Fire Suppression System for class A, B and C fires. Unit shall be equipped with means for Remote Annunciation. System, shall include Fusible Link Detection for Automatic Actuation, Manual Pull Station, and Multiple Nozzles for Total Flooding Application. Agent storage shall be located on building exterior in weatherproof enclosure and shall be a KIDDE 21 lb tank. Audible alarm shall be included with system.

P. FORCED AIR VENTILATION SYSTEM: Provide a forced air ventilation system with UL listed Class 1 Div 1 explosion proof equipment. Provide a wall mounted switch next to the door.

Q. LOADING RAMP: Provide one (1) loading ramp that is 44” wide x 88” long that is fabricated from 12 gauge steel. Ramp shall be colored yellow and rated for 275 PSF.

R. CHEMICAL STORAGE BUILDING shall be U.S. Chemical Storage (800-233-1480), Fireloc Model FL2008 or approved equal.

PART 3 EXECUTION

3.1 ERECTION

A. General: Erect building in accordance with the manufacturer's approved erection instructions and diagrams, unless specified otherwise. Correct defects or errors in the fabrication of building components in an approved manner. Replace defects or errors in fabrication of components which cannot be corrected in an approved manner. Space all framing elements accurately to assure the proper fitting of prefabricated wall and roof panels.

END OF SECTION

SECTION 13200

RESIDENCES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The work includes furnishing all design, construction, labor, equipment and materials required for construction of the modular residences as shown on the Drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. All design, construction and workmanship shall be as required under the latest version of the International Building Code and local governing agencies with jurisdiction over this type kind of construction. Residence shall conform to local, State and Federal codes and regulatory agency requirements. All workmanship shall be in accordance with the best practices of the trades. The erector of the residence shall be a registered contractor with the State of Oregon.

B. Licenses, Permits and Inspections: The Contractor shall be responsible for obtaining all licenses, permits and inspections required for construction and occupancy of the building.

C. Guarantee: The Contractor shall fully guarantee the design and construction in accordance with the Contract Documents.

D. Substitutions: Shall be in accordance with the provisions as established in the Bidders Instructions for "or equal" products.

1.3 SUBMITTALS

A. The following submittals shall be made in accordance with SECTION 01340:

1. The Contractor shall supply structural calculations stamped by a structural engineer registered in the State of Oregon.

2. The Contractor shall supply construction permit drawings prior to the start of construction of the building.

3. The Contractor shall supply brochures of all proposed equipment including, but not limited to, heating and ventilating equipment, electrical equipment, lighting fixtures, plumbing fixtures, and kitchen appliances.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Materials shall be as shown on the Drawings and as specified to meet the requirements of the International Building Code and all local, State and Federal governing agencies with jurisdiction over this type kind of construction and in accordance with the approved submittals.

PART 3 EXECUTION

3.1 EXECUTION

A. General: The residence shall be constructed in accordance with the International Building Code and all local, State and Federal governing agencies with jurisdiction over this type kind of construction and in accordance with the approved submittals.

B. Permits and Inspections: The Contractor shall be responsible for applying for and obtaining all permits and inspection required for construction of the residence.

C. All workmanship shall be in accordance with the best practices of the trades.

END OF SECTION

SECTION 13441

HATCHERY ALARM, MONITORING AND CONTROL FUNCTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Instrumentation control loops.
   2. Operator control of automated headtank level
   3. Operator interface, displays and alarms
   4. historical trends and alarm history

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 13500 – Programmable Logic Controller, Hatchery I/O Monitoring.

1.2 QUALITY ASSURANCE

A. Instrumentation contractor. The system shall be furnished as a unit with undivided responsibility with a single manufacturer of national repute in the field of instrumentation and control. The instrumentation contractor shall be able to demonstrate with installations of similar size, style and type, their ability to perform as specified. The instrumentation contractor shall maintain service facilities staffed with qualified representatives. The representatives shall be factory-trained and qualified to service the proposed equipment.

B. System includes all software and hardware required for a complete and operating system.

1.3 SYSTEM DESCRIPTION

A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents. Descriptions are provided as follows:
   1. Control system overview and general description
      a. Individual process equipment, listed in paragraph 2 below, will be supplied with their own controlling devices. These will interface with panels provided by the instrumentation contractor.
      b. Headtank level is to be controlled by the PLC varying the speed of Well #1. The VFD is the final control element. The headtank level transmitter is the primary element.
      c. Chilled water buffer tank temperature is controlled by the PLC modulating a motorized 3-way valve that bypasses the heat exchanger.
      d. Chilled water buffer tank level is controlled by two redundant control loops, each with a level sensor and VFD. The two VFDs will alternate.
   2. Major equipment to be controlled

a. Chiller (has a permissive relay operated by temperature switch, see detail 2/E27)
b. Generator and transfer switch
c. Well Pump VFD
d. Chilled water pump VFDs
e. Air backwash system at the intake structure
f. Liquid cooler (start circuit needs a permissive relay operated by a temperature switch when the temperature is too low for efficient chiller operation)

3. Major field mounted instruments (does not include local gages)
   a. See instrument list.
4. Manual control functions
   a. Cyclone pumps,
   b. Formalin pumps
   c. Incubation rooms exhaust fan
   d. Formalin room exhaust fan
5. Automatic control functions/interlocks
   a. Chiller (glycol side) temperature control loop
   b. Liquid cooler temperature control loop
6. Major indications provided at local control panels and motor starters/VFD's
   a. ON/OFF
   b. Speed
   c. Bypass ON/OFF
7. Remote indications and alarms
   a. See alarm list.

B. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but are rather intended to supplement and complement the drawings and other specification sections. The control loop descriptions shall not be considered equal to a bill of materials.

C. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on drawings.

1.4 SUBMITTALS

A. The instrumentation contractor shall provide a complete set of system wiring diagrams showing all wire numbers and field connections. Wire numbering system shall be developed by the contractor.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 HATCHERY ALARM AND MONITORING

A. Analog trends and Alarm history are to be recorded on a desktop PC in the multi-purpose room.
   1. The term "PLC" is defined in section 13500. It is an I/O device and includes analog inputs and outputs, digital communication to field devices, and alarm monitoring with annunciation. Not merely ladder logic.
   2. The term "CACP" refers to a Central Alarm and Control Panel. It is located in an office. It contains a touch screen Operator Interface System (HMI), alarm buzzer, acknowledge pushbutton, and emergency switches to activate VFD bypass starters.
   3. Software shall run on a desktop PC computer, and shall interface with the PLC to receive all data.
   4. The primary function of this PC is to record alarms and analog trends for retrieval later. This PC shall also be capable of displaying real-time flows, temperature, levels, and active alarms, as well as historical graphs of flow trends, temperature trends, level trends, and alarm history for those inputs shown on the drawings. This PC shall also annunciate alarms and accept an alarm acknowledge from an operator.

B. Alarm and Control
   1. All alarm and control functions will be performed by an I/O device in the Generator Room, which will be referred to as a PLC. See Spec 13500.
   2. Alarm contacts on field devices: All levels, D.O. concentrations, flows that are monitored for alarming shall have an adjustable time period, adjustable in the PLC, before alarming upon the opening or closing of field contacts. Adjustments are to be password protected.
   3. All alarms are to be latched (sealed in) at the annunciator until acknowledged
   4. Alarms that are not acknowledged within the period specified will actuate an alarm dialer.
   5. Alarm schedule is as follows:

ALARM SCHEDULE

INSTRUMENT	CONDITION	COMMENT
TAL-CPW	LOW TEMPERATURE	
LAL-W1	LOW LEVEL	
LAL-W2	LOW LEVEL	
LAL-W4	LOW LEVEL	
LAL-I1	LOW LEVEL	(14) IN SERIES
LAL-I2	LOW LEVEL	(14) IN SERIES
LAL-I3	LOW LEVEL	(7) IN SERIES
LAL-I4	LOW LEVEL	(7) IN SERIES
LAL-SW	LOW LEVEL	
LAL-GW	LOW LEVEL	
LAL-CW	LOW LEVEL	
LAL-RN	LOW LEVEL	
LAL-RS	LOW LEVEL	
LAL-RQ	LOW LEVEL	
LAL-A1	LOW LEVEL	
LAL-A2	LOW LEVEL	
LAL-A3	LOW LEVEL	
LAL-A4	LOW LEVEL	
LAL-A5	LOW LEVEL	
LAL-A6	LOW LEVEL	
LDAH	DIFFERENTIAL LEVEL HIGH	INTAKE SCREEN
LAH-VAULT	FLOOD	
BACKWASH	ALARM	
VAULT POWER FAIL	ALARM	
CHILLER	ALARM	
FUEL TANKS	LOW LEVEL	
CHEMICAL SHED	ALARM	
UV1	ALARM	
UV2	ALARM	
LOX LEVEL LOW	LOW LEVEL	
GENERATOR	ALARM	
CLARIFIER PUMP SEAL FAIL	ALARM	

C. Analog I/O
   1. Analog inputs: All analog inputs to the PLC shall be configured by software for historical trending. The PC computer in the office can set datalogging intervals, but not process setpoints or alarm level setpoints.
   2. Analog outputs: All alarm setpoints for minimum and maximum values shall be operator adjustable via the PLC's operator interface software. Password protected.
   3. Analog outputs:
      a. There is no control from the PC computer.

b. All setpoints shall be operator adjustable at the PLC display screen.
c. All PID gains and reset values can be displayed, but changes will be password protected.
d. Well priorities shall also be password protected.

D. Operator Interface Software/PLC Configuration:
1. General:
a. All calculations, trip points from analog values, timers, numeric manipulations, etc. shall be accomplished in the PLC and not in the operator interface software.
b. Alarms:
1) All open/close valves and on/off motors monitored by the PLC system shall have a maximum time value allowed to either open/close or start/stop.
2) Failure to achieve the control function within this maximum time value will result in a time out alarm for each piece of equipment.
3) An alarm will be generated from the PLC to the operator interface software for indication of the control function time out failure (i.e. Pump XXX-XXX FAIL TO START or Valve XXX-XXX FAIL TO CLOSE, etc.).
4) Other specific alarms are designated in the control loop descriptions.
5) All alarms are to be sealed in at the PLC until acknowledged via the operator interface.
c. Analog inputs: All analog inputs to the PLC shall be configured in the operator interface software for historical trending.
d. Analog outputs: All setpoints for minimum and maximum values shall be operator adjustable via the operator interface software.
e. Operator entries: Entries made by the operator (such as operation modes, setpoints, etc.) shall be displayed on the process screens for information.
f. The PC at the Multi-Purpose room will communicate with the PLC in the electrical room by network connection (Ethernet is preferred). The PC is used for display, recording and datalogging and must be compatible to accept the network signal.
2. Display Screens:
a. Display of process data and alarms must be available at two locations. At an operator interface touch screen (HMI) on the PLC enclosure in th4e electrical room and also at the PC computer in the Multi-Purpose room.
b. General: The screens for process control/observation shall be configured using a 3-level hierarchy plus an alarm screen, PLC System status screen, Report Selection screen, and real-time/historical trend displays.
1) The top level is the plant overview.
2) The second level is the process screens with the equipment control detail screens the bottom level.

c. Plant overview: The process overview screen shall consist of a full schematic of the process and contain active displays for the major plant flows and levels.
   1) Each process flow area shall be "active" so that clicking an icon will take the operator to a process screen showing full status for all of the items in that process area.
   2) At the bottom of the process overview screen shall be a button to move to the alarm screen, a button to move to the historical/real time trend display, a button to move to report generation, and a button to move to the PLC system status screen.

d. Process screens: The Process Screens shall be developed to show the full status for each piece of equipment within the process displayed.
   1) The color of the equipment shall vary as well as a text indicator to show the status of each valve, pump, etc.
   2) All analog values associated with the process displayed shall be shown.
   3) Each piece of equipment which can be controlled shall be "active" and allow the operator to click on the equipment and bring up a pop-up equipment changes control detail screen.
   4) There shall be three buttons in the same location at the bottom of each process screen to move back to the plant overview screen, the alarm screen, and the trend screen.

e. Equipment control detail pop-up: Develop a set of standard equipment control detail pop-ups to be used for each type of equipment controlled from the OIS.
   1) Each pop-up shall include a DONE button that hides the pop-up when done.
   2) Equipment symbol elements in the pop-up shall be animated to show when the equipment changes state to the command state.

f. Alarm of analog values: shall be adjustable at either display screen for all flow, temperatures and levels.

g. Alarm screen: Regardless of which screen an operator is on, a flashing red ALARM box will come up on the current screen directing the user to the alarms screen.
   1) The flashing red ALARM box will not go away until the alarm is acknowledged by a user, at a display screen, or by the dialer, over a phone connection.
   2) All alarms will have a time date stamp and will be printed to a dedicated printer.
   3) Alarm designation names are called out in the respective control loop description.
   4) By clicking the alarm box on any screen, the operator will view the Alarm Screen.

3. Screen list:
   a. Hatchery Overview Modifications(1).
   b. Process Screens (2):

1) Headtank level, well pump speeds, and which well is controlling.
2)

c. Equipment Detail Control Pop-Ups (3):
1) PID Controller (with Auto/Manual selection);
2) Pump Start/Stop
3) Pump Control w/VFD.
4) Active alarms
5) Alarm history (last 20 alarms)

4. The OIS displays shall be animated as necessary to clearly convey flows, levels, temperatures, equipment status, operation modes, process displays, alarms, etc.
a. Equipment status color:
1) ON-Red.
2) OFF-Green.
3) OPEN-Red.
4) CLOSED-Green.
5) FAIL-Amber (flashing).
6) VALVE IN TRANSITION-Yellow.
7) Provide numeric representation of process signals in engineering units. Graphical animation shall also be used to depict levels in tanks, wetwells, and sumps where these signals are available.
8) All OIS displays shall use consistent styles to convey information to operator, and for operator entry.

5. Automatic control:
a. With HAND/OFF/AUTO selector switches in the AUTO position and the dispenser control switches in the AUTO position (Auto Mode), the preparation unit will operate from an automated sequential batching operation initiated on LOW level in the again (mix) tank.

6. Manufacturer-supplied control panels:
a. Status and process displays for:.
1) Cyclone Pump ON/OFF status (4).
2) Head tank LOW level .
3) Head tank HIGH level .
4) Chilled water pump ON/OFF status
5) Glycol pump ON/OFF status
6) Clarifier pump on/off status
b. Alarms: as shown in the schedule above
c. Operator entries
1) AUTO/MANUAL pump selection.
2) Alarm acknowledge.
d. OIS display:
1) Status: None.
2) Operator entries: None.
3) Alarms:
a) System summary FAULT (2).
4) Historical logging:

a) Above alarms.
5) Historical trending: None.

e. Chiller
1) Display the following data:
a) Operating or alarm status:
(1) Low evaporator pressure or high condenser pressure.
(2) Low chilled-water temperature.
(3) Refrigerant high pressure.
(4) High or low oil pressure.
(5) High oil temperature.
(6) Loss of chilled-water flow.
(7) Control device failure.
(8) Glycol low flow alarm
(9) Low oil alarm
(10) Compressor Motor fault
(11) Fan motor fault
b) Operating hours.
c) Outside-air temperature if required for chilled-water reset.
d) Temperature and pressure of operating setpoints.
e) Entering and leaving temperatures of chilled water/glycol.
f) Refrigerant pressures in evaporator and condenser.
g) Saturation temperature in evaporator and condenser.
h) No cooling load condition.
i) Elapsed time meter (compressor run status).
j) Anti-recycling timer status.
k) Percent of maximum motor amperage.
l) Current-limit setpoint.
m) Number of compressor starts.

f. Well pumps #1,3 VFDs
1) Speed
2) Run / Off indication
3) Run time hours
4) Minimum run speed indication (display icon as yellow instead of red)
5) If PID functions are performed in the VFD: the setpoint, reset, gain and input reference signal.
6) Amps of all three phases.
a) Stop VFD upon low load condition.
7) Fault and fault code

g. Generator annunciator
1) Show all 17 indicators required by NFPA 110

h. Transfer switch
1) Not in automatic
2) Normal voltage source, each phase
3) Normal voltage dropout alarm
4) Normal voltage unbalance alarm
5) Engine start

6) Switch connected to Normal Source
7) Switch connected to Emergency Source
8) Emergency voltage source, each phase
9) Engine exerciser enabled/disabled
10) Engine exerciser week, day, hour, minute
11) Failure to sync alarm
12) Extended parallel time alarm
13) TS locked out

i. Dissolved Oxygen Monitors
j. Level transmitters

7. All Operator entries are at the PLC display screen at the electrical room, with restricted entries at the PC:
   a. Provide HMI software and display graphics to display all data.
   b. Provide PC software as necessary to display trends, record trends and display history.
   c. Setpoints and well priorities (described below) are entered only at the PLC's HMI and shall be password protected
   d. The PC entries are limited to: display of process values, display of trends, changing of datalogging frequency, and acknowledging an alarm. No changing of setpoints or well priorities.
   e. Other than well pump control described below, there are no computer entries for process control of flows, temperatures, levels, Dissolved Oxygen concentrations nor to control chiller, or generator.

3.2 CONTROL LOOPS

A. Well #1 and #3 control of headtank level. Pump speed is controlled by the level in the aeration headtank as described below.

B. Well #2 deice flow

3.3 HEADTANK LEVEL CONTROL LOOP AND WELL PUMP CONTROL

A. Headtank level control loop: the well pump #1 speed will control the level in the GW headtank. This VFD is the final control element. Well #2 can be cross-connected, during emergencies, to supply the headtank, but it is not in the loop. It is intended that well #2 be operated manually in an emergency mode only.

B. Definitions
   1. GW headtank is the Ground water (well water) headtank. It contains a level transmitter.
   2. CACP is the Central Alarm control panel located in the multi-purpose room, room 113.
   3. GPM gallons per minute
   4. PC is a personal computer, located in an office. It is intended that this display be used for datalog recording and display of trends and alarm history, not for control.
   5. PLC is an I/O device, located in the electrical (generator) room

6. OIS (operator interface software) or HMI (human-machine interface) refer to touch screen displays. There are two of these: one on the PLC and one on the CACP. The PC monitor may also be referred to as a display of these same parameters.

C. Control description
   1. It is expected that the operators will not want to run the well pump at maximum speed, therefore we will have a limit for max speed, as described below, such parameter to be entered into the software by display screen graphical display "page" for the well #1. This operator entered limit will be called a "redline"
   2. At the PLC display, and at the CACP display, there will be available a display screen page for well #1 parameters. It will display aquifer level as received (in % of span), flow in GPM, pump ON/OFF status, VFD speed in percent of 60Hz, and, for well #1, the headtank level. A link from this page will be available to display VFD settings, as defined in 13500.
      a. The flowmeter display has an upper flow red line setpoint entry (with keypad) in GPM. Whenever flow is above the redline, the flowmeter readout, in GPM, will be displayed in red. (in manual mode, described below, this will limit the flow. In automatic mode, it merely displays in red and is not a flow limit)
      b. The aquifer level display will be a vertical bar graph, blue lower, white upper, with a lowest mark stating the elevation in feet above mean sea level of the pump setting, and the upper limit stating the elevation of finished grade.
   3. At the PLC display, or the CACP display, the operator selects for well #1:
      a. One of the following modes: Manual flow, Automatic flow, or Automatic level.
      b. Manual flow. Manual flow means "ON or OFF and speed as directed by the operator entry"
         1) Manual flow, if selected, will display a slider bar "Manual Flow", and a maximum flow setpoint entry (with keypad) in GPM, and a START/STOP button.
         2) The lower limit of the flow is determined by the minimum cooling flow over the submersible motor, or 30Hz, whichever is higher. Note: well #1 is a 6" motor in 12" casing, which requires .50 ft/sec cooling flow which occurs at 2250 RPM, which is 39.2Hz. Confirm pump setting and size in the field.
         3) The higher limit of the flow is determined by the maximum pump speed at 60 Hz, or the max flow "redline" setpoint whichever is lower.
      c. Automatic flow. Automatic flow means "turn on and adjust flow (pump speed, not headtank level) as determined by software"
         1) Automatic flow, if selected, will display an entry box "Automatic Flow Setpoint" , such entry box, with keypad, will select a setpoint for a P-I loop, in addition to the redline setpoint entry described above.

2) Lower limit of the P-I output, as described above
3) Upper limit of the P-I output, results in 60Hz from the VFD. Not limited by the redline setpoint.

d. Automatic level. Controlling pump's speed is determined by P-I loop output.
1) Setpoint: keep water elevation in the headtank at 3718 feet above mean sea level, which is below the overflow level, as transmitted by LIT-GW. Reverse acting.

4. Minimum VFD speed, and the VFD setpoints for the VFD's internal programmable relays must be settable from the PLC's operator display screen.
5. Additional operational information:
   a. There is no attempt to limit or warn of excess use above the water right.
   b. If any input to or output from the PLC fails, VFDs can be manually operated.

END OF SECTION

SECTION 13500
PROGRAMMABLE LOGIC CONTROLLER (PLC) CONTROL SYSTEM
HATCHERY I/O MONITORING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Programmable logic controller (PLC), including hardware, desktop PC, printer, software, programming, and training.
2. Design and fabrication of programmable logic controller (PLC) control system, including software, programming, and training.
3. Onsite installation, startup, checkout.

Work by Others:
4. Concrete pads for cabinets.
5. Outsite services of factory-trained service representative.

B. Related Sections include but are not necessarily limited to:
1. Division 1 - General Requirements.
2. Section 13441 – Hatchery Alarm, monitoring and controls.
3. Section 16910 – Process Instrumentation

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):
   a. C37.90.2, Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
   b. C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
   c. C62.45, IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
2. Electronic Industries Association (EIA):
   a. TIA-232-E, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
   b. 422-A, Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
3. International Organization for Standardization (ISO):
   a. ISO 9001, Quality Systems-Model for Quality Assurance in Design, Development, Production, Installation and Servicing.
4. National Electrical Manufacturers Association (NEMA):
   a. ICS 1, General Standards for Industrial Control and Systems.
   b. ICS 4, Terminal Blocks for Industrial Use.

c. ICS 6, Enclosures for Industrial Controls and Systems.
d. LS1, Low Voltage Surge Protection Devices.
e. Publication No. 250, Enclosures for Electrical Equipment (1000 V maximum).

5. National Fire Protection Association (NFPA):
   a. National Electrical Code (NEC).
6. Underwriters Laboratories, Inc. (UL):
   a. UL 1283, Standard for Safety-Electromagnetic Interference Filters.
   b. UL 1449, Standard for Transient Voltage Surge Suppressors.

B. Qualifications:
1. Installation supervisor shall have had experience in overseeing installation and startup of at least three similar installations.
2. Programmer(s) shall have had experience in programming PLCs for at least two projects of similar size and complexity.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 01340.
2. See Section 13441.
3. Product technical data including:
   a. Annotated hard copies of PLC software programs.
      1) Submit program for logic in ladder diagram format as used for the specific PLC system. Annotate program listing to include the following:
         a) Written description of each rung's function.
         b) Reference to control loop number for each rung where applicable.
         c) Reference to instrumentation tag number of I/O devices for each rung where applicable.
      2) Provide written descriptions completely defining all function blocks used in program.
      3) Provide list of all addresses referenced in logic diagram with description of data associated with each address.
   b. Results of factory testing procedures.
   c. Arrangement drawings for PLC system components.
   d. Panel and enclosure plans, sections and details.
   e. Access opening locations and required clearances for each panel and enclosure.
   f. Enclosure internal wiring and terminal blocks.
   g. Full size diagrams of all CRT process control displays with identification of actual colors.
   h. Index of all training offered by PLC system equipment manufacturers including operations and maintenance.
   i. List of all recommended spares for maintenance purposes with each item separately priced.
4. Certifications:
   a. Qualifications of installation supervisor.

b. Qualifications of programmer(s).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Rockwell Automation, Allen-Bradley.
      a. Control-Logix or Flex I/O with 15" PanelView touch screen displays, RSView software on the PC in the office, Ethernet bridge and capability for remote reprogramming over a phone modem.
   2. Group Schneider: Modicon. . (for referrals to integrators, contact Modicon at Boise 208-938-8530)
      a. Momentum PLC, 15" Magelis touch screen displays, Citect software for both operator display and for the office PC computer, Concept software, Modbus Ethernet bridge, and capability for remote reprogramming over a phone modem.
   3. General Electric Company.
      a. VersaMax or equivalent, Wonderware or other appropriate graphic software for the office PC computer, and capability for remote reprogramming over a phone modem.

B. The PC computer that is used as a datalogger to record analog history and alarm history must have one year warranty and have a factory technical support hotline. The following are acceptable vendors:
   1. Dell
   2. Gateway

C. Submit request for substitution.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Section 13441.

B. The PLC system shall accomplish the control requirements of the loop descriptions, Drawings, and Specifications.

C. PLC programming shall be documented and factory tested.

D. Operator interface functionality shall include:
   1. Indication of process variables.
   2. Configuration of control loop parameters (e.g. setpoints, gains, etc.).
   3. Adjustment of controller output.
   4. Display of real time and historical process trends.
   5. Selector switch and pushbutton station controls.
   6. System and process status indicators.
   7. Graphic representation of hatchery operations with interactive status and measurement symbols.
   8. Annunciation.

9. more specifics are detailed in section 13441 and 16910.

E. The PLC system shall generate the following reports:
   1. List of all entries initiated by operator including the following:
      a. Console key changes.
      b. Beginning and final values of setpoint and output changes.
      c. Mode changes (i.e., auto to manual).
      d. Time change was made.
   2. Event list:
      a. Description of event.
      b. Time of event.
      c. Resolution of 100 milliseconds maximum.
   3. Custom reports:
      a. Standard format:
         1) User configurable.
         2) Contain selected information from any log, event, or alarm list.
         3) Capable of producing custom log report for periodic and on-demand printing of a list of process or calculated variables.
      b. Variable format:
         1) User configurable.
         2) Ability to include any system data including:
            a) Calculated time based averages.
            b) Totalizations.
            c) Minimum values.
            d) Maximum values.
      c. Reports shall not require software programming by the user to setup.

F. The PLC system shall operate in ambient conditions of -32 to 140 DegF temperature and 5 to 95 percent relative humidity without the need for purging or air conditioning. Provide appropriate heaters and fans to meet UL508A requirements.

G. Utilize a power turn-on time delay circuit when powering up or down DC power supplies to ensure power supply output voltage has reached the proper value prior to application of power to solid state logic and output circuits.

H. Environmental Controls:
   1. Furnish circulation fans in solid state control system enclosures.
   2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.
   3. Air conditioning applications shall include means of preventing moisture condensation.

I. All PLC control system components shall be capable of meeting or exceeding electromagnetic interference tests per ANSI/IEEE C37.90.2.

J. Incorporate the following minimum safety measures:
   1. Watchdog function to monitor:

a. Internal processor clock failure.
b. Processor memory failure.
c. Loss of communication between processor and I/O modules.
d. Processor ceases to execute logic program.

2. An emergency power disconnect shall be placed in the power circuit feeding the power supply as a means of removing power from the entire PLC system.
3. Safe wiring:
   a. Unless otherwise specified, activation of alarms and stopping of equipment shall result from the de-energization of control circuits, rather than the energization of control circuits.
   b. Low voltage control signal wires:
      1) Place in conduit segregated for that purpose only.
      2) Twisted shielded wire pair.
      3) Not located in the same conduit or bundle with power wiring.
4. Initial safety conditions:
   a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.
   b. Utilize program each time PLC is re-initiated and the control program activated.
5. Monitoring of internal faults and display:
   a. Internal PLC system status and faults shall be monitored and displayed. Monitored items shall include:
      1) Memory ok/loss of memory.
      2) Processor ok/processor fault.
      3) Scan time overrun.
6. Control of programs:
   a. Protect access to PLC program loading with password protection or with locked, key operated selector switches.
7. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.
8. Incorporate noise suppression and inductive load suppression design into input, output, and logic modules.
   a. Provide surge suppressors directly across the coils of all inductive devices which are energized by PLC outputs. Install the surge suppressor at location of the inductive device.
9. Operator intervention:
   a. Logic system failure shall not preclude proper operator intervention.

2.3 COMPONENTS

A. PLC System Central Processor Unit (CPU):
   1. CPU shall provide communications with other control systems and man-machine interfaces as specified.
   2. Memory:
      a. Battery-backed RAM.

b. EEPROM program back-up:
1) Automatically download to RAM in the event RAM is corrupted.

3. Memory battery backup shall be capable of 60 days memory retention with fresh battery.
   a. Provide visual indication of battery status and alarm low battery voltage.
   b. Memory battery backup shall be capable of 14 days memory retention after the "Battery Low" indicating LED is on.
4. Plug-in card design to allow quick field replacement of faulty devices.
   a. Provide unit designed for field replacement and expansion of memory without requiring rewiring or use of special tools.
5. 20 percent minimum spare useable memory capacity after all required programming is in place and operating.
6. Capable of executing all control functions required by the Specifications and Drawings.
7. Built-in three-mode (proportional-integral-derivative) control capabilities.
   a. As directly selectable algorithms requiring no user knowledge of programming languages.
8. On line reconfigurable.
9. Lighted status indicators for "RUN" and "FAILURE."
10. Capable of manual or automatic control mode transfer from the operating console stations or from within the control strategy.
11. The PLC must be reprogrammable over the phone lines by a phone modem at 9600 baud rate. Include software and passcodes.

B. Input/output (I/O) Modules:
1. Provide plug-in modular-type I/O racks with cables to connect to all other required PLC system components.
2. Provide I/O system with:
   a. I/O solid state boards with status lights indicating I/O status.
   b. Electric isolation between logic and field device.
   c. Capability of withstanding low energy common mode transient to 1000 V without failure.
   d. Incorporate noise suppression design.
   e. Capable of meeting or exceeding electrical noise tests, NEMA ICS1-109.60-109.66.
   f. Capable of being removed and inserted into the I/O rack under power, without affecting any other I/O modules in the rack.
   g. Install 20 percent spare I/O modules of each type: isolated analog in, isolated analog out, discrete in, discrete out, and 20% spare communication capacity.
3. Input/output connection requirements:
   a. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
   b. Prewire I/O modules to terminal blocks.
   c. Provide terminal blocks with continuous marking strip.
   d. Size terminals to accommodate all active data base points and spares.
   e. Provide terminals for individual termination of each signal shield.

f. Field wiring shall not be disturbed when removing or replacing an I/O module.

4. Discrete I/O modules:
   a. Interface to ON/OFF devices.
   b. I/O status indicator on module front.
   c. Voltage rating to match circuit voltage.
   d. Output module current rating:
      1) Match maximum circuit current draw.
      2) Minimum 1.0 continuous A/point for 120 Vac applications.
   e. Isolated modules for applications where one module interfaces with devices utilizing different sources of power.
5. Discrete outputs shall be fused:
   a. Provide one fuse per common or per isolated output.
   b. Provide blown fuse indication.
   c. External fusing shall be provided if output module does not possess internal fusing.
   d. Fuses provided external to output model shall:
      1) Be in accordance with module manufacturer's specifications.
      2) Be installed at terminal block.
6. Analog I/O modules:
   a. Input modules to accept signals indicated on Drawings or Specifications.
   b. Minimum 12 bit resolution.
   c. I/O chassis supplied power for powering connected field devices.
   d. Differential inputs and outputs.
   e. User configurable for desired fault-response state.
   f. Provide output signals as indicated on Drawings and Specifications.
   g. Individual D/A converter for each output module.
   h. Individual A/D converter for each input module.

C. Power Supply Units:
1. Provide regulated power units:
   a. Designed to operate with PLC system and shall provide power to:
      1) All components of PLC system.
      2) All two-wire field instruments.
      3) Other devices as indicated on Drawings or Specifications.
   b. Capable of supplying PLC system when all of the specified spare capacity is utilized.
   c. Each power supply shall be sized such that it will carry no more than 75 percent of capacity under normal loads.
2. Electrical service to PLC system is 105 to 125 V, 60 HZ, +1 percent, 1 Phase power.
3. Separate AC circuit breakers shall be provided for each power supply.
4. If the PLC system is field expandable beyond the specified spare capacity, and if such expansion requires power supply modification, note such requirements in the submittals and allow room for power supply modification in the PLC system enclosure.

5. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
6. Power distribution:
   a. Immune to transients and surges resultant from noisy environment.
   b. Shall provide constant voltage level DC distribution to all devices.
7. Provide uninterruptible power supply (UPS) to sustain full power to UPS powered loads listed below for a minimum of 6 minutes following loss of primary power and to ensure that the transient power surges and dips do not affect the operation of the PLC system.
   a. UPS powered loads:
      1) All rack mounted PLC components.
      2) Local operator consoles.
      3) All power supplies furnished with the PLC and associated loads.
   b. Input:
      1) 120 Vac +10 percent.
      2) 60 HZ.
      3) Line fuse protection.
   c. Output:
      1) 120 Vac (5 percent.
      2) 60 HZ.
      3) Short circuit protected.
      4) Instantaneous transfer time.
   d. Alarm contact upon battery low.
   e. ANSI/IEEE C62.41 Class A voltage surges of 6000 V attenuated to less than 50 V on the output.
   f. Battery: Maintenance free.
      1) If required by NEC 480, install battery in ventilated space.

D. Power Supply Surge Protection (Hard wired type):
   1. Acceptable manufacturer:
      a. Innovative Technology, Model HS-P-SP.
      b. Joslyn, Model 1260-41
      c. MCG, 4000 series
   2. Utilize for 120 Vac power supplied to PLC.
   3. Design and fabrication:
      a. Components, except for enclosure, shall meet all requirements related to construction, performance, manufacturing/production-line testing, ratings, and markings as stated in UL 1449 for a transient voltage surge suppressor rated as required by these Contract Documents.
      b. Maximum continuous line voltage: 130 Vac.
      c. Shall be rated for maximum continuous line current of protected equipment as listed in the drawings.
      d. Wired in series with the power supply.
      e. Device protection modes:
         1) Line to neutral (L-N).
         2) Line to ground (L-G).
         3) Neutral to ground (N-G).

f. Peak surge current, single pulse, 8x20 microsecond waveform:
   1) 65,000 amps total.
   2) 45,500 amps phase.
g. Maximum values of actual let through voltage for installed surge protection devices shall be in accordance with the following table:

LET THROUGH VOLTAGE FOR INSTALLED SURGE PROTECTIVE DEVICES

B3/C1 IMPULSE WAVE PER NOMINAL CONTINUOUS VOLTAGE, RMS	ANSI/IEEE C62.41 6,000 V 3,000 A
120 L-N	210
120 L-G	230
120 N-G	380

h. Diagnostics:
   1) Local indication that protective circuitry is functioning properly.
   2) Contacts for remote annunciation of malfunction.

E. Analog Signal Line Surge Protection (4-20 mA, 24 Vdc signals):
   1. Acceptable manufacturer:
      a. Innovative Technology.
         1) At field mounted device: OEM-D24 (conduit model).
         2) At PLC: OEM-D22TX-24D.
      b. Only manufacturers with ISO 9001 certification are acceptable.
   2. Series wired.
   3. Bi-directional, encapsulated, multi-stage hybrid circuit utilizing low impedance surge path design.
   4. Maximum continuous operating voltage: 30 V L-L, L-G.
   5. Peak surge current: 10,000 amps.
   6. Maximum let-through voltage when exposed to a B3/C1 impulse wave)per ANSI/IEEE C62.41) of 6,000 volts and 3,000 amps.
      a. 50 volts for conduit model.
      b. 40 volts for PLC mounted model.
   7. Locate at field mounted device and in PLC termination cabinet.

F. Discrete Signal Line Surge Protection (24 Vdc) or Data Line Surge Protection:
   1. Acceptable manufacturer:
      a. Innovative Technology, Model D2S, D4S, or D6S.
      b. Only manufacturers with ISO 9001 certification are acceptable.
   2. Install surge suppressor at PLC terminations for discrete I/O wiring applications where signal line extends outside of building.
   3. Install surge suppressor at both ends of data lines where data line extends outside of building.
   4. Series wired.
   5. All mode protection (normal and common).
   6. Less than 1 nanosecond response time.

7. Maximum let-through voltage exposed to a B3/C1 impulse wave per ANSI/IEEE C62.41 of 6,000 volts and 3,000amps:

MAX CONTINUOUS VOLTAGE	MAX LET-THROUGH VOLTAGE
7.5 L-L	20
7.5 L-G	30
7.5 SHD-G	170
15 L-L	30
15 L-G	40
15 SHD-G	170
36 L-L	70
36 L-G	70
36 SHD-G	170

G. Plug-In Type Surge Protective Devices:
   1. Acceptable manufacturers:
      a. Tripp Lite.
      b. Innovative Technology.
      c. Leviton.
   2. Utilize for computers, printers, and all microprocessor based equipment with plug-in to power source.
   3. Design and fabrication:
      1) Shall meet all requirements related to construction, performance, manufacturing/production-line testing, ratings, and markings as stated in UL 1449 for a transient voltage surge suppressor rated as required by these Contract Documents.
      b. Maximum continuous line voltage: 130 V.
      c. Maximum continuous line current of protected equipment: 15 A.
      d. Connection means: NEMA 5-15 plug.
      e. Device protection modes:
         1) Line to neutral (L-N).
         2) Line to ground (L-G).
         3) Neutral to ground (N-G).
      f. Peak surge current, 8x20 microsecond waveform:
         1) 26,000 amps/phase.
         2) 26,000 amps N-G.
      g. Maximum values of actual let through voltage for surge protective devices tested in accordance with UL 1449 shall be as follows:
         1) L-N: 330 V.
         2) L-G: 330 V.
         3) N-G: 400 V.

h. Minimum EMI/RFI noise rejection (all modes), as indicated below:

NOISE REJECTION			
5O kHz	150 kHz	1 MHz	6-1000 MHz
20 dB	40 dB	80 dB	30 dB

i. Diagnostics: Local indication that protective circuitry is functioning properly.
j. Each suppression unit shall be UL 1449 listed and shall bear the suppressed voltage rating issued by UL for all protected modes.
k. Each suppression unit shall be UL 1283 listed.

H. PLC System Enclosure:
1. Meet NEMA (Publication No.250) rating indicated on Drawings and Specifications.
2. Factory assemble all PLC system components in enclosure.
3. Furnish enclosures with the following features:
   a. Full length flush pan doors with full length stainless steel piano hinges rated for 1.5 times door plus instrument weight.
   b. Doors with locking handles and three point catch.
   c. Key doors alike.
   d. Placed so that doors may be fully opened for easy access to wiring and components for troubleshooting and testing purposes.
   e. Gasketed windows to allow viewing of the processor or I/O indicators.
   f. Welds ground smooth to touch and appearance.
   g. Exterior color: ANSI Gray.
4. Enclosure thickness, grounding, and electrical spacings shall be in accordance with NEMA ICS 6.
5. Component placement:
   a. Mount all controller components vertically within the enclosure to allow maximum convection cooling.
   b. Either install power supplies above all other equipment with at least 10 IN of clearance between the power supply and the enclosure top, or adjacent to other components, but with sufficient spacing for circulation of cooling air.
   c. Do not place I/O racks directly above the CPU or power supply.
   d. Locate incoming line devices (isolation or constant voltage transformers, local power disconnects, surge suppressors, etc.) so as to keep power wire runs within an enclosure as short as possible.
   e. If items such as magnetic starters, contactors, relays, and other electromagnetic devices must be located within the same enclosure as the PLC system components, place a barrier with at least 6 IN of separation between the magnetic area and the control area.
   f. Place circulating fans close to major heat generating devices.
   g. Segregate input/output modules into groups of identical type.

6. Wiring:
   a. Factory wire enclosures to identified terminal blocks equipped with screw type lags.
   b. Install all wiring without splicing in factory in raceways:
      1) Raceways shall have removable covers.
   c. Provide enclosure wiring color coded as follows:

COLOR	SERVICE
Black	AC hot conductor
White	AC neutral
Brown	AC intermediate conductors
Orange	DC positive (non-grounded)
Yellow	DC negative (non-grounded)
Red	DC intermediate
Gray	Grounded conductor
Green	Cabinet ground

   d. Identify all wires with plastic sleeve type wire markers at each end.
   e. Keep AC power lines separate from low-level DC lines, I/O power supply cables, and all I/O rack interconnect cables.
   f. Keep AC signal wires separate from DC signal wires.
   g. When I/O wiring must cross AC power wiring, it shall only do so at right angles.
   h. Allow 2 IN between the I/O modules and any raceway, between the terminal strip and raceway, and between the terminal strip and I/O modules.
   i. Grounding:
      1) Separate ground wires from power wiring at the enclosure point of entry.
      2) Minimize ground wire length within the enclosure by locating the ground reference point as close as possible to the point of entry of the plant power supply.
      3) Ground all electrical racks or chassis and machine elements to a central ground bus.
         a) Locate the central ground bus in the magnetic area of the enclosure.
         b) Any non-conductive materials (such as paint) shall be scraped away from the area where a chassis makes contact with the enclosure.
      4) Ground the enclosure to the ground bus. It is imperative that good electrical connections are made at the point of contact between the ground bus and enclosure.
   j. Termination requirements:
      1) Terminal block markings, mechanical characteristics and electrical characteristics shall be in accordance with NEMA ICS 4.

2) Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the enclosure.
3) Prewire I/O modules to terminal blocks.
4) Terminals shall facilitate wire sizes as follows:
   a) 120 Vac applications: Wire size 12 AWG and smaller.
   b) Other: Wire size 14 AWG and smaller.
5) Provide terminal blocks with continuous marking strip.
6) Tag each I/O terminal to indicate tag number of the connected device.
7) Size terminals to accommodate all active database points and spares.
8) Provide terminals for individual termination of each signal shield.
9) Field wiring shall not be disturbed when removing or replacing an I/O module.

7. Equip enclosures with interior lighting and interior power receptacles as follows:
   a. Furnish one light fixture.
   b. One electrical power receptacle.
   c. Place the electrical power receptacle and the light fixture on a circuit breaker separate from control circuits.

I. Process Control Operator Interface System:
1. Provide operator interface with the PLC control system. There must be two operator interface touch screen displays, one at the PLC enclosure in the generator room and one at the Central Alarm Control Panel (CACP) in an office. The PC used for datalogging and historical trends and alarm history must also have a graphical display.
2. Provide all functions and interfaces specified and shown on the Drawings.
3. Provide interface for PLC programming.
4. Utilize a touch screen and personal computer(s) (PCs) as operator interfaces.
5. PCs will have the following features:
   a. Specifier: The following features will be quite adequate for most applications. Consider modifying the PC requirements if added capabilities are warranted for your application.
   b. Minimum 300 MHz Pentium II processor with 512 K cache.
   c. Minimum 32 MB RAM, expandable.
   d. Minimum 4 GB hard drive.
   e. USB user port.
   f. 32 K CD-ROM drive.
   g. 56 Kbps modem.
   h. Accelerated graphics port video card with minimum 4 MB.
   i. Software for relational database
   j. IBM compatible software
6. Utilize CRT(s) with the following features:
   a. Minimum refresh rate: 75 HZ.
   b. Minimum size (nominal/actual viewing): 17 IN/15.6 IN.
   c. Automatic and manual degaussing.
   d. Resolution: 1280 X 1024 or higher.

e. No glare, flat screen.
f. Adjustable tilt.
g. Maximum dot pitch: 0.28 mm.
h. 256 user selectable colors for displays.
i. Adjustable brightness and contrast.

7. Keyboards for PC:
   a. Detachable.
   b. Incorporate Standard IBM-QWERTY design as well as assigned function keys.
   c. Tactile entry.
   d. Single entry access to specific loops, alarms, displays, or discrete action initialization.
   e. Password protection to prevent unauthorized entries.
      1) Operator access mode allows operator to:
         a) Call up displays.
         b) Initiate print outs.
         c) Vary process variable operating setpoints and outputs within limits established in engineering mode.
      2) Engineering access mode allows a qualified supervisory employee to setup all control loop configuration data such as gains, time constants, bias constants, control algorithms, alarm limits, and operating limits.
8. Utilize microprocessor based flat-panel type operator interfaces with the following features:
   a. Acceptable manufacturers:
      1) Allen-Bradley Panel View 1500.
      2) Modicon Magelis 15” touch screen
   b. Design and fabrication:
      1) Mount on door of PLC cabinet.
      2) Display:
         a) Fifteen (15) IN diagonal.
         b) 640x400 pixels minimum
         c) Thin film transistor (TFT) color.
      3) Touch screen.
      4) 120 Vac, 60 HZ power supply.
      5) Real time battery backed clock.
      6) Provide password protection to prevent unauthorized entries.
      7) RS-232 printer port.
      8) Operating temperature: 32 DegF to 113 DegF.
      9) Humidity: 30 to 85 percent RH-non-condensing.
   c. Provide displays of all process variables, alarms, and indications as required in Contract Documents.
      1) Provide separate graphical displays for operator monitoring and control purposes as described in section 13441:
9. Operator displays provide the following or equivalent:
   a. Overview displays:

1) Provide indication of groups of process control loops and points for simultaneous viewing. Indication shall be as follows:
   a) Bar graph display showing contact status or individual deviations between process variables and setpoint or target values.
   b) Loops in manual control.
   c) High and low process alarm limits.
   d) Points in alarm.
   e) Identify each group by number and title.

b. Group display:
   1) Separate display of each group shown in overview display. Indication shall be as follows:
      a) Numerical display of process variable, setpoint, output magnitudes, and ratio and bias values.
      b) Status of discrete points.
      c) Identify group and points by number and tag name.
      d) Any point shall be configurable in any group and displayed in as many groups as necessary.
      e) Display format of analog points:
         (1) Process variable shown graphically by using a vertical bar.
         (2) Set point shall be shown using vertical bar.
         (3) Output shall be shown as a vertical bar.
         (4) All process variable bar-chart displays shall be shown against 0 to 100 percent graphic scaling.
         (5) These values shall be displayed numerically in engineering units along with a designation of control mode.
      f) Display format of digital points:
         (1) Status input shall be shown as a filled upper and lower box.
         (2) Control mode shall be shown.
         (3) Output, if required, shall be shown.
   2) At the group display, the operator shall be able to:
      a) Select a control loop or point for control action.
      b) Change control mode of loop selected (manual, automatic, cascade).
      c) Change setpoint.
      d) Issue commands to start/stop and open/close two-state equipment.
      e) Change output of loop while loop is in manual.
      f) Select a loop and initiate further display such as the detail display, trend, or hourly averaging.
      g) Display and change ratio and bias values.
      h) Control field equipment such as motor-operated valves and switches.

c. Detail display:
   1) Provides separate display for each point.

2) Representations of each analog and digital point shall be single user configured faceplate. Display shall include alphanumeric representations of all variables and parameters for single loops including but not limited to:
   a) Alarm points.
   b) Limits.
   c) Constants.
   d) Interconnections to other loops.
   e) Calculating functions.
3) The operator shall be able to call up a display for any analog or digital point in the system.
   a) For analog loops, the operator shall be able to manipulate setpoint, output, ratio, bias, and control modes through the detail display.
   b) For digital points, the operator shall be able to issue commands to start/stop and open/close two-state equipment.
   c) For manual loading output stations, the operator shall be able to manipulate analog output values.

d. Trend displays:
   1) Real time historical trend displays.
   2) Real time on line trend displays.
   3) Capable of displaying minimum of three points per display.
   4) Operator shall be able to select any desired sample time interval.
e. Graphics:
   1) Utilize dynamic variables with unique tags per graphic.
   2) Multiple color coding of alarm points and equipment operating status.
   3) Standard symbol library:
      a) Up to 150 symbols.
      b) User defined.
      c) Must not require software programming.
   4) Interactive in real time with process variables and equipment status.
   5) Single keystroke access from graphic to group display or other custom graphic displays.
   6) Capable of being edited by moving, copying, or grouping user defined areas of screen.
   7) Vector commands for graphical shapes including but not limited to:
      a) Line.
      b) Arc.
      c) Circle.
      d) Box.
      e) Triangle.
      f) Imported symbols.
f. Alarm monitoring:

1) Notify the operator upon the occurrence of any alarm, with a pop-up display (banner) regardless of the display on the screen being viewed.
2) Alarms shall be presented in order of:
   a) Priority.
   b) Time of occurrence.
   c) Non-acknowledged presented ahead of acknowledged.
3) Utilize single touch, keystroke or pushbutton to:
   a) Acknowledge alarms.
4) Alarm list presented to operator shall include:
   a) Time of occurrence.
   b) Time of acknowledgement.
   c) Description.
   d) Acknowledgement status.
5) Alarm list printed by either of the following:
   a) On command.
   b) Periodically.
6) Audible alarming capability for user selected alarms.

J. PLC System Software and Programming:
1. Provide all hardware and programming required to provide communication between the PLC and the man-machine interface.
2. Provide programming to accomplish all control and monitoring requirements of the Drawings and Specifications.
3. Provide two copies of control logic program on CD.
4. Full documentation capability.
   a. Provide description for each rung.
5. On/off line programming.
6. Offline simulation prior to download.
7. Two step commands requiring operator verification prior to deletion of any programming.

K. Printers:
1. Two laser type printers shall be provided.
   a. One laser type printer utilized for alarm printer.
   b. One laser type printer utilized for printing reports.
2. Laser printers:
   a. Rated engine speed: 6 pages per minute minimum.
   b. Printer engine resolution: Up to 600 dpi.
   c. Minimum input paper tray capacity: 100 sheets.
   d. Minimum output paper tray capacity: 100 sheets.
   e. Capable of printing:
      1) Letter size paper.
      2) Legal size paper.
   f. Minimum toner or cartridge capacity: 2200 pages.
   g. Operating temperature: 50 to 105 DegF.
   h. Operating humidity: 20 to 80 percent (non-condensing).

2.4 ACCESSORIES

A. Provide all accessories required to furnish a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

2.5 SOURCE QUALITY CONTROL

A. Provide a performance test after factory completion and prior to shipment.
   1. Conduct a test where the system is operated continuously and checked for correct operation including loop controls, displays, printing, keyboard functions, alarm responses, and on/off sequencing control.
   2. Conduct testing with dummy I/Os to verify each control loop operation.
   3. Allow for Owner and Engineer representatives to witness testing program. Provide minimum of 15 days notice prior to testing.
   4. Do not ship prior to successful completion of this testing program.

2.6 MAINTENANCE MATERIALS

A. Furnish Owner with the following extra materials:
   1. One spare I/O card of each card type for every 10 cards or fraction thereof installed.
   2. One spare toner cartridge per laser printer provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install PLC control system in accordance with manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by these Specifications.
   2. Supervise adjustments and installation checks.
   3. Maintain and submit an accurate daily or weekly log of all commissioning functions.
      a. All commissioning functions may be witnessed by the Engineer.
      b. All reports shall be cosigned by the Contractor and the Engineer if witnessed.
   4. Conduct startup of equipment and perform operational checks.
   5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.3 DEMONSTRATION

A. Demonstrate system in accordance with Section 16980.

B. On-Site Training:

1. Provide employee of the manufacturer or certified representative to provide 3 days of operating and maintenance training at the Project site after the system has successfully undergone all field testing and acceptance procedures.
   a. As a minimum, training shall cover:
      1) Hardware overview.
      2) Software overview.
      3) Maintenance.
      4) Trouble shooting.
      5) Operation, e.g. changing set points, passwords, etc.

END OF SECTION