AR TARGET SHEET

The following document was too large to scan as one unit, therefore, it has been broken down into sections.

EDMC#: 0068956
SECTION: 4 OF 4

DOCUMENT #:

TITLE: Modification of RCRA Permit for TSD of Dangerous Waste Rev 008 to Incorporate Final Permit Conditions for IDF

Tabular summary on each diagram.

<u>Transmitting Instruments:</u> Output capability.

<u>Receiving Instruments:</u> Input impedance.

<u>Loop Wiring Impedance:</u> Estimate based on wire sizes and lengths shown.

Total loop impedance.

Reserve output capacity.

Conduit and cable schedule names.

<u>Interconnecting Wiring Diagrams:</u>

Diagrams, device designations, and symbols in accordance with NEMA ICS 1.

Diagrams shall bear electrical Construction Subcontractor's signature attesting diagrams have been coordinated with Division 16, ELECTRICAL.

<u>Show:</u>

Electrical connections between equipment, consoles, panels, terminal junction boxes, and field mounted components.

Component and panel terminal board identification numbers, and external wire and cable numbers.

Circuit names matching Conduit and Cable Schedule.

Intermediate terminations between field elements and panels for, e.g., to terminal junction boxes and pull boxes.

Pull boxes.

<u>Factory Demonstration Test (FDT):</u> Provide FDT documentation for control panels.

<u>Installation Details:</u> Include modifications or further details required to adequately define installation of I&C components.

List of spares, expendables, test equipment and tools.

SUBMITTALS–APPROVAL NOT REQUIRED

Information/Record (IR): For PICS equipment, provide Manufacturer's Certificate of Proper Installation and readiness for operation.

Tank Farm Contractor Training Plan: In accordance with Article TRAINING.

Construction Quality Control Test Data: Provide documentation of Operation Readiness Test (ORT) and Performance Acceptance Test (PAT).

Operation and Maintenance (O&M) Manuals:

Content and Format:

Complete sets O&M manuals.

Sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for each PICS component.

Final versions of Legend and Abbreviation Lists.

Include:

Process and Instrumentation Diagrams: One reproducible copy of revised P&ID to reflect as-built PICS design.

Refer to paragraph Shop Drawings for the following items:

Bill of Materials.

Catalog Cuts.

Component Data Sheets.

Panel Control Diagrams.

Panel Wiring Diagrams, one reproducible copy.

Loop Diagrams, one reproducible copy.

Interconnecting Wiring Diagrams, one reproducible copy.

Device O&M manuals for components, electrical devices, and mechanical devices include:

Operations procedures.

Installation requirements and procedures.

Maintenance requirements and procedures.

Troubleshooting procedures.

Calibration procedures.

Internal schematic and wiring diagrams.

Component Calibration Sheets from field quality control calibrations.

List of spares, expendables, test equipment and tools provided.

List of additional spares, expendables, test equipment and tools recommended.

<u>Factory Demonstration Test (FDT), Operational Readiness Test (ORT), and Performance Acceptance Tests (PAT) Submittals:</u>

<u>Preliminary Test Procedures:</u> Outlines of proposed tests, forms, and checklists.

<u>Final Test Procedures:</u> Proposed test procedures, forms, and checklists.

<u>Test Documentation:</u> Copy of signed off test procedures when tests are completed.

<u>Application Software Submittal and Design Workshops:</u>

<u>Location:</u> There shall be a minimum of six (6) workshops held at the Tank Farm Contractor's facility (or by video and audio conferencing) during the course of the project.

<u>Objective:</u> To provide a vehicle by which the Tank Farm Contractor is able review and comment on PLC, OIU, communication hardware, standard software, and application software submittals and application software development.

Documentation: Application software supplier shall summarize resolutions reached in each workshop, including cost and schedule impacts and distribute copies to Tank Farm Contractor.

Order and minimum topics to be covered in each workshop:

Applications Software Design Workshop (kick off) that establishes project processes, including:

Workshop objectives.

Submittal process.

Review Work Sequence and schedule.

Loop Specifications, P&ID Review Workshop:

Application Software Supplier use P&IDs and Specifications to present how the proposed control system design and Applications Software will meet the functional requirements specified herein.

At the completion of workshop Applications Software Supplier modifies as necessary Loop Specifications.

Submit finalized Loop Specification along with an outline of any application software cost and schedule impacts.

PLC Software Standards Submittal Workshop: PLC Software Standards shall be developed in a Software Standards Workshop. Ladder diagram standards for commonly used functions, including the following:

Objective: To develop, implement, and review implementation of PLC Software Standards in ladder logic programming.

Ladder diagram standards for commonly used functions, including the following:

High and low process variable alarm checking.

Instrument failure alarm detection.

Equipment start/stop control.

Equipment failure detection.

Equipment run time.

Leak detection and equipment interlocks.

Signal filtering.

Flow totalization.

Alarm routines.

Interface with OIU.

Memory mapping, data transfer (read/write, remote set point adjustment, pump control and alarm management).

Submit for review ladder logic programming for each PLC including: descriptive ladder logic, cross references, memory map and point databases.

OIU Standard Workshop:

Objective: To develop, implement, and review implementation of OIU standards with Tank Farm Contractor.

Design Products and Topics to be Finalized:

OIU and PLC integration.

OIU tag naming conventions.

Process, set point, and runtime graphics.

Display paging and navigation.

Dynamic Objects: Pumps, valves, gates, compressors, etc.

Equipment control through pop up windows.

General data entry through the OIU.

<u>Dynamic Objects:</u> Pumps, valves, gates, process indicators, indicators with alarms, data entry, controller face plate, and tanks.

Security.

Alarm Management.

<u>Minimum OIU Design Products and Topics to be Finalized for Each OIU:</u>

Eight (8) Process Graphics.

Eight (8) Pop-Up Equipment Operation Control Graphics.

One (1) Alarm Summary Process Control Graphic.

One (1) Alarm History Process Control Graphic.

One (1) Equipment Runtime Process Control Graphic.

One (1) Analog Process Summary Control Graphic.

Submit for review OIU programming and development for each OIU computer including: memory mapping, database structures, graphic displays, and alarms.

<u>DELIVERY, STORAGE, AND HANDLING:</u>

Provide site and warehouse storage facilities for PICS equipment.

Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer.

Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

Cover panels and other elements that are exposed to dusty construction environments.

Electrical equipment (valves, instruments, sensors, enclosures) shall be wired complete and in accordance with the manufacturer's wiring diagrams and instructions.

Completed wiring diagrams shall be incorporated in the O&M submittal.

ENVIRONMENTAL REQUIREMENTS:

Standard Environmental Requirements: Unless otherwise noted, provide equipment for continuous operation in these environments:

Freestanding Panel and Consoles:

Inside: NEMA 12.

Smaller Panels and Assemblies (that are not Freestanding):

Inside: NEMA 4X.

All Other Locations: NEMA 4X.

Field Elements: Outside.

Special Environmental Requirements: Design panels for continuous operation in environments listed:

Building Sump Local Control Panel to be installed inside Cell No. 1 and Cell No. 2 Crest Pad Buildings.

Transfer Pump Local Control Panel to be installed inside Cell No. 1 and Cell No. 2 Leachate Transfer Buildings.

Leachate Storage Tank Local Control Panel to be installed outdoors adjacent to Cell No. 1 and Cell No. 2 Leachate Storage Tanks.

Combined Sump Local Control Panel to be installed inside Cell No. 1 and Cell No. 2 Crest Pad Buildings.

Control Panel to be installed inside Cell No. 1 and Cell No. 2 Crest Pad Buildings.

Environmental Design Requirements: Environmental conditions are defined below:

Inside:

Temperature: 10 to 30 degrees C.

Relative Humidity: 15 to 90 percent noncondensing.

NEC Classification: Nonhazardous.

Outside:

Temperature: Minus 40 to 40 degrees C.

Relative Humidity: 15 to 90 percent noncondensing.

NEC Classification: Nonhazardous (except for interior of Combined Sump Assemblies).

Snow Accumulation: 5 inches.

SEQUENCING AND SCHEDULING:

Activity Completion: The following is a list of key activities and their completion criteria:

Shop Drawings: Reviewed and approved.

Factory Demonstration Testing of Control Panels: Reviewed and accepted.

Hardware Delivery: Hardware delivered to site and inventoried by Tank Farm Contractor.

ORT: Completed and required test documentation accepted.

PAT: Completed and required test documentation accepted.

PICS Substantial Completion: When Construction Manager issues Certificate of Substantial Completion.

Prerequisites:

All PICS Submittals have been completed.

PICS has successfully completed FDT and PAT.

Tank Farm Contractor training plan is on schedule.

All spares, expendables, and test equipment have been delivered to Tank Farm Contractor.

PICS Acceptance: When Construction Manager issues a written notice of Final Payment and Acceptance.

Prerequisites:

Certificate of Substantial Completion issued for PICS.

Punch-list items completed.

Final revisions to O&M manuals accepted.

Maintenance service agreements for PICS accepted by Tank Farm Contractor.

Prerequisite Activities and Lead Times: Do not start the following key Project activities until the prerequisite activities and lead times listed below have been completed and satisfied:

Activity	Prerequisites and Lead Times
Submittal reviews by Engineer and Tank Farm Contractor	Tank Farm Contractor acceptance of Submittal breakdown and schedule.
Hardware purchasing, fabrication, and assembly.	Associated shop drawing Submittals completed.
Shipment	Completion of PICS Shop Drawing and Quality Control Submittals, preliminary O&M manuals, and Factory Demonstration Testing.
ORT	ORT procedures completed; notice 3 weeks prior to start.
Tank Farm Contractor Training	Tank Farm Contractor training plan completed.
PAT	Startup, Tank Farm Contractor training, and PAT procedures completed; notice 4 weeks prior to start.

PART 2--PRODUCTS

GENERAL:

The general functions of the PICS are as depicted on the Drawings. The PICS Contractor shall provide a full-featured system that is complete, calibrated, and fully operational.

Like Equipment Items:

Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

LOOP SPECIFICATIONS:

Location: Article SUPPLEMENTS.

Organization: By unit process and loop number.

Functional Requirements for Control Loops:

Shown on Drawings, in Panel Control Diagrams, and Process and Instrumentation Diagrams (P&ID). P&ID format and symbols are in accordance with ISA S5.1, except as specified or shown on Drawings.

Supplemented by Loop Specifications.

Subheadings for Each Loop:

Functions: Clarifies functional performance of loop, including abstract of interlocks.

Components: Lists major components for each loop. Information listed include: Tag numbers.

Component Identification Codes: Alphanumeric codes of required components. Refer to Component Specification referenced in Article SUPPLEMENTS.

Component Names and Options: Required to tailor general Component Specifications to specific application. For example, special materials, mounting, size, unit range, scale, set points, and controller options.

I&C COMPONENTS:

Components for Each Loop: Major components for each loop are listed in Instrument List referenced in Article SUPPLEMENTS. Furnish all equipment that is necessary to achieve required loop performance.

Component Specifications: Generalized specifications for each type of component are located in Article SUPPLEMENTS.

NAMEPLATES AND TAGS:

Panel Nameplates: Enclosure identification located on the enclosure face.

Location and Inscription: As shown.

Materials: Laminated plastic attached to panel with stainless steel screws.

Letters: 1/2-inch white on black background, unless otherwise noted.

Component Nameplates—Panel Face: Component identification located on panel face under or near component.

Location and Inscription: As shown.

Materials: Laminated plastic attached to panel with stainless steel screws.

Letters: 3/16-inch white on black background, unless otherwise noted.

Component Nameplates—Back of Panel: Component identification located near component inside of enclosure.

Inscription: Component tag number.

Materials: Adhesive backed, laminated plastic.

Letters: 3/16-inch white on black background, unless otherwise noted.

Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches:

Inscription: Refer to:

Table under paragraph Standard Pushbutton Colors and Inscriptions.

Table under paragraph Standard Light Colors and Inscriptions.

P&IDs in Drawings.

Materials: Engraved plastic, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.

Letters: Black on gray or white background.

Service Legends: Component identification nameplate located on face of component.

Inscription: As shown.

Materials: Adhesive backed, laminated plastic.

Letters: 3/16-inch white on black background, unless otherwise noted.

Nametags: Component identification for field devices.

Inscription: Component tag number.

Materials: 16-gauge, Type 304 stainless steel.

Letters: 3/16-inch imposed.

Mounting: Affix to component with 16- or 18-gauge stainless steel wire or stainless steel screws.

ELECTRICAL REQUIREMENTS:

In accordance with Division 16, ELECTRICAL.

I&C and electrical components, terminals, wires, and enclosures: UL recognized or UL listed.

Wires Within Enclosures:

ac Circuits:

Type: 600-volt, Type SIS stranded copper.

Size: For current to be carried, but not less than No. 14 AWG.

Analog Signal Circuits:

Type: 600-volt stranded copper, twisted shielded pairs.

Size: No. 16 AWG, minimum.

Other dc Circuits:

Type: 600-volt, Type SIS stranded copper.

Size: For current carried, but not less than No. 18 AWG.

Special Signal Circuits: Use manufacturer's standard cables.

Wire Identification: Numbered and tagged at each termination.

Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

Wires entering or leaving enclosures, terminate and identify as follows:

Analog and discrete signal, terminate at numbered terminal blocks.

Special signals, terminated using manufacturer's standard connectors.

Identify wiring in accordance with Division 16, ELECTRICAL.

Terminal Blocks for Enclosures:

Wire spare PLC I/O points to terminal blocks.

One wire per terminal for field wires entering enclosures.

Maximum of two wires per terminal for 18-WG wire for internal enclosure wiring.

Spare Terminals: 20 percent of all connected terminals, but not less than 5 per terminal block.

General:

Connection Type: Screw compression clamp.

Compression Clamp:

Complies with DIN-VDE 0611.

Hardened steel clamp with transversal groves that penetrate wire strands providing a vibration-proof connection.

Guides strands of wire into terminal.

Screws: Hardened steel, captive and self-locking.

Current Bar: Copper or treated brass.

Insulation:

Thermoplastic rated for minus 55 to plus 110 degree C.

Two funneled shaped inputs to facilitate wire entry.

Mounting:

Standard DIN rail.

Terminal block can be extracted from an assembly without displacing adjacent blocks.

End Stops: Minimum of one at each end of rail.

Wire Preparation: Stripping only permitted.

Jumpers: Allow jumper installation without loss of space on terminal or rail.

Marking System:

Terminal number shown on both sides of terminal block.

Allow use of preprinted and field marked tags.

Terminal strip numbers shown on end stops.

Mark terminal block and terminal strip numbers as shown on Panel Control Diagrams and Loop Diagrams.

Terminal Block, General-Purpose:

Rated Voltage: 600V ac.

Rated Current: 30 amp.

Wire Size: No. 22 to No. 10 AWG.

Rated Wire Size: No. 10 AWG.

Color: Grey body.

Spacing: 0.25 inch, maximum.

Test Sockets: One screw test socket 0.079-inch diameter.

Manufacturer and Product: Entrelec; Type M4/6.T.

Terminal Block, Ground:

Wire Size: No. 22 to No. 12 AWG.

Rated Wire Size: No. 12 AWG.

Color: Green and yellow body.

Spacing: 0.25 inch, maximum.

Grounding: Ground terminal blocks electrically grounded to the mounting rail.

Manufacturer and Product: Entrelec; Type M4/6.P.

Terminal Block, Blade Disconnect Switch:

Rated Voltage: 600V ac.

Rated Current: 10-amp.

Wire Size: No. 22 to No. 12 AWG.

Rated Wire Size: No. 12 AWG.

Color: Grey body, orange switch.

Spacing: 0.25 inch, maximum.

Manufacturer and Product: Entrelec; Type M4/6.SN.T.

Terminal Block, Fused, 24V dc:

Rated Voltage: 600V dc.

Rated Current: 16-amp.

Wire Size: No. 22 to No. 10 AWG.

Rated Wire Size: No. 10 AWG.

Color: Grey body.

Fuse: 0.25 inch by 1.25 inches.

Indication: LED diode 24V dc.

Spacing: 0.512 inch, maximum.

Manufacturer and Product: Entrelec; Type M10/13T.SFL.

Terminal Block, Fused, 120V ac:

Rated Voltage: 600V ac.

Rated Current: 16-amp.

Wire Size: No. 22 to No. 10 AWG.

Rated Wire Size: No. 10 AWG.

Color: Grey body.

Fuse: 0.25 inch by 1.25 inches.

Indication: Neon Lamp 110V ac.

Leakage Current: 1.8 mA, maximum.

Spacing: 0.512 inch, maximum.

Manufacturer and Product: Entrelec; Type M10/13T.SFL.

Terminal Block, Fused, 120V ac, High Current:

Rated Voltage: 600V ac.

Rated Current: 35 amps.

Wire Size: No. 18 to No. 8 AWG.

<u>Rated Wire Size:</u> No. 8 AWG.

<u>Color:</u> Grey.

<u>Fuse:</u> 13/32 inch by 1.5 inches.

<u>Spacing:</u> 0.95 inch, maximum.

<u>Manufacturer and Product:</u> Entrelec; Type MB10/24.SF.

<u>Grounding of Enclosures:</u>

Furnish copper isolated ground bus. Take car to ensure that this bus is connected to the safety ground bus at only one point.

<u>Single Point Ground for Each Analog Loop:</u>

Group and connect shields in following locations:

Control Panel.

Ground terminal block rails to ground bus.

<u>Analog Signal Isolators:</u> Furnish signal isolation for analog signals that are sent from one enclosure to another and where required to provide proper function. Do not wire in series instruments on different panels, cabinets, or enclosures.

<u>Power Distribution Within Panels:</u>

<u>Feeder Circuits:</u>

One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.

Make provisions for feeder circuit conduit entry.

Furnish terminal blocks for termination of wires.

<u>Power Panel:</u> Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.

Locate to provide clear view of and access to breakers when door is open.

Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker.

Branch Circuit Breaker: Select size of circuit breaker to suit load at 250V ac.

Breaker Manufacturers and Products: Allen-Bradley 1492-GH.

Circuit Wiring: P&IDs and Control Diagrams on Drawings show function only. Use following rules for actual circuit wiring:

Devices on Single Circuit: 20, maximum.

Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.

Branch Circuit Loading: 12 amperes continuous, maximum.

Panel Lighting and Service Outlets: Put on separate 15-amp, 120V ac branch circuit.

Provide 120-volt ac plugmold for panel components with line cords.

Signal Distribution:

Within Panels: 4 to 20 mA dc signals may be distributed as 1 to 5V dc.

Outside Panels: Isolated 4 to 20 mA dc only.

All signal wiring in twisted shielded pairs.

Between Panels: 4 to 20 mA dc signals isolated by current signal isolators.

Signal Switching:

Use dry circuit type relays or switches.

No interruption of 4 to 20 mA loops during switching.

Switching Transients in Associated Signal Circuit:

4 to 20 mA dc Signals: 0.2 mA, maximum.

1 to 5V dc Signals: 0.05V, maximum.

Current Signal Isolators:

Solid state three- and four-way isolation of the input signal, two output signals, and external power supply.

Features:

Zero and span trim adjustments using 15-turn potentiometers.

Calibration independent of load.

Signal Interface:

Input: 4 to 20 mA dc maximum impedance: 75 ohms.

Output: Two 4 to 20 mA dc. Capable of drives output load impedance up to 1,050 ohms independent of supply voltage to isolator.

Enclosure: NEMA 1, unless otherwise noted.

Mounting: DIN rail, unless otherwise noted.

Power: 115V ac, unless otherwise noted.

Manufacturer: Moore ECT Isolators; or approved equal.

Intrinsic Safety:

Programmable three-channel switching amplifier with intrinsically safe input circuits, used to isolate and transfer discrete signals from Class I, Class II, or Class III hazardous location to a nonhazardous location.

Inputs: Three-channel dry contact inputs to switching amplifier.

Outputs: Three-channel SPDT dry relay contact outputs, each selectable to be (N.O.) or (N.C.) Output function dependent upon input condition.

Indications: Two-color switching status LED for each channel. "Yellow" LED when output relay is energized. "Green" LED with power ON status, "Red" LED for Fault Condition.

Supply Voltage: 10-30 VDC.

Power Consumption: >2 watts.

Output contact Ratings: 500 VA/60W.

Approvals and Certifications: FM approved, and CSA Certified.

Manufacturer and Product: TURK MD13-231Ex0-R/24VDC or equal.

Relays:

General:

Relay Mounting: Plug-in type socket.

Relay Enclosure: Furnish dust cover.

Socket Type: Screw terminal interface with wiring.

Socket Mounting: Rail.

Provide holddown clips.

Control Circuit Switching Relay, Nonlatching:

Type: Compact general-purpose plug-in.

Contact Arrangement: 3 Form C contacts.

Contact Rating: 10A at 28V dc or 240V ac.

Contact Material: Silver cadmium oxide alloy.

Coil Voltage: As noted or shown.

Coil Power: 1.2 watts (dc), 1.75VA (ac).

Expected Mechanical Life: 10,000,000 operations.

Expected Electrical Life at Rated Load: 100,000 operations.

Indication Type: Neon or LED indicator lamp.

Push to test button.

Manufacturer and Product: Allen-Bradley; 700-HA Series.

For all 11-pin relays use Allen-Bradley 700-HN203. For 8-pin relays, use Allen-Bradley 700-HN203.

Control Circuit Switching Relay, Latching:

Type: Dual coil mechanical latching relay.

Contact Arrangement: 2 Form C contacts.

Contact Rating: 10A at 28V dc or 120V ac.

Contact Material: Silver cadmium oxide alloy.

Coil Voltage: As noted or shown.

Coil Power: 2.7 watts (dc), 5.3VA (ac).

Expected Mechanical Life: 500,000 operations.

Expected Electrical Life at Rated Load: 50,000 operations.

Manufacturer and Product: Potter and Brumfield; Series KB/KBP.

Control Circuit Switching Relay, Time Delay:

Type: Adjustable time delay relay.

Contact Arrangement: 3 Form C contacts.

Contact Rating: 10A at 240V ac.

Contact Material: Silver cadmium oxide alloy.

Coil Voltage: As noted or shown.

Operating Temperature: Minus 10 to 55 degrees C.

Repeatability: Plus or minus 0.5 percent.

Timing Module: Solid state multifunction plug-in module. Plugs into socket to add timing feature to general purpose relay.

Manufacturer and Products: Allen-Bradley 700-HT1 for ac, 700-HT2 for dc.

Power Supplies:

Furnish to power instruments requiring external dc power, including two-wire transmitters and dc relays.

Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with plus or minus 0.05 percent voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.

Provide output over voltage and over current protective devices to:

Protect instruments from damage due to power supply failure.

Protect power supply from damage due to external failure.

Enclosures: NEMA 1 in accordance with NEMA 250.

Mount such that dissipated heat does not adversely affect other components.

Fuses: For each dc supply line to each individual two-wire transmitter.

Type: Indicating.

Mount so fuses can be easily seen and replaced.

Resistors: All resistors used to derive a 1-5V dc signal from a 4-20 mA dc signal shall be 250 ohm, ±1 percent, 3 watts, axial lead, non-inductive wire wound, welded construction, silicone coated, 1,000V ac dielectric. Vishay-Dale RS-2B-NS or equal. 250 ohms is a standard value in this line, and use of a resistance other that 250 ohms is not acceptable.

Internal Panel Lights for Freestanding Panels:

Type: Switched 100-watt fluorescent back-of-panel lights.

Quantity: One light for every 4 feet of panel width.

Mounting: Inside and in the top of back-of-panel area.

Protective metal shield for lights.

Service Outlets for Freestanding Panels:

Type: Three-wire, 120-volt, 15-ampere, GFI duplex receptacles.

Quantity:

For Panels 4 Feet Wide and Smaller: One.

For Panels Wider Than 4 Feet: One for every 4 feet of panel width, two minimum per panel.

Mounting: Evenly spaced along back-of-panel area.

Standard Pushbutton Colors and Inscriptions: Use following color code and inscriptions for pushbuttons, unless otherwise noted in Instrument List, Article SUPPLEMENTS.

Tag Function	Inscription(s)	Color
OO	ON	Red
	OFF	Green
OC	OPEN	Red
	CLOSE	Green
OCA	OPEN	Red
	CLOSE	Green
	AUTO	White
OOA	ON	Red
	OFF	Green
	AUTO	White
MA	MANUAL	Yellow
	AUTO	White
SS	START	Red
	STOP	Green
RESET	RESET	Red
EMERGENCY STOP	EMERGENCY STOP	Red

Unused or Noninscribed Buttons: Black.

Standard Light Colors and Inscriptions: The following table gives the inscriptions for service legends, and the lens colors for indicating lights.

Tag Function	Inscription(s)	Color
ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Green
FAIL	FAIL	Amber
HIGH	HIGH	Red
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

Lettering Color:

Black on white and amber lenses.

White on red and green lenses.

FABRICATION:

General:

Panels with external dimensions and instruments arrangement as shown on Drawings.

Panel Construction and Interior Wiring: In accordance with the National Electrical Code, state and local codes, NEMA, ANSI, UL, and ICECA.

Fabricate panels, install instruments, wire, and plumb, at the PICS factory.

Electrical Work: In accordance with Division 16, ELECTRICAL.

Shop Assembly: No panel assembly other than correction of minor defects or minor transit damage shall be done on panels at site.

UL Label for Enclosures: UL label stating “Listed Enclosed Industrial Control Panel.”

Wiring Within PICS Panels:

Routed through slotted PVC wiring duct with mating cover.

Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.

Arrange wiring neatly, cut to proper length, and remove surplus wire.

Abrasion protection for wire bundles which pass through holes or across edges of sheet metal.

Connections to Screw Type Terminals:

Locking-fork-tongue or ring-tongue lugs.

Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations and to avoid crossovers at a 90 degree angle.

Wires terminated in a crimp lug, maximum of one.

Lugs installed on a screw terminal, maximum of two.

Connections to Compression Clamp Type Terminals:

Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.

Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two, or quantity as approved by manufacturer.

Splicing and tapping of wires, allowed only at device terminals or terminal blocks.

Terminate 24V dc and analog terminal blocks separate from 120V ac circuit terminal blocks.

Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.

Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

Plastic Wire Ducts Fill: Do not exceed manufacturer's recommendation.

Temperature Control:

Freestanding Panels:

Nonventilated Panels: Size to adequately dissipate heat from equipment mounted inside panel or on panel.

Ventilated Panels:

Provide all ventilated panels with louvers and fans with filters or other cooling means as required to maintain internal temperature between 40 degrees F to 90 degrees F.

For panels with backs against wall, furnish louvers on top and bottom of panel sides.

For panels without backs against wall, furnish louvers on top and bottom of panel back.

Louver Construction: Stamped sheet metal.

Ventilation Fans:

Furnish where required to provide adequate cooling.

Create positive internal pressure within panel.

Fan Motor Power: 120 volts, 60-Hz ac, thermostatically controlled.

Air Filters: Washable aluminum, Hoffman Series A-FLT.

Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.

Freestanding Panel Construction:

Materials: Sheet steel, unless otherwise shown on Drawings with minimum thickness of 12-gauge, unless otherwise noted.

Panel Fronts:

Fabricated from a single piece of sheet steel, unless otherwise shown on Drawings.

No seams or bolt heads visible when viewed from front.

Panel Cutouts: Smoothly finished with rounded edges.

Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.

Internal Framework:

Structural steel for instrument support and panel bracing.

Permit panel lifting without racking or distortion.

Lifting rings to allow simple, safe rigging and lifting of panel during installation.

Adjacent Panels: Securely bolted together so front faces are parallel.

Doors: Full height, fully gasketed access doors where shown on Drawings.

Latches: Three-point, Southco Type 44.

Handles: "D" ring, foldable type.

Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.

Rear Access Doors: Extend no further than 24 inches beyond panel when opened to 90-degree position.

Front and Side Access Doors: As shown on Drawings.

Nonfreestanding Panel Construction:

Based on environmental design requirements required and referenced in Article ENVIRONMENTAL REQUIREMENTS, provide the following:

For panels listed as inside:

Enclosure Type: NEMA 12 in accordance with NEMA 250.

<u>Materials:</u> Steel.

For all other panels:

<u>Enclosure Type:</u> NEMA 4X in accordance with NEMA 250.

<u>Materials:</u> Type 316 stainless steel.

<u>Metal Thickness:</u> 14-gauge, minimum.

<u>Doors:</u>

Rubber-gasketed with continuous hinge.

Stainless steel lockable quick-release clamps.

<u>Manufacturers:</u>

Hoffman Engineering Co.

H. F. Cox.

<u>Factory Finishing:</u>

<u>Enclosures:</u>

<u>Stainless Steel and Aluminum:</u> Not painted.

<u>Nonmetallic Panels:</u> Not painted.

<u>Steel Panels:</u>

Sand panel and remove mill scale, rust, grease, and oil.

Fill imperfections and sand smooth.

Prepare metal and paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.

Sand surfaces lightly between coats.

<u>Dry Film Thickness:</u> 3 mils, minimum.

<u>Color:</u> Light gray.

Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.

CORROSION PROTECTION:

Corrosion-Inhibiting Vapor Capsule Manufacturers:

Northern Instruments; Model Zerust VC.

Hoffmann Engineering Co; Model A-HCI.

SOURCE QUALITY CONTROL:

Factory Demonstration Testing (FDT):

Scope: Test PICS control panels to demonstrate panel assemblies are operational, prior to shipment:

Location: PICS factory.

Loop-Specific Functions: Demonstrate proper functions for each control loop, as shown on P&IDs and as required.

Make following documentation available to Construction Manager both before and after FDT:

Master copy of FDT procedures.

List of equipment to be tested including make, model, and serial number.

Equipment and loop verification sheets signed by PICS Construction Subcontractor showing that each equipment and loop has been tested and has functioned properly.

PART 3--EXECUTION

EXAMINATION:

For equipment not provided by PICS, but that directly interfaces with the PICS, verify the following conditions:

Proper installation.

Calibration and adjustment of positioners and I/P transducers.

Correct control action.

Switch settings and dead bands.

Opening and closing speeds and travel stops.

Input and output signals.

Report discrepancies to the Construction Manager.

INSTALLATION:

Material and Equipment Installation: Retain a copy of manufacturers' instructions at site, available for review at all times.

Electrical Wiring: As specified in Division 16, ELECTRICAL

Removal or Relocation of Materials and Equipment:

Remove from site materials that were part of the existing facility but are no longer used, unless otherwise directed by Construction Subcontractor to deliver to Construction General Contractor.

Repair affected surfaces to conform to type, quality, and finish of surrounding surface.

CONSTRUCTION QUALITY CONTROL

Testing:

Onsite testing shall be required for each major process instrumentation and control system in accordance with this section and submitted/accepted test procedures. Provide personnel and equipment in support of Operation Readiness (ORT) and Performance Acceptance (PAT) testing.

Tests shall be performed to demonstrate that each function is implemented and operational. These tests are electrical component tests to be performed in advance of facility-wide construction acceptance testing (CAT). CAT shall be performed in accordance with Division 1 requirements. Copies of all tests shall be submitted as specified herein.

Startup and Testing Team:

Thoroughly inspect installation, termination, and adjustment for components and systems.

Complete onsite tests.

Complete onsite training.

Provide startup assistance.

Operational Readiness Testing (ORT) Inspections and Calibrations: Prior to startup, inspect and test to ensure that entire PICS is ready for operation.

Loop/Component Inspections and Calibrations:

Check PICS for proper installation, calibration, and adjustment on a loop-by-loop and component-by-component basis.

Prepare component calibration sheet for each active component (except simple hand switches, lights, gauges, and similar items).

Project name.

Loop number.

Component tag number.

Component code number.

Manufacturer for elements.

Model number/serial number.

Summary of functional requirements, for example:

Indicators and recorders, scale and chart ranges.

Transmitters/converters, input and output ranges.

Computing elements' function.

Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).

Calibrations, for example:

<u>Analog Devices:</u> Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.

<u>Discrete Devices:</u> Actual trip points and reset points.

Space for comments.

These inspections and calibrations will be witnessed by the Construction Manager or designated representative(s).

<u>Performance Acceptance Tests (PAT):</u>

<u>General:</u>

Test all PICS elements to demonstrate that PICS satisfies all requirements.

<u>Test Format:</u> Cause and effect.

Person conducting test initiates an input (cause).

Specific test requirement is satisfied if correct result (effect) occurs.

<u>Procedures, Forms, and Checklists:</u>

Conduct tests in accordance with, and documented on, Tank Farm Contractor accepted procedures, forms, and checklists.

Describe each test item to be performed.

Have space after each test item description for sign off by appropriate party after satisfactory completion.

<u>Required Test Documentation:</u> Test procedures, forms, and checklists. All signed by Construction Manager and Construction General Contractor.

<u>Conducting Tests:</u>

Provide special testing materials, equipment, and software.

Wherever possible, perform tests using actual process variables, equipment, and data.

If it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation.

Define simulation techniques in test procedures.

Coordinate PICS testing with Construction Manager and affected Construction Subcontractors.

Test Requirements:

Once facility has been started up and is operating, perform a witnessed PAT on complete PICS to demonstrate that it is operating as required. Demonstrate each required function on a paragraph-by-paragraph and loop-by-loop basis.

Perform local and manual tests for each loop before proceeding to remote and automatic modes.

Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.

Make updated versions of documentation required for PAT available to Construction Manager at site, both before and during tests.

Make one copy of O&M manuals available to Construction Manager at the site both before and during testing.

TRAINING:

General:

Provide an integrated training program to meet specific needs of Tank Farm Contractor's personnel in accordance with submitted and accepted training plan.

Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.

Provide instruction on two working shifts as needed to accommodate the Tank Farm Contractor's personnel schedule.

Tank Farm Contractor reserves the right to make and reuse video tapes of training sessions.

Provide reference handouts that cover the course content for all personnel attending any course or training session.

Operations and Maintenance Training:

Include a review of O&M manuals and survey of spares, expendables, and test equipment.

Use equipment similar to that provided or currently owned by Tank Farm Contractor.

Provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics or instrumentation.

Operations Training:

Training Session Duration: One 8-hour instructor days.

Number of Training Sessions: Two.

Location: Site.

Content: Conduct training on loop-by-loop basis.

Loop Functions: Understanding of loop functions, including interlocks for each loop.

Loop Operation: For example, adjusting process variable set points, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.

Interfaces with other control systems.

Maintenance Training:

Training Session Duration: One 8-hour instructor days.

Number of Training Sessions: One.

Location: Project site.

Content: Provide training for each type of component and function provided.

Loop Functions: Understanding details of each loop and how they function.

Component calibration.

Adjustments: For example, controller tuning constants, current switch trip points, and similar items.

Troubleshooting and diagnosis for components.

Replacing lamps, fuses.

Component removal and replacement.

Periodic maintenance.

CLEANING/ADJUSTING:

Repair affected surfaces to conform to type, quality, and finish of surrounding surface.

Cleaning:

Prior to closing system using tubing, clear tubing of interior moisture and debris.

Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

PROTECTION:

Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

Periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules just prior to Final Payment and Acceptance.

SUPPLEMENTS:

Supplements listed below, following "END OF SECTION," are part of this Specification.

Supplement 1—Instrument Listing for Cell No. 1 and Cell No. 2.

Supplement 2—Component Specifications.

Supplement 3—PLC Input and Output List.

Supplement 4—Loop Specifications.

END OF SECTION 13401

INSTRUMENT LISTING FOR CELL NO. 1 AND CELL NO. 2

Item	Rev	Tag 1	Tag 2	Tag 3	Tag 4	Description	Description	Drawing	Component Number	Process Ranges	Eng. Units	Detail	Comments
		Area	Process	ISA	Eqt #								
1	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Enclosure	H-2-830855	Reference 13401 PICS	NA		Reference Controls on Dwg. H-2-830857 sheet 1	48"W x 20"D x 72"High NEMA 12
2	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Operator Interface Unit	H-2-830855	Y50	NA			Ethernet Communication
20	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Main and Sub Breakers	H-2-830855	Reference 13401 PICS	NA			
21	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	High Density Breakers	H-2-830855	Reference 13401 PICS	NA			
22	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Surge Protection	H-2-830855	Reference 13401 PICS	NA			
23	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	24 V dc Power Supplies	H-2-830855	Reference 13401 PICS	NA			Size power supplies for all control loops and various local control panel power
24	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	PLC, I/O, Power Supply and Chassis	H-2-830855	Y50	NA			
24	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	PLC Programming and Communication Software	H-2-830855	Y50	NA			
24	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Programming Laptop	H-2-830855	Y50	NA			
25	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Ethernet Switch and Mouting Bracket	H-2-830855	Y50	NA			
26	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Wiring Duct	H-2-830855	Reference 13401 PICS	NA			
27	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Wiring Terminal Strips Analog	H-2-830855	Reference 13401 PICS	NA			
28	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Interposing Relays	H-2-830855	Reference 13401 PICS	NA			
29	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Wiring Terminal Strips Discrete and Power	H-2-830855	Reference 13401 PICS	NA			
3	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Locking Mechanism	H-2-830855	Reference 13401 PICS	NA			
30	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Cooling Fan	H-2-830855	Reference 13401 PICS	NA			
30	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Temperature Thermostat	H-2-830855	Reference 13401 PICS	NA		Reference Controls on Dwg. H-2-830857 sheet 2	

INSTRUMENT LISTING FOR CELL NO. 1 AND CELL NO. 2

Item	Rev	Tag 1	Tag 2	Tag 3	Tag 4	Description	Description	Drawing	Component Number	Process Ranges	Eng. Units	Detail	Comments
		Area	Process	ISA	Eqt #								
31	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Programming Receptacle	H-2-830855	Reference 13401 PICS	NA			
32	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Uninterruptible Power Supply	H-2-830855	Y40	NA		Reference Controls on Dwg. H-2-830857 sheet 2	1050 VA, 120V in - 120V out
33	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Incandescent Lighting	H-2-830855	Reference 13401 PICS	NA			
34	0	219(Y)	LH	CP	001	Crest Pad Building Control Panel	Signal Isolators	H-2-830855	Reference 13401 PICS	NA		Reference Controls on Dwg. H-2-830857 sheet 2	
40	0	219(Y)	LH	LCP	002	Crest Pad Building Sump Local Control Panel	Enclosure	H-2-830855	Reference 13401 PICS	NA		Reference Controls on Dwg. H-2-830857 sheet 2	16"W x 8"D x 16"H NEMA 4X with internal relays, terminals
41	0	219(Y)	LH	LCP	003	Combined Sump Instrinsic Safety Local Control Panel	Enclosure	H-2-830855	Reference 13401 PICS	NA		Reference Controls on Dwg. H-2-830857 sheet 2	16"W x 8"D x 16"H NEMA 4X with internal relays, terminals
68	0	219(Y)201	LH	LCP	004	Leachate Storage Tank Local Control Panel	Enclosure	H-2-830855	Reference 13401 PICS	NA		Reference Controls on Dwg. H-2-830857 sheet 2	16"W x 8"D x 16"H NEMA 4X with internal relays, terminals
42	0	219(Y)1	LH	LCP	005	Leachate Transfer Pump Local Control Panel	Enclosure	H-2-830855	Reference 13401 PICS	NA		Reference Controls on Dwg. H-2-830857 sheet 2	16"W x 8"D x 16"H NEMA 4X with internal relays, terminals
4	0	219(Y)	LH	LI	101	Leachate Collection and Removal System	Panel Mount Level Indicator	H-2-830854 sheet 1 of 4	S27	0 to 26.75	Inches		
43	0	219(Y)	LH	LT	101	Leachate Collection and Removal System	Submersible Pressure Transducer	H-2-830854 sheet 1 of 4	L42	0 to 26.75	Inches	Detail No. 6 on Dwg. H-2-830854	Sensor supplied with termination enclosure (TBX)
5	0	219(Y)	LH	LI	104	Leak Detection System	Panel Mount Level Indicator	H-2-830854 sheet 1 of 4	S27	0 to 26.75	Inches		
44	0	219(Y)	LH	LT	104	Leak Detection System	Submersible Pressure Transducer	H-2-830854 sheet 1 of 4	L42	0 to 26.75	Inches	-	Sensor supplied with termination enclosure (TBX) under this section and installed by pump vendor
45	0	219(Y)	LH	HS	105	Crest Pad Building Sump Control Panel	Local Control Panel Mount Handswitch	H-2-830854 sheet 1 of 4	M12	NA	On/Off		Bypass Operation
46	0	219(Y)	LH	LDE	105	Crest Pad Building Sump	Leak Detection Sensor	H-2-830854 sheet 1 of 4	L109	Actuate elevation 720.5	Feet	Detail No. 4 on Dwg. H-2-830854	1/4" stem actuation from bottom
47	0	219(Y)	LH	LSH	105	Crest Pad Building Sump High	Level Float	H-2-830854 sheet 1 of 4	L8	Actuate elevation 722.0	Feet	Detail No. 1 on Dwg. H-2-830854	
48	0	219(Y)	LH	LSHH	105	Crest Pad Building Sump High High	Level Float	H-2-830854 sheet 1 of 4	L8	Actuate elevation 723.0	Feet	Detail No. 1 on Dwg. H-2-830854	
49	0	219(Y)	LH	LSL	105	Crest Pad Building Sump Low	Level Float	H-2-830854 sheet 1 of 4	L8	Actuate elevation 721.0	Feet	Detail No. 1 on Dwg. H-2-830854	

INSTRUMENT LISTING FOR CELL NO. 1 AND CELL NO. 2

Item	Rev	Tag 1	Tag 2	Tag 3	Tag 4	Description	Description	Drawing	Component Number	Process Ranges	Eng. Units	Detail	Comments
		Area	Process	ISA	Eqt #								
50	0	219(Y)	LH	HS	107	Combined Sump Instrinsic Safety Local Control Panel	Local Control Panel Mount Handswitch	H-2-830854 sheet 2 of 4	M12	NA	On/Off		Bypass Operation
51	0	219(Y)	LH	LDE	107	Combined Sump Pump	Leak Detection Sensor	H-2-830854 sheet 2 of 4	L109	Actuate elevation 714.2	Feet	Detail No. 4 on Dwg. H-2-830854	1/4" stem actuation from bottom
52	0	219(Y)	LH	LSH	107	Combined Sump High	Level Float	H-2-830854 sheet 2 of 4	L8	Actuate elevation 718.5	Feet	Detail No. 1 on Dwg. H-2-830854	
53	0	219(Y)	LH	LSHH	107	Combined Sump High High	Level Float	H-2-830854 sheet 2 of 4	L8	Actuate elevation 720.0	Feet	Detail No. 1 on Dwg. H-2-830854	
54	0	219(Y)	LH	LSL	107	Combined Sump Low	Level Float	H-2-830854 sheet 2 of 4	L8	Actuate elevation 715.0	Feet	Detail No. 1 on Dwg. H-2-830854	
55	0	219(Y)	LH	LSLL	107	Combined Sump Low Low	Level Float	H-2-830854 sheet 2 of 4	L8	Actuate elevation 714.9	Feet	Detail No. 1 on Dwg. H-2-830854	
7	0	219(Y)	LH	FI	202	Leachate Collection and Removal System Low Flow Pump	Panel Mount Flow Indicator	H-2-830854 sheet 1 of 4	S27	0 to 25	GPM		0-30 PSI Range
56	0	219(Y)	LH	FIT	202	Leachate Collection and Removal System Low Flow Pump	In-Line Flow Magmeter	H-2-830854 sheet 1 of 4	F4	0 to 25	GPM	Section A on Dwg. H-2-830847	0-30 PSI Range with integral transmitter
57	0	219(Y)	LH	HS	202	Leachate Collection and Removal System Low Flow Pump	Motor Control Handswitch	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
84	0	219(Y)	LH	PI	202	Leachate Collection and Removal System Low Flow Pump	Pressure Gauge	H-2-830854 sheet 1 of 4	P4/P6	0 to 30	PSI		0-30 PSI Range with Diaphragm Seal
58	0	219(Y)	LH	YL	202	Leachate Collection and Removal System Low Flow Pump	Motor Control On Indicator	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
8	0	219(Y)	LH	FI	203	Leachate Collection and Removal System High Flow Pump	Panel Mount Flow Indicator	H-2-830854 sheet 1 of 4	S27	0 to 250	GPM		0-60 PSI Range
59	0	219(Y)	LH	FIT	203	Leachate Collection and Removal System High Flow Pump	In-Line Flow Magmeter	H-2-830854 sheet 1 of 4	F4	0 to 250	GPM	Section A on Dwg. H-2-830847	0-60 PSI Range with integral transmitter
60	0	219(Y)	LH	HS	203	Leachate Collection and Removal System High Flow Pump	Motor Control Handswitch	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
85	0	219(Y)	LH	PI	203	Leachate Collection and Removal System High Flow Pump	Pressure Gauge	H-2-830854 sheet 1 of 4	P4/P6	0 to 60	PSI		0-60 PSI Range with Diaphragm Seal
61	0	219(Y)	LH	YL	203	Leachate Collection and Removal System High Flow Pump	Motor Control On Indicator	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
9	0	219(Y)	LH	FI	204	Leak Detection System Pump	Panel Mount Flow Indicator	H-2-830854 sheet 1 of 4	S27	0 to 15	GPM		0-15 PSI Range

INSTRUMENT LISTING FOR CELL NO. 1 AND CELL NO. 2													
Item	Rev	Tag 1	Tag 2	Tag 3	Tag 4	Description	Description	Drawing	Component Number	Process Ranges	Eng. Units	Detail	Comments
		Area	Process	ISA	Eqt #								
62	0	219(Y)	LH	FIT	204	Leak Detection System Pump	In-Line Flow Magmeter	H-2-830854 sheet 1 of 4	F4	0 to 15	GPM	Section A on Dwg. H-2-830847	0-15 PSI Range with integral transmitter
63	0	219(Y)	LH	HS	204	Leak Detection System Pump	Motor Control Handswitch	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
86	0	219(Y)	LH	PI	204	Leak Detection System Pump	Pressure Gauge	H-2-830854 sheet 1 of 4	P4/P6	0 to 15	PSI		0-15 PSI Range with Diaphragm Seal
64	0	219(Y)	LH	YL	204	Leak Detection System Pump	Motor Control On Indicator	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
65	0	219(Y)	LH	HS	205	Crest Pad Building Sump Pump	Motor Control Handswitch	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
89	0	219(Y)	LH	PI	205	Crest Pad Building Sump Pump	Pressure Gauge	H-2-830854 sheet 1 of 4	P4/P6	0 to 15	PSI		0-15 PSI Range with Diaphragm Seal
66	0	219(Y)	LH	YL	205	Crest Pad Building Sump Pump	Motor Control On Indicator	H-2-830854 sheet 1 of 4	M12	NA			Provided under Section 16440
67	0	219(Y)	LH	HS	207	Combined Sump Pump	Motor Control Handswitch	H-2-830854 sheet 2 of 4	M12	NA			Provided under Section 16440
69	0	219(Y)	LH	YL	207	Combined Sump Pump	Motor Control On Indicator	H-2-830854 sheet 2 of 4	M12	NA			Provided under Section 16440
12	0	219(Y)	LH	HS	219	Crest Pad Building	Control Panel Mount Switch	H-2-830854 sheet 1 of 4	M12	NA			Alarm Acknowledge Switch
70	0	219(Y)	LH	JSH	219	Crest Pad Building	Power Relay	H-2-830854 sheet 1 of 4	Reference 13401 PICS	NA			Power Relay mounted inside Control Panel
10	0	219(Y)1	LH	TI	219	Crest Pad Building	Panel Mount Temp Indicator	H-2-830854 sheet 2 of 4	S27	-40 to 40	Celsius		
71	0	219(Y)	LH	TIT	219	Crest Pad Building	Temperature Transmitter	H-2-830854 sheet 1 of 4	T3	-40 to 40	Celsius		With integral transmitter
72	0	219(Y)	LH	YAL	219	Crest Pad Building	Alarm Light	H-2-830854 sheet 1 of 4	M31	NA			
11	0	219(Y)1	LH	TI	220	Leachate Transfer Building	Panel Mount Temp Indicator	H-2-830854 sheet 2 of 4	S27	-40 to 40	Celsius		
73	0	219(Y)1	LH	TIT	220	Leachate Transfer Building	Temperature Transmitter	H-2-830854 sheet 2 of 4	T3	-40 to 40	Celsius		With integral transmitter
74	0	219(Y)1	LH	YAL	220	Leachate Transfer Building	Alarm Light	H-2-830854 sheet 2 of 4	M31	NA			

INSTRUMENT LISTING FOR CELL NO. 1 AND CELL NO. 2													
Item	Rev	Tag 1	Tag 2	Tag 3	Tag 4	Description	Description	Drawing	Component Number	Process Ranges	Eng. Units	Detail	Comments
		Area	Process	ISA	Eqt #								
88	0	219(Y)201	LH	HS	301	Leachate Storage Tank Local Control Panel	Local Control Panel Mount Handswitch	H-2-830854 sheet 2 of 4	M12	NA	On/Off		Bypass Operation
75	0	219(Y)201	LH	LSHH	301	Leachate Storage Tank	Level Switch	H-2-830854 sheet 2 of 4	L1A	Actuate elevation 728.3	Feet	Detail No. 2 on Dwg. H-2-830854	
76	0	219(Y)201	LH	LSLL	301	Leachate Storage Tank	Level Switch	H-2-830854 sheet 2 of 4	L1A	Actuate elevation 722.7	Feet	Detail No. 2 on Dwg. H-2-830854	
77	0	219(Y)201	LH	LT	301	Leachate Storage Tank	Submersible Pressure Transducer	H-2-830854 sheet 2 of 4	L42	0 to 108	Inches	Detail No. 3 on Dwg. H-2-830854	Sensor supplied with termination enclosure (TBX) and Lightning Arrestor
78	0	219(Y)201	LH	LI	301-1	Leachate Storage Tank	Local Control Panel Mount Level Indicator	H-2-830854 sheet 2 of 4	S27	0 to 108	Inches		Provide Signal Isolator, and Lightning Arrestor
6	0	219(Y)201	LH	LI	301-2	Leachate Storage Tank	Panel Mount Level Indicator	H-2-830854 sheet 2 of 4	S27	0 to 108	Inches		Provide Signal Isolator
79	0	219(Y)1	LH	HS	302	Leachate Transfer Pump	Panel Mount Motor Control Handswitch	H-2-830854 sheet 2 of 4	M12	NA	On/Off		Motor On/Off control switch
87	0	219(Y)1	LH	PI	302	Leachate Transfer Pump	Pressure Gauge (Load)	H-2-830854 sheet 2 of 4	P4/P6	0 to 15	PSI		0-15 PSI Range with Diaphragm Seal
90	0	219(Y)1	LH	PI	303	Leachate Transfer Pump	Pressure Gauge (Suction)	H-2-830854 sheet 2 of 4	P4/P6	0 to 100	Inches		0-100 Inches Range with Diaphragm Seal
80	0	219(Y)1	LH	FIT/FQI	302-1	Leachate Transfer Pump	In-Line Flow Magmeter	H-2-830854 sheet 2 of 4	F4	0 to 300	GPM	Section A on Dwg. H-2-830851	0-15 PSI Range. Flow and Total Integral with same indicator.
81	0	219(Y)1	LH	YL	302-1	Leachate Transfer Pump	Local Control Panel Mount Motor Control On Indicator	H-2-830854 sheet 2 of 4	M12	NA			
82	0	219(Y)1	LH	FQI	302-2	Leachate Transfer Pump	Local Control Panel Mount Flow Totalizer Indicator	H-2-830854 sheet 2 of 4	S27	0 to 10,000	Gallons		Flow and Total Integral to same meter. Provied Signal Isolator
83	0	219(Y)1	LH	YL	302-2	Leachate Transfer Pump	Motor Control On Indicator	H-2-830854 sheet 2 of 4	M12	NA			Provided under Section 16440

(Y) = A for Cell No. 1	For Cell No. 1 reference corresponding H-2-830854 sheet 1 of 4 and sheet 2 of 4.
(Y) = E for Cell No. 2	For Cell No. 2 reference corresponding H-2-830854 sheet 3 of 4 and sheet 4 of 4.

COMPONENT SPECIFICATIONS:

F4 Flow Element and Transmitter, Electromagnetic:

General:

Function: Measure, indicate, and transmit the flow of a conductive process liquid in a full pipe.

Type:

Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.

Full bore meter with magnetic field traversing entire flow-tube cross section.

Unacceptable are insert magmeters or multiple single point probes inserted into a spool piece.

Parts: Flow element, transmitter, interconnecting cables, and mounting hardware. Other parts as noted.

Service:

Stream Fluid:

As noted.

Suitable for liquids with a minimum conductivity of 5 microS/cm and for demineralized water with a minimum conductivity of 20 microS/cm.

Flow Stream Descriptions: If and as described below.

Operating Temperature:

Element:

Ambient: Minus 5 to 140 degrees F, typical, unless otherwise noted.

Process: Minus 5 to 140 degrees F, typical, unless otherwise noted.

Transmitter:

Ambient: Minus 5 to 140 degrees F, typical, unless otherwise noted.

Storage: 15 to 120 degrees F, typical, unless otherwise noted.

Performance:

Flow Range: As noted.

Accuracy: Plus or minus 0.5 percent of rate for all flows resulting from pipe velocities of 2 to 33 feet per second.

Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.

Features:

Zero stability feature to eliminate the need to stop flow to check zero alignment.

No obstructions to flow.

Very low pressure loss.

Measures bi-directional flow.

Process Connection:

Meter Size (diameter inches): As noted.

Connection Type: 150-pound ANSI raised-face flanges or wafer style depending on meter size, unless otherwise noted.

Flange Material: Carbon steel, unless otherwise noted.

Power (Transmitter): 120V ac, 60-Hz, unless otherwise noted.

Element:

Meter Tube Material: Type 304 or 316 stainless steel, unless otherwise noted.

Liner Material:

Teflon, unless otherwise noted.

Low activated waste leachate solution.

Liner Protectors: Covers (or grounding rings) on each end to protect liner during shipment.

Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.

Electrode Material: Type 316 stainless steel or Hastelloy C, unless otherwise noted.

Grounding Ring:

Required, unless otherwise noted.

Material: Type 316 stainless steel, unless otherwise noted.

Enclosure: NEMA 4X, minimum, unless otherwise noted.

Transmitter:

Mounting: Integral, unless otherwise noted.

Display: Required, unless otherwise noted.

Digital LCD display, indicating flow rate and total.

Bi-directional Flow Display: Required, unless otherwise noted.

Forward flow rate.

Forward, net totalization.

Parameter Adjustments: By keypad or non-intrusive means.

Enclosure: NEMA 4X, minimum, unless otherwise noted.

Empty Pipe Detection: Drives display and outputs to zero when empty pipe

Signal Interface (at Transmitter):

Analog Output:

Isolated 4 to 20 mA dc for load impedance from 0 to at least 500 ohms minimum for 24V dc supply.

Supports Superimposed Digital HART protocol.

Cables:

Types: As recommended by manufacturer.

Lengths: As required to accommodate device locations.

Built-in Diagnostic System:

Features:

Field programmable electronics.

Self-diagnostics with troubleshooting codes.

Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.

Initial flow tube calibration and subsequent calibration checks.

Factory Calibration:

Calibrated in an ISO 9001 and NIST certified factory.

Factory flow calibration system must be certified by volume or weight certified calibration devices.

Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.

Factory Ready for Future In situ Verifications: If noted.

Original meter parameter values available from vendor by request.

Accessories:

In situ Verification System: If noted.

Quantity: One complete system provided for the project.

Verifies quantitatively that the meter and signal converter's present condition is the same as originally manufactured.

Physical access to the flow-tube not required.

Meet standards established by the National Testing Laboratory.

Tests and stores over 50-meter parameters related to primary coils, electrodes, interconnecting cable and signal converter.

Verification standard shall be plus or minus 1 percent of wet calibration for meters produced using the calibration verification service, or plus or minus 2 percent for standard meters.

Windows-based software

Primary Simulation System: If noted.

Quantity: One complete system provided for the project.

Verifies proper operation of the signal converter by simulating the flow meter's output signal.

Generates pulsed dc excitation signal with a reference voltage of 70 mV.

Generated signal ranges from 0 to 99 percent (0 to 32.8 feet per second) with a resolution of 0.1 percent.

Switch selectable for forward, reverse and zero flow rate.

Verifies various input and output signals.

Manufacturers:

Krohne Electromagnetic Integral Systems: Aqua Flux Flowmeter (size: 3/8 to 120 inches).

Endress & Hauser, Inc. Flow Measuring System: Promag 50/53W (size: 1 to 78 inches).

Invensys Foxboro (includes IMT 25 Series Intelligent Magnetic Flow Transmitter): 9100A Series Flanged Body Flow Tubes (size: 1 to 78 inches).

L1A Multipoint Level Element and Switches, Admittance:

General:

Function: Operate switches at two separate, distinct, preset product levels in a vessel.

Type: Admittance using low power radio frequency circuit.

Parts: Element and electronics unit. For remote mount, interconnecting cable.

Service: Fluid as noted.

Performance:

Set Points: As noted.

Temperature: Operating range minus 40 to 140 degrees F.

Unaffected by coating buildup on element.

Features:

Electronics Unit:

Filtering: Built-in RFI protection.

Fail-Safe Contacts: Field convertible switch action.

Enclosure Type: Explosion-proof and weatherproof (NEMA 4).

Electronics Mounting: Integrally with element, unless otherwise noted.

When remote, provide cable with length as required to accommodate device locations.

Response Time: 20 milli-seconds standard, or as noted.

Element:

Type: Probe rod.

Insertion Length: As required to achieve noted set points.

Material: 316 stainless steel, unless otherwise noted.

Rating: Element and cable intrinsically safe.

Grounding Element: Required for nonmetallic tank applications.

Process Connection: 3/4-inch NPT unless otherwise noted.

Signal Interface: Contacts, 3 DPDT rated 5A continuous at 120V ac, minimum.

Power: 120V ac 50/60-Hz, or as noted.

Manufacturers and Products:

Drexelbrook; Model 506-3100.

Princo.

Endress & Hauser, Inc.

L8 Level Switch, Float:

General:

Function: Actuate contact at preset liquid level.

Type: Direct-acting float with an enclosed mercury switch and integral cable.

Service: Liquid; low activated waste leachate solution, unless otherwise noted.

Performance:

Set Point: As noted.

Differential: 1-inch maximum.

Temperature: 0 to 180 degrees F.

Features:

Entire Assembly: Watertight and impact-resistant.

Float Material and Size: Polyethylene/foam filled; 4.5-inch diameter tear drop.

Cable:

Combination support and signal.

Length as noted or as necessary per mounting requirements.

Type SO nitrile PVC jacket, AWG No. 18/2 or No. 18/4.

Mounting:

Pipe:

Cable-to-pipe clamp, corrosion-proof cable for 1-inch pipe.

Pipe-to-wall bracket for 1-inch pipe.

Suspended Type: As noted.

Signal Interface:

Switch Type: Mercury tilt.

Switch Contacts:

Isolated, rated 4.5A continuous at 120V ac.

As required (for example 1NO, 1NO+1NC) to meet functional requirements, or as shown.

Manufacturers and Products:

Consolidated Electric Co.; Model LS.

Anchor Scientific; Roto-Float, Type P/Type S.

L42 Level Element/Transmitter, Submersible, Wastewater:

General:

Function: Measure and transmit a signal proportional to level.

Type: Totally submersible pressure sensor (loop powered).

Parts: Sensor, interconnecting cable, sensor termination enclosure.

Service:

Fluid: Wastewater, unless otherwise noted.

Performance:

Process Range:

As noted.

Provide fixed factory range such that noted process range is between 40 and 80 percent of fixed factory range.

Accuracy: 0.25 percent of full scale.

Temperature, Operating: Minus 4 to plus 140 degrees F.

Overpressure: Range dependent.

4X for ranges of 5 psig and above (to a maximum of 2,000 psi).

Greater than 4X for ranges below 5 psig.

Long Term Stability: Plus or minus 0.1 percent full scale/year, typical.

Features:

Sensor:

Silicon sensing element.

Titanium body.

Diaphragm: Elastomeric nitrile rubber, unless otherwise noted.

<u>Pressure Connection:</u> "Flush" diaphragm.

NEMA 6 rating (submersible to 2,300 feet).

<u>Temperature Compensation:</u> Plus 28 to 80 degrees F.

<u>Dimensions:</u> 5.9L by 1.0 diameter, inches, nominal.

Loop powered, 9-30V dc.

Open face with perforated Protective Plate: 1.35 diameter, inches.

<u>Interconnecting Cable:</u>

<u>Length:</u> As required.

Polyurethane sheathed.

Kevlar strain relief cord.

Integral vent tube.

<u>Sensor Termination Enclosure:</u>

<u>Enclosure:</u> NEMA 4X, PVC/polycarbonate.

Desiccant module.

Micro filter.

<u>Wall and 2-Inch Pipe Mounting Kit:</u> Required, unless otherwise noted.

<u>Lightning Arrestor(s):</u> Required, unless otherwise noted.

<u>Signal Interface:</u> 4 to 20 Ma dc output, for load impedance of 0 to 750 ohms, minimum for 24V dc supply without load adjustment.

<u>Area Classification:</u> Intrinsically safe; certified for use in Class 1, Division 1, Groups A, B, C, and D atmospheres.

<u>Manufacturers:</u>

Druck; Type PTX 1290 with STE110.

Pressure Systems, Inc. KPSI; Series 720 with Series 815 Aneroid Bellows and Series 840 Junction Box.

L109 Level Detection Switch, Rises on Stem:

General:

Function: Actuate contact at preset liquid level.

Type: Direct acting; rises on stem.

Service: Liquid, water, wastewater, unless otherwise noted.

Performance:

Set point as noted.

Switch Actuation Point: Approximately 3/4-inch distance from end of stem to weighted support collar.

Operating Temperature Range: Minus 40 to plus 110 degrees F.

Features:

Assembly Material: Brass stem, Buna N Float, and Type 316 stainless steel wetted parts.

Float Size: 2-inch diameter.

Mounting: Suspension cable with compact-sized float, slosh shield, and weighted collar suspended in standpipes or sumps for leak detection.

Signal Interface:

Switch Type: Magnetic reed switch.

Switch Contacts:

SPST Isolated, rated at 20 VA.

NC (by inverting float on unit stem).

Cable and Lead Wires: No. 22 AWG, 25 feet of length of PVC jacketed cable.

Manufacturer and Product: GEMS; Specialty Switches Liquid Level Switch, Model LS-750.

M12 Hand Switch and Light, Oiltight, Round:

General:

Function: Select, initiate, and display discrete control functions.

Type: Heavy-duty, oiltight, industrial.

General Features:

Mounting: 30.5 mm single round hole. Panel thickness 1/16 inch to 1/4 inch.

Legend Plate: Standard size square style aluminum field and black markings, unless otherwise noted. Markings as shown.

Configuration: Light, pushbutton, or switch as noted or shown.

Light Features:

Lights: 6V ac lamps and integral transformer for operation from 120V ac, unless otherwise noted.

Lens Color: Color as specified under PANEL, STANDARD LIGHT COLOR AND INSCRIPTIONS, or as noted.

Pushbutton and Switch Features:

Guard: Full guard with flush button, unless otherwise noted.

Operator: Black pushbutton, black non-illuminated knob on switch, unless otherwise noted.

Boot: None, unless otherwise noted.

Signal Interface:

Contact Block:

Type: Silver-coated butting, unless otherwise noted.

Rating: 10 amps continuous at 120V ac or as noted.

Sequence: Break-before-make, unless otherwise shown.

Arrangement: Normally open or normally closed as shown, or perform functions noted.

Terminals: Screw with strap clamp, unless otherwise noted.

NEMA Rating: NEMA 4, watertight and dusttight and NEMA 13, oiltight.

Manufacturers/Models:

Allen-Bradley; Bulletin 800T.

Eaton Corp.; Cutler-Hammer, Type 10250T.

Square D Co.; Class 9001, Type K.

M31 Warning Light, Indoor/Outdoor:

General:

Function: Visual alarm.

Type: Rotating reflector or flashing bulb.

Parts: Light and spare bulbs.

Performance:

Temperature, Operating: Minus 35 to 190 degrees F.

Flash Rate: Nominally 90 per minute.

Features:

Dome Color: Amber, unless otherwise noted.

Lamp Life: 200 hours.

Lamp: Incandescent/25 watts.

Enclosure:

Type: Water-resistant closed cell neoprene gasket.

Mounting: Wall bracket, unless otherwise noted.

UL Listing: Indoor/outdoor use.

Power: 120V ac, 50/60-Hz.

Spare Bulbs: Two for each light.

Manufacturers:

Federal Signal; Model 225.

Benjamin Electric Manufacturing; Series KL-4000.

P4 Pressure Gauge:

General:

Function: Pressure indication.

Type: Bourdon tube.

Performance:

Scale Range: As noted.

Accuracy: Plus or minus 0.50 percent of full scale.

Features:

Liquid Filled: Required unless otherwise noted.

Glycerin fill, unless otherwise noted.

Dial: 4-1/2-inch diameter, unless otherwise noted.

Case Material: Black phenolic plastic, unless otherwise noted.

Element Material: Phosphor-bronze, unless otherwise noted.

Throttling Devices:

Pulsation dampener required, unless otherwise noted.

Brass, unless otherwise noted.

Pointer: Micrometer-adjustable.

Movement: Stainless steel, Teflon coated bearings, rotary geared.

Window: Glass, unless otherwise noted.

Socket Materials: brass, unless otherwise noted.

Threaded reinforced polypropylene front ring for easy zero adjustment.

Case Type: Solid front with solid wall between window and element. Rear of case, gasketed pressure relief.

Process Connection:

Mounting: Lower stem, unless otherwise noted.

Size: 1/2 inch, unless otherwise noted.

Connection Type: Threaded (NPT).

Manufacturers and Products:

Ashcroft; Duragauge Model 1279/1379.

Weksler; Royal Process Gauge Model AAXX.

Ametek U.S. Gauge; Solfrunt Model 19XX.

P6 Pressure Seal, Diaphragm:

General:

Function: Isolate sensing element from process fluid.

Type: Fluid filled, corrosion resistant.

Service:

Pressure: Same as associated sensor.

Temperature: As noted.

Features:

Material Lower Housing: Type 316 stainless steel, unless otherwise noted.

Diaphragm Material: Type 316 stainless steel, unless otherwise noted. Bleed screw in upper housing.

Fill Fluid: As noted. Factory filled and assembled when possible.

Process Connections:

Instrument: 1/2-inch female NPT, unless otherwise noted.

Process: 1/2-inch female NPT, unless otherwise noted.

Connection Material: compatible with pressure indicator and process lines.

Manufacturers:

Ametek, Mansfield and Green Division; Type SG.

Ashcroft; Type 101.

S27 Indicator, Digital Panel:

General:

Function: Display analog signal, or totalize analog signal, and display engineering units.

Type: 7-segment digital, horizontal edgewise.

Performance:

Range: As noted, engineering units as noted.

Accuracy: Plus or minus 0.1 percent full scale.

Temperature, Operating: 32 to 120 degrees F.

Features:

Digits: 4-1/2; 0.56-inch high minimum; 7-segment LED, gas plasma, or vacuum fluorescent.

Decimal Point: Field selectable.

Input Impedance: 100 ohms maximum.

Service Legend: Permanent, display of engineering units.

Response Time: 1 second maximum to 0.1 percent accuracy.

Signal Interface: 4 to 20 mA dc.

Enclosure:

Type: NEMA 4X.

Mounting: Panel; approximately 2-inch high, 4-inch wide, 5-inch deep.

Power: 120V ac, 50/60-Hz unless otherwise noted.

Manufacturers:

Red Lum Controls.

Action Instruments.

Analogic.

Moore Industries.

T3 Temperature Element and Transmitter, Resistance:

General:

Function: Measure the temperature of ambient, and transmit analog signal proportional to temperature.

Type: RTD.

Parts: Element and transmitter.

Service:

Process: As noted.

Process Temperature Range: As noted.

Element:

Type:

Single-element, unless otherwise noted

Three-wire, RTD.

Platinum, 100 ohm nominal at 0 degrees C.

Performance:

Accuracy: Greater of plus or minus 4 degrees F or plus or minus 0.75 percent of reading.

Features:

Dimensions: 1/4-inch diameter.

Length to accommodate thermowell insertion and extension lengths.

Spring-loaded element when well is used.

Sheath:

Type 316 Stainless Steel, unless otherwise noted.

Process Operating Temperature Range: Minus 320 to 900 degrees F, unless otherwise noted.

Terminal Connection Head:

General purpose, NEMA 4 weatherproof, unless otherwise noted.

Maximum Temperature: 220 degrees F, unless otherwise noted.

Thermowell Connection: Union Coupler, unless otherwise noted.

Sensitive Length: 1.6 inch minimum, measured from closed end.

Transmitter:

Ambient Operation Conditions.

Temperature: minus 40 to 140 degrees F, with display.

Relative Humidity: 0 to 100 percent, noncondensing.

Type: Two-wire, powered by a remote power supply.

Performance:

Accuracy: Greater of plus or minus 0.7 degree F or plus or minus 0.06 percent of span.

Response Time: 1.2 second 90 percent response time for 80 percent input step, with minimum damping.

Electrical Safety: Standard unless otherwise noted.

Features:

Indicator: Three line LCD, unless otherwise noted.

Automatic reference junction compensation.

Failsafe Mode:

User configurable ON, unless otherwise noted.

Downscale, unless otherwise noted.

Electric Damping: 1.2 seconds.

Signal Interface: 4 to 20 mA dc

Power: 24V dc external power supply.

Digital Communication: HART.

One HART communicator to be supplied for all HART capable transmitters, if not already supplied under another Specification section.

Enclosure:

Materials: Epoxy coated, low-copper aluminum, unless otherwise noted.

Type: NEMA 4X.

Mounting: Wall, as noted.

For wall, provide stainless steel mounting set, unless otherwise noted.

Manufacturers and Products:

Foxboro; RTT20 Series Transmitter with PR Series RTD and Thermowell.

Rosemount; 78 Series Platinum RTD and Model 644H Transmitter.

Y40 Uninterruptible Power Supply System:

General:

Function: Provides isolated, regulated uninterrupted ac output power during a complete or partial interruption of incoming line power.

Major Parts: Inverter, a battery charger, sealed battery.

Performance:

Capacity: As noted.

Input Power:

120V ac single-phase/60 Hz, unless otherwise noted.

Connections: As noted.

Output Power:

120V ac single-phase/60 Hz, unless otherwise noted.

Connections: As noted.

On-line Efficiency: 85 percent minimum, unless otherwise noted.

Backup Runtime:

Full Load: 9 minutes minimum, unless otherwise noted.

Half Load: 24 minutes minimum, unless otherwise noted.

Continuous no-break power with no measurable transfer time.

Sine-Wave Output Power Regulation:

Plus or minus 5 percent or less total harmonic distortion.

Meet or exceed CSA C22.2 No. 107.1 for harmonic distortion.

Voltage Regulation: Plus or minus 3 percent nominal.

Operating Temperature: 0 to 40 degrees C (32 to 104 degrees F).

Lightning and Surge Protection:

Pass lightning standard ANSI/IEEE C62.41 Categories A and B test.

2000 to 1 attenuation of input spike.

Isolation:

True separately derived power source as per NEC Article 250-5d with output neutral bonded to ground.

Complete from line.

Less than 2 pF effective input to output capacitance.

Features:

Enclosure: Floor mounted cabinet, unless otherwise noted.

RS232 external interface with full-duplex output capable of:

Remote monitoring of meter functions and alarm conditions.

Remote diagnostic testing.

Remotely set point display and adjustment.

Manufacturers:

Best Power, FERRUPS Uninterruptible Power System.

Controlled Power.

American Power Conversion; Back-UPS Pro.

Y50 Programmable Logic Controller and Operator Interface Unit System:

General:

Function: Microprocessor based system configured, assembled, and programmed in order to implement the safe automatic control and measurement of process control equipment.

System incorporates programmable logic controllers, processors, power supplies, operator interface units, communication hardware, programming and development software, and cables, and programming laptop.

Programmable Logic Controller (PLC):

Function: Used for process monitoring and control by emulating functions of conventional panel mounted equipment such as relays, timers, counters, current switches, calculation modules, PID controllers, stepping switches, and drum programmers.

PLC Parts: Central processing unit (CPU), power supply, local input/output modules, local (chassis/rack) controllers, I/O terminals board and termination cable assemblies, and factory assembled programming laptop, ETHERNET and OIU communication interconnecting cables.

PLC Central Processing Unit (CPU) Specifications:

Type: Microprocessor, 16-bit minimum.

Memory: 32K words.

I/O Capacity: 4096 inputs, 4096 outputs.

Standard RAM with lithium battery for 2 years backup.

Scan Time: 0.9 ms/1K ladder logic.

Communications:

Two communication ports, RS-232/RS485 and 10BASE-T Ethernet channel.

10 Mbps communications – TCP/IP protocol.

RS-232 and DH-485 Communication protocols.

Instruction Set:

Timers and Counters.

Math: Signed integer and floating-point math including add, subtract, multiply, divide, square root, exponent, and compare.

Register Operations: Shift registers, bit shift, bit set, bit clear, data move and data format conversion.

Process Loop Control: User configurable direct or reverse acting PID loop control computation with the capability of both AUTO and MANUAL modes of operation, remote access to controller tuning constants.

Real Time Clock: Date and time set and compare.

Miscellaneous: Jump or skip to a label, one shot, quantity drums, pre-configured analog alarm functions, subroutines, quantity.

Environment:

Operating Temperature: 0 to 55 degrees C (32 to 131 degrees F).

Storage Temperature: -25 to 70 degree C (-13 to 158 degrees F).

Relative Humidity: (noncondensing) 5 to 95 percent at 0 to 55 degrees C (32 to 131 degrees F).

Heat Dissipation: 15 Watts.

Agency Approvals and Standards:

UL listed.

CSA certified.

or another state approved agency.

Random Access Memory (RAM):

Type: CMOS type.

Word Size: 16 bits, minimum.

Battery Backup: 24 months, minimum.

Memory Size: Sufficient to implement all applications software plus 50 percent spare.

Read only memory (ROM) for controller's operating system and diagnostics.

Memory Protection: Keylock switch.

Manufacture and Product: Allen-Bradley 1747-L552.

PLC Power Supply: One unit for each input/output base assembly.

Voltage: 120/220 volts (user selectable), 60 Hz input; 24 VDC output.

Mounting: Integral with PLC chassis.

Manufacture and Product: Allen-Bradley 1747-P4.

PLC Input/Output: Complete input/output system specifications:

Discrete Input Modules:

Voltage: 24 VDC.

Operating Power: 2 watts.

Points per Module: 16 maximum.

LED status indicator for each point.

Isolation: Between input point and PLC, 1,500 volts rms.

Discrete Output Modules:

Voltage: 24VDC.

Operating Power: 2 watts.

Load Rating: 2 amps continuous.

Isolation: Between PLC and output point, 1,500 volts rms.

Points per Module: 16 maximum.

LED status indicator for each point.

Isolated Discrete Output Modules:

Type: Isolated Form C relay.

Voltage: 120 volts, 60-Hz.

Isolated Outputs per Module: 8 Maximum.

Load Rating: 2 amps continuous.

Operating Power: 2.5 watts.

LED status indicator and fuse for each point.

Analog Input and Output Modules:

Voltage: 24 volts dc.

Power: 3 watts.

Differential Analog Points Per Module: 8 maximum.

Isolated Analog Output Points Per Module: 8 maximum.

Isolation: Between PLC and I/O point and between I/O points, 1,500 volts rms.

<u>Analog Input Resolution:</u> 12 bits minimum.

<u>Analog Output Resolution:</u> 12 bits minimum .

<u>Manufacturer and Series:</u> Allen-Bradley 1746 Series.

<u>Operator Interface Unit:</u>

<u>Function:</u> Panel mounted terminal unit with color video display screen and keypad which enable an operator to monitor and interface with the process control system programmable logic controller. OIU linked with PLC over ETHERNET network.

<u>Type:</u> Microprocessor based device and programmable using Microsoft Windows based development software. *(Note: PICS PLC and OIU design is based upon the Allen-Bradley SLC-5/05E programmable logic controller and the Allen-Bradley Panelview 600 operator interface unit).*

<u>Parts:</u> Central processing unit (CPU), power supply, video display touch screen, keypad, Ethernet and printer ports.

<u>Specifications:</u>

<u>Electrical:</u> DC Power Supply Limits: 85 to 264 VAC AC Power, Power Consumption 60 VA maximum.

<u>Mechanical:</u> Enclosure NEMA Type 12/13, 4X (Indoor use only), LED Indicators – “Green” COMM, “Red” FAULT.

<u>Display:</u> Active Matrix Thin Film resistor (TFT) with cold cathode fluorescent (CCF) backlight.

<u>Size:</u> 4.54 x 3.4 in.

<u>Pixels:</u> 320 x 234.

<u>Touch Cells:</u> 128 (16 columns x 8 rows).

<u>Touch Cell Size:</u> (20 x 29 pixels).

<u>Terminal Memory:</u> total application flash memory 240K bytes (application screens)

Environment:

Operating Temperature: -0 to 55 degrees C (32 to 131 degrees F).

Storage Temperature: -25 to 70 degrees C (-13 to 158 degrees F).

Relative Humidity: (noncondensing) 5 to 95 percent at 0 to 55 degrees C (32 to 131 degrees F).

Heat Dissipation: 32 Watts.

Agency Approvals and Standards: UL, CSA certified, or another state approved agency.

Manufacturer and Model: Panelview600 or equal.

Software Packages:

PLC Programming: Microsoft Windows based RSLogix500 programming and communication software (RSLinx) with master disk, most recent revisions, and 2-year support.

OIU Programming: Microsoft Windows based Panelbuilder32 development software with master disk, most recent revisions, and 2-year support.

Ethernet Switch:

Function: Mixed Media 10/100 Base T 8 port modular fiber switch with 4 port fiber module and 4 port RJ45 dual speed module.

Specifications:

Address Table 24K nodes with address aging.

Cooling Method: Internal 9-CFM fan.

Filtering and Forwarding Rate: 16-port aggregate, 2380K packets per second.

Latency, 100 Mbps: 5 μs + packet time; 10 Mbps: 15 μs + packet time, Packet Buffers 8 MB dynamic.

Processing Type: Store and forward with IEEE 802.3x full-duplex flow control

Standards: IEEE 802.3: 10BASE-T, 10BASE-FL; IEEE 802.3u: 100BASE-TX, 100BASE-FX.

Connectors:

LE1401A, (1) power.

LE1419C: (4) pairs of SC.

LE1425C: (4) RJ-45.

Indicators Chassis: Power; Per port: LK: ON when link is operational; Act: ON with port activity; FDX/HDX: ON for full-duplex mode, OFF for half-duplex mode; 100/10: ON for 100 Mbps, OFF for 10 Mbps

Power Input: 110–240 VAC, 47–63 Hz, internal, autosensing; 20 W.

Size: 1.75 inches high (1U) by 17 inches wide by 9 inches deep (4.4 x 43.2 x 22.9 cm); weight: 2.5 pounds (1.1 kg).

Agency Approvals and Standards: UL, CSA or another state approved agency.

Manufacturer and Product: Black Box LE1401A; or equal.

Programming Notebook (Laptop) Computer:

Function: Notebook computer used to implement, test, and store all PLC and OIU application software programming. Install and configure all PLC and OIU vendor software packages and licenses onto laptop. Complete and save application software to notebook computer and to backup R/W CD(s).

Specifications:

Processor 2650: Intel Pentium 4-M processor at 2.0 GHz, 512 KB cache.

Memory: 128 MB DDR SDRAM standard, upgradable to 512 MB maximum, SDRAM configurations include one of 128, 192, 256, 384 or 512 MB.

I/O Ports:

25-hole pin parallel connector.

15-pin monitor connector.

6-pin PS/2-style keyboard, mouse, and keypad.

2-USB (Universal Serial Bus) compliant 4-pin connectors.

RJ-11 connector for modem.

RJ-45 connector for connection to Ethernet multimedia switch.

Chassis:

14.1-inch XGA Display: Height: 36 mm (1.42-inch); width: 328 mm (12.9-inch); depth: 275 mm (10.8-inch); weight: 7.25 lbs. with CD, floppy and battery.

Display: Displays 15-inch SXGA+ TFT active-matrix display with 1400 x 1050 resolution; height: 38 mm (1.5-inch); width: 332 mm (13.1-inch); depth: 275 mm (10.8-inch).

Power: Lithium Ion battery, AC Adapter: Input voltage: 90 to 135 VAC and 164 to 264 VAC.

Slots: Connectors: (1) Type I or Type II card, 3.3 and 5 V cards supported, Warm-swap Capable.

Graphics: 16MB DDR 4X AGP NVIDIA® GeForce2TM.

Storage: 20 GB4 Ultra ATA hard drive.

Optical Devices:

Fixed Bay integrated in left side with CD-RW: 24x/10x/24x max.

Removable Media: Fixed Floppy drive standard.

Communication Devices: Network Interface Cards, Integrated 10/100 network interface card.

Modems: Standard: Internal 56K5 capable v.92 Fax modem .

Software & Accessories: Microsoft® Windows® 2000 or XP Professional Small Business most recent version. Insure compatibility between platform and vendor software packages prior to installation.

Utilities: Norton AntiVirusTM 2003, introductory version.

Manufacturer and Model: Dell Inspiron 2650 or equal.

PLC INPUT AND OUTPUT LIST

Item	Rev	Tag 1 Area	Tag 2 Process	Tag 2 ISA	Tag4 Loop	Description	P&ID	Engineering Units	Voltage/Current	Address	Typical Wiring Diagram	Notes
1	0	219(Y)	LH	FIT	203	Leachate Collection and Removal System High Flow Pump Flow	H-2-830854 Sheet 1 of 4	GPM	4-20mA	I:01/00	No. 1	
2	0	219(Y)	LH	FIT	202	Leachate Collection and Removal System Low Flow Pump Flow	H-2-830854 Sheet 1 of 4	GPM	4-20mA	I:01/01	No. 1	
3	0	219(Y)	LH	FIT	204	Leak Detection System Pump Flow	H-2-830854 Sheet 1 of 4	GPM	4-20mA	I:01/02	No. 1	
4	0	219(Y)	LH	LT	101	Leachate Collection and Removal System Level	H-2-830854 Sheet 1 of 4	Inches	4-20mA	I:01/03	No. 2	
5	0	219(Y)	LH	LT	104	Leak Detection System Level	H-2-830854 Sheet 1 of 4	Inches	4-20mA	I:01/04	No. 2	
6	0	219(Y)	LH	TIT	219	Crest Pad Building Temperature	H-2-830854 Sheet 1 of 4	Celsius	4-20mA	I:01/05	No. 3	
7	0	219(Y)201	LH	LT	301	Leachate Storage Tank Level	H-2-830854 Sheet 1 of 4	Inches	4-20mA	I:01/06	No. 2/No. 6	Add Signal Isolator
8	0	219(Y)1	LH	FIT	302	Leachate Transfer Pump Discharge Flow	H-2-830854 Sheet 1 of 4	GPM	4-20mA	I:01/07	No. 1/ No. 6	Add Signal Isolator
9	0	219(Y)1	LH	TIT	220	Leachate Transfer Building Temperature	H-2-830854 Sheet 1 of 4	Celsius	4-20mA	I:02/00	No. 3	
10	0	219(Y)	LH			Spare Input			4-20mA	I:02/01		Wire in spare inputs
11	0	219(Y)	LH			Spare Input			4-20mA	I:02/02		Wire in spare inputs
12	0	219(Y)	LH			Spare Input			4-20mA	I:02/03		Wire in spare inputs
13	0	219(Y)	LH			Spare Input			4-20mA	I:02/04		Wire in spare inputs
14	0	219(Y)	LH			Spare Input			4-20mA	I:02/05		Wire in spare inputs
15	0	219(Y)	LH			Spare Input			4-20mA	I:02/06		Wire in spare inputs
16	0	219(Y)	LH			Spare Input			4-20mA	I:02/07		Wire in spare inputs
17	0	219(Y)	LH	HS	203	Leachate Collection and Removal System High Flow Pump Auto Status	H-2-830854 Sheet 1 of 4	On/Off/Auto	24V dc	I:03/00	No. 4	
18	0	219(Y)	LH	YL	203	Leachate Collection and Removal System High Flow Pump On Status	H-2-830854 Sheet 1 of 4	On/Off	24V dc	I:03/01	No. 4	
19	0	219(Y)	LH	HS	202	Leachate Collection and Removal System Low Flow Pump Auto Status	H-2-830854 Sheet 1 of 4	On/Off/Auto	24V dc	I:03/02	No. 4	
20	0	219(Y)	LH	YL	202	Leachate Collection and Removal System Low Flow Pump On Status	H-2-830854 Sheet 1 of 4	On/Off	24V dc	I:03/03	No. 4	
21	0	219(Y)	LH	HS	204	Leak Detection System Pump Auto Status	H-2-830854 Sheet 1 of 4	On/Off/Auto	24V dc	I:03/04	No. 4	
22	0	219(Y)	LH	YL	204	Leak Detection System Pump On Status	H-2-830854 Sheet 1 of 4	On/Off	24V dc	I:03/05	No. 4	
23	0	219(Y)	LH	LSH	105	Crest Pad Building Sump Level High	H-2-830854 Sheet 1 of 4	High/Normal	24V dc	I:03/06	No. 4	
24	0	219(Y)	LH	LSHH	105	Crest Pad Building Sump Level High High	H-2-830854 Sheet 1 of 4	High-High /Normal	24V dc	I:03/07	No. 4	
25	0	219(Y)	LH	LSL	105	Crest Pad Building Sump Level Low	H-2-830854 Sheet 1 of 4	Low/Normal	24V dc	I:03/08	No. 4	
26	0	219(Y)	LH	LDE	105	Crest Pad Building Sump Leak Detector	H-2-830854 Sheet 1 of 4	Leak/Normal	24V dc	I:03/09	No. 4	
27	0	219(Y)	LH	JSH	219	Crest Pad Building Power Status	H-2-830854 Sheet 1 of 4	Normal/Fail	24V dc	I:03/10	No. 4	
28	0	219(Y)	LH	HS	205	Crest Pad Building Sump Pump Auto Status	H-2-830854 Sheet 1 of 4	On/Off/Auto	24V dc	I:03/11	No. 4	
29	0	219(Y)	LH	YL	205	Crest Pad Building Sump Pump On Status	H-2-830854 Sheet 1 of 4	On/Off	24V dc	I:03/12	No. 4	
30	0	219(Y)	LH	HS	219	Crest Pad Building General Alarm Acknowledge Status	H-2-830854 Sheet 1 of 4	Acknowledge/Off	24V dc	I:03/13	No. 4	
31	0	219(Y)	LH			Spare	H-2-830854 Sheet 1 of 4		24V dc	I:03/14	No. 4	Wire in spare inputs
32	0	219(Y)	LH			Spare	H-2-830854 Sheet 1 of 4		24V dc	I:03/15	No. 4	Wire in spare inputs
33	0	219(Y)	LH			Spare	H-2-830854 Sheet 1 of 4		24V dc	I:04/00	No. 4	Wire in spare inputs
34	0	219(Y)201	LH	LSHH	301	Leachate Storage Tank Level Switch	H-2-830854 Sheet 2 of 4	High High/Normal	24V dc	I:04/01	No. 4	
35	0	219(Y)201	LH	LSLL	301	Leachate Storage Tank Level Switch	H-2-830854 Sheet 2 of 4	Low Low /Normal	24V dc	I:04/02	No. 4	
36	0	219(Y)	LH			Spare			24V dc	I:04/12	No. 4	Wire in spare inputs
37	0	219(Y)1	LH	YL	302-2	Leachate Transfer Pump On Status	H-2-830854 Sheet 2 of 4	On/Off	24V dc	I:04/04	No. 4	
38	0	219(Y)	LH	LSHH	107	Combined Sump Level Switch	H-2-830854 Sheet 2 of 4	High High/Normal	24V dc	I:04/05	No. 4	
39	0	219(Y)	LH	LSH	107	Combined Sump Level Switch	H-2-830854 Sheet 2 of 4	High /Normal	24V dc	I:04/06	No. 4	
40	0	219(Y)	LH	LSL	107	Combined Sump Level Switch	H-2-830854 Sheet 2 of 4	Low/Normal	24V dc	I:04/07	No. 4	
41	0	219(Y)	LH	LSLL	107	Combined Sump Level Switch	H-2-830854 Sheet 2 of 4	Low Low/Normal	24V dc	I:04/08	No. 4	
42	0	219(Y)	LH	LDE	107	Combined Sump Leak Detector	H-2-830854 Sheet 2 of 4	Leak/Normal	24V dc	I:04/09	No. 4	
43	0	219(Y)	LH	HS	207	Combined Sump Pump Auto Status	H-2-830854 Sheet 2 of 4	On/Off/Auto	24V dc	I:04/10	No. 4	
44	0	219(Y)	LH	YL	207	Combined Sump Pump On Status	H-2-830854 Sheet 2 of 4	On/Off	24V dc	I:04/11	No. 4	
45	0	219(Y)	LH			Spare			24V dc	I:04/12	No. 4	Wire in spare inputs
46	0	219(Y)	LH			Spare			24V dc	I:04/13	No. 4	Wire in spare inputs
47	0	219(Y)	LH			Spare			24V dc	I:04/14	No. 4	Wire in spare inputs
48	0	219(Y)	LH			Spare			24V dc	I:04/15	No. 4	Wire in spare inputs
49	0	219(Y)	LH	YS	203	Leachate Collection and Removal System High Flow Pump Start Command	H-2-830854 Sheet 1 of 4	Start/Stop	120 Vac	O:05/00	No. 4	Note: Interlock Control
50	0	219(Y)	LH	YS	202	Leachate Collection and Removal System Low Flow Pump Start Command	H-2-830854 Sheet 1 of 4	Start/Stop	120 Vac	O:05/01	No. 4	Note: Interlock Control
51	0	219(Y)	LH	YS	204	Leak Detection System Pump Start Command	H-2-830854 Sheet 1 of 4	Start/Stop	120 Vac	O:05/02	No. 4	Note: Interlock Control
52	0	219(Y)	LH	YS	219	Crest Pad Building General Alarm	H-2-830854 Sheet 1 of 4	Normal/Fail	120 Vac	O:05/03	No. 5	
53	0	219(Y)	LH	YS	205	Crest Pad Building Sump Pump Start Command	H-2-830854 Sheet 1 of 4	Start/Stop	120 Vac	O:05/04	No. 4	Note: Interlock Control

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PLC INPUT AND OUTPUT LIST

Item	Rev	Tag 1 Area	Tag 2 Process	Tag 2 ISA	Tag4 Loop	Description	P&ID	Engineering Units	Voltage/Current	Address	Typical Wiring Diagram	Notes
54	0	219(Y)	LH	YS	207	Combined Sump Pump Start Command	H-2-830854 Sheet 2 of 4	Start/Stop	120 Vac	O:05/05	No. 4	Note: Interlock Control
55	0	219(Y)1	LH	YS	220	Leachate Transfer Building General Alarm	H-2-830854 Sheet 2 of 4	Normal/Fail	120 Vac	O:05/06	No. 4	Note: Interlock Control
56	0	219(Y)	LH			Spare Output			24V dc	O:05/07	No. 5	
57	0	219(Y)	LH			Spare Output			24V dc	O:06/00	No. 4	Wire in spare outputs
58	0	219(Y)	LH			Spare Output			24V dc	O:06/01	No. 4	Wire in spare outputs
59	0	219(Y)	LH			Spare Output			24V dc	O:06/02	No. 4	Wire in spare outputs
60	0	219(Y)	LH			Spare Output			24V dc	O:06/03	No. 4	Wire in spare outputs
61	0	219(Y)	LH			Spare Output			24V dc	O:06/04	No. 4	Wire in spare outputs
62	0	219(Y)	LH			Spare Output			24V dc	O:06/05	No. 4	Wire in spare outputs
63	0	219(Y)	LH			Spare Output			24V dc	O:06/06	No. 4	Wire in spare outputs
64	0	219(Y)	LH			Spare Output			24V dc	O:06/07	No. 4	Wire in spare outputs

(Y) = A for Cell No. 1. For Cell No. 1 reference corresponding H-2-830854 sheet 1 of 4 and sheet 2 of 4.
(Y) = E for Cell No. 2. For Cell No. 2 reference corresponding H-2-830854 sheet 3 of 4 and sheet 4 of 4.

Supplement 4

Loop Descriptions

PLC and OIU Application Software

DOCUMENT OBJECTIVES

This Supplement No. 4 to Specification Section 13401, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS) provides the basis for estimating the minimum level of effort required to implement PLC and OIU application software for Cell No. 1 and Cell No. 2 Integrated Disposal Facilities (IDF).

Unless otherwise directed by the Tank Farm Contractor during Application Software Submittal and Design Workshops, this document provides guidelines for the programming and testing of all PLC and OIU application software. *Note: Issues related to Application Software Submittal and Design Workshops are discussed in Section 13401, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS).*

This Supplement No. 4 shall be used in conjunction with Contract Documents (drawings and specifications, and supplements) and relevant PICS supplier technical information and manuals while developing application software.

PICS Supplements shall be provided to Construction General Contractor in electronic format upon request.

Reference Management Directive TFC–MD–034, Rev. A, attached to this supplement for directives on HMI (OIU) configurations.

PLC AND OIU PROGRAM LAYOUT

1. Programmable Logic Controller (PLC) Application Software: Provide PLC application software as necessary for a fully functional and operable PLC system in accordance with the project design. PLC programming includes, but shall not be limited to the following:

    a. PLC application software development and installation

    b. PLC equipment configuration

    c. PLC interface with Operator Interface Unit (OIU)

    d. System testing

    e. PLC application software debugging and trouble-shooting

    f. System hardware and software documentation

    g. PLC system startup

    h. PLC system training.

2. ETHERNET Address: For more information on SLC500 Ethernet Addressing see Allen-Bradley Quick Start Ethernet SLC500 Processor > Publication 1747-10.4.

    a. Host Name: (To be assigned by Tank Farm Contractor)

b. IP Address: (To be assigned by Tank Farm Contractor)

c. Subnet Masking: 255.255.255.0

d. Gateway address: None

3. PLC Memory Allocation: Provide PLC programming and documentation with logical, structured groupings of PLC memory registers. Allocate memory within each group to allow for 50 percent spare capacity. Examples of functional groupings shall be:

a. Inputs > I:01/00

b. Outputs > O:01/00

c. Control Operation Bits > B3:0 through B3: 200

d. Timers > T4:0 through T4:100

e. Counter > C5:0 through C5:100

f. Sequencers > R6:0 through R6:100

g. Ethernet Diagnostic Files > N7:00 through N7:50

h. Scaled Analog Inputs > F8:00 through F8:49

i. Process Calculations, Runtime, and Flow Totalization > F8:50 through F8:100

j. Process Set-points, Comparisons, and Scaling Ranges for Analog Inputs > F9:0 through F9:100

k. Reserve for future SCADA Discrete Write Commands to Processor > N10:0 through N10:100

l. Reserve for future SCADA Analog Write Commands from Processor > F11:0 through F11:100

m. Reserve for future SCADA Discrete Read Status from Processor > N12:0 through N12:100

n. Reserve for future SCADA Analog Read Status from Processor > F13:0 through F13:100

o. Reserve for future PID Control Files > MG14:0 or N14:0

p. Reserve for future Messaging > N15

q. Other Diagnostic Files > N16

4. PLC Programming Sub-routines: Divide PLC program into logical sub-routines. Each sub-routine shall contain the programming for a process or set of equipment. Examples of logical subroutines include:

    a. Ethernet Communication

    b. Process flow, level, and temperature signal scaling, totalizing and alarming

    c. Landfill leachate collection and removal system pump control

    d. Landfill leak detection system pump control

    e. Landfill crest pad building sump pump monitoring

    f. Landfill crest pad building miscellaneous control

    g. Leachate storage tank level measurement and leak detection

    h. Leachate collection and transmission line leak detection

    i. Leachate transfer pump control and flow totalization

    j. Combined sump pump control and leak detection

    k. Leachate transfer building miscellaneous control.

5. PLC Program Documentation: Each PLC program shall be fully annotated with descriptive notations that define the functions associated with each program element. Provide the following minimum level of program documentation.

    a. Each program element shall have a descriptive name associated.

    b. Each program sub-routine and article associated within a major program shall be proceeded by a description of the sub-routine and article function.

    c. Each major program shall be proceeded by a description of the program and a listing of the associated program sub-routines and articles.

6. The program documentation shall be developed using the PLC suppliers standard program documentation software. The PLC program documentation shall also include a complete cross reference listing of all program elements and their location within each program.

7. Program OIU to enable secured access to process set-points and control modes of operation. OIU shall be configured with process status display screens, set-point entry, equipment control mode, equipment runtime, flow totaling, alarm status, and alarm enable/disable screens. Process set-point and equipment control mode shall be implemented using RETURN ENTRY at the control panel mounted OIU.

8. Program OIU with three (3) security levels: engineer, operator, and system administrator. Engineer shall have access to all displays. Operator shall have access to all process status and

alarm display screens but not control mode, alarm enable/disable, and set-point screens. Administrator shall have access to process status, and alarm enable/disable screens.

9. Configure and link OIU Main Menu, Sub-Menu and Data screens in a logical fashion allowing Operator(s) to logically move through each process control loop, with the ability to access data entry set-point and control modes.

10. Program and configure alarm screens for each alarm as described in Section 3.2 PLC Loop Descriptions of this Supplement. OIU alarm screens shall enable operator(s) to visually identify and acknowledge all alarm conditions for each process control loop. Alarms shall be acknowledged at local alarm display ONLY.

PLC & OIU PROGRAMMING

PLC STANDARD FUNCTIONS

1. General — PICS shall implement functions for the purpose of program standardization and minimum PLC application software capability. Functions may not be applicable to every program control loop or network.

2. PLC Standard Function No. 1 — Equipment Run Timers: For each equipment ON status input, track the runtime of the associated equipment item. Accumulate equipment runtime in tenths of hours using retentive timers with no timer reset due to equipment stoppage or power loss. Provide a command interface to allow reset or adjustment of equipment run time.

3. PLC Standard Function No. 2A — Equipment Failure Detection: Provide for each equipment item controlled by the PLC for which the PLC receives ON and AUTO or REMOTE status signals. Monitor for a fail condition when the unit is in the AUTO or REMOTE mode. A failure condition shall be activated when the unit is commanded by the PLC to run, and the PLC does not receive the unit's ON status signal after a 10-second delay period. When a failure condition is detected, inhibit the PLC run command to the unit. Reset the failure condition when the unit is taken out of AUTO or REMOTE mode.

4. PLC Standard Function No. 2B — Equipment Flow Failure Detection: Provide for each pump controlled by the PLC for which the PLC receives a PLC receives ON and AUTO or REMOTE, status and a PUMP DISCHARGE flow signal. Monitor for a fail condition when the unit is in the AUTO or REMOTE mode. A failure condition shall be activated when the unit is commanded by the PLC to run, and the PLC does not receive or maintain a positive flow value for a 10-second delay period. When a failure condition is detected, inhibit the PLC run command to the unit. Reset the failure condition when the unit is taken out of AUTO or REMOTE mode.

5. PLC Standard Function No. 3 — Analog Signal Scaling: Provide program logic to scale process analog signals to engineering units that correspond to the calibrated range of the field sensor. Store the scaled value in a PLC memory register for use in process control programming and for transmission to the OIU. Program PLC to monitor each analog input and ALARM in the event a process signal is out of the 4-20mA range. A process signal out-of-range ALARM condition shall prevent associated process control from taking place. Program

PLC and OIU such that in the event a process signal is out-of-range, data point on OIU shall change to color YELLOW enabling personnel to know the data is incorrect.

6. PLC Standard Function No. 4 — Analog alarms: Provide the capability to detect and annunciate alarms, such as high-high, high, low, and low-low for analog process signals. The PLC shall continuously compare the scaled process signal to a set-point value stored in PLC register memory. If the scaled process signal exceeds the alarm set-point, the PLC shall initiate an alarm signal to the OIU system and to external annunciation equipment as noted in the Process Control Loop Descriptions. The analog alarm function shall also have the following capabilities:

   a. Provide time delays on all alarm set-points. When the PLC detects the scaled process signal exceeding set-point, initiate the alarm delay timer. At the end of the time delay, activate the alarm.

   b. Unless specified in the Loop Functional Descriptions, all analog alarms shall be self resetting. The PLC shall reset the alarm condition when the scaled process signal value is within the set-point value plus a 2 percent deadband.

   c. Where noted in the Loop Functional Descriptions, provide alarm ENABLE/DISABLE program logic that respond to commands from the OIU. Suppress the activation of alarms when commanded to the DISABLE mode.

   d. Provide program logic to receive, and store in PLC register memory, alarm set-point commands from the OIU.

7. PLC Standard Function No. 5 — Discrete alarms: Provide adjustable alarm delay timers on all discrete alarm input signals monitored by the PLC. Upon detection of the alarm condition, the PLC shall initiate the time delay. At the end of the time period, the PLC shall communicate the alarm condition to the OIU system and to external annunciation equipment as noted in the Process Control Loop Descriptions. The discrete alarm function shall also have the following capabilities:

   a. Unless specified in the Loop Functional Descriptions, all discrete alarms shall be self resetting. The PLC shall reset the alarm condition when the alarm input signal resets.

   b. Where noted in the Loop Functional Descriptions, provide alarm ENABLE/DISABLE program logic that respond to commands from the OIU. Suppress the activation of alarms when commanded to the DISABLE mode.

8. PLC Standard Function No. 7 — Process Flow Totalizers: For all process flow signals provide program logic in the PLC to accumulate flow totals and flow total RESET. The totaled value stored in the PLC shall be transmitted to the OIU for display and historical logging. PLC shall increment flow total when pump ON status and minimum flow status is confirmed.

9. PLC Standard Function No. 8 — Pump Restart Time Delay: Provide adjustable delay timers in PLC program so as to prevent rapid restart of all pumps. An adjustable timer for each pump's AUTO start control logic, shall begin to countdown once a pump has stopped operating. PLC

shall not execute AUTO start control logic for each pump until respective adjustable delay timer's accumulated value is equal to preset value.

10. PLC Standard Function No. 9 — Power Failure: Program PLC to prevent PLC from executing process equipment automatic control during a power failure condition.

PLC Loop Descriptions

Note: Loop Descriptions are typical for both Cell No. 1 and Cell No. 2 process equipment.

1. Landfill Leachate Collection and Removal System (Loops 101, 202 and 203). Reference P&ID Drawing H-2-830854 sheet 1 of 4.

   a. General — Landfill leachate collection and removal system consists of one collection sump, high and low flow collection pumps, one common level sensor, two flow transmitters, pump discharge piping, and ancillary valves. Pumps shall extract leachate from landfill collection and removal system sump and pump leachate to an above grade leachate storage tank via an underground double walled containment pipe. PLC shall monitor discharge flow from each pump via flow transmitters installed in each pump's discharge line. PLC shall automatically compute total extracted leachate from sump. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

   b. Program — Program PLC to implement continuous monitoring of liquid levels inside landfill leachate collection and removal sump and provide automatic operation of high and low flow pumps. Program PLC to automatically operate pumps ON/OFF based upon liquid levels inside the landfill leachate collection and removal system sump. PLC shall automatically operate pumps ON/OFF in order to insure that liquid levels over landfill liner - as measured from the bottom of the sump - do not exceed 12-inches.

   c. AUTO Operation — Automatic operation requires operator(s) place each pump's respective ON-OFF-AUTO control switch (located at MCC) to AUTO mode. Pump operation and alarm set-points shall be entered at the control panel mounted OIU. The pumps shall operate between separate start and stop level set-points.

   d. Process Control Set-points — Operator(s) shall enter the following control set-points at the control panel mounted OIU:

      (1) High flow pump start level in inches

      (2) Low flow pump start level in inches

      (3) High flow pump stop level in inches

      (4) Low flow pump stop level in inches

(5) Landfill leachate collection and removal system high-high level alarm in inches

(6) Landfill leachate collection and removal system high level alarm in inches.

e. REMOTE Operation — None.

f. ON (manual) Operation — ON operation requires the following steps be taken by operator(s):

(1) Operator(s) shall place high and low flow pump's respective ON-OFF-AUTO control switch (located at MCC) to ON mode.

g. Interlocks — Interlocks shall prevent operation of leachate collection and removal pumps in the event of a leachate storage tank high-high level alarm condition, or a leak alarm condition in either the landfill crest pad building sump, leachate storage tank or combined sump.

h. Alarms — Program PLC to monitor process and alarm for the following minimum conditions:

(1) Landfill leachate collection and removal system high-high level

(2) Landfill leachate collection and removal system high level

(3) Landfill leachate collection and removal system high flow pump fail

(4) Landfill leachate collection and removal system low flow pump fail

(5) Landfill leachate collection and removal system high flow pump flow fail

(6) Landfill leachate collection and removal system low flow pump flow fail

(7) Landfill leachate collection and removal system level signal fail

(8) Landfill leachate collection and removal system high flow pump flow signal fail

(9) Landfill leachate collection and removal system low flow pump flow signal fail.

i. Runtime and Flow Totaling — Program PLC to implement runtime and flow totals for each leachate collection and removal system pump. PLC increments equipment runtime and process flows when respective pump ON status and minimum flow status is confirmed. PLC control logic shall be programmed to allow runtime and flow value reset and adjustment.

2. Landfill Leak Detection System (Loops 104 and 204). Reference P&ID Drawing H-2-830854 sheet 1 of 4.

a. General — Landfill leak detection system consists of one leak detection sump, collection pump, one level sensor, flow transmitter, pump discharge piping , and ancillary valves. Leak detection system pump shall extract leachate from landfill leak detection sump and pump this leachate to an above grade leachate storage tank via an underground double walled containment pipe. PLC shall monitor discharge flow from leak detection pump via flow transmitter installed in pump's discharge line. PLC shall automatically compute total extracted leachate from sump. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

b. Program — Program PLC to implement continuous monitoring of liquid levels inside landfill leak detection system chamber and provide automatic operation of leak detection pump. Program PLC to automatically operate leak detection pump ON/OFF based upon liquid levels inside leak detection sump.

c. AUTO Operation — Automatic operation requires operator(s) place leak detection pump's ON-OFF-AUTO control switch (located at MCC) to AUTO mode and enter sump pump operation control set-points at the control panel mounted OIU. The landfill leak detection system pump shall operate between separate start and stop level set-points.

d. Process Control Set-points – Operator(s) shall enter the following control set-points at the control panel mounted OIU:

(1) Leak detection system pump start level in inches

(2) Leak detection system pump stop level in inches

(3) Landfill leak detection system high-high level alarm in inches

(4) Landfill leak detection system high level alarm in inches

e. REMOTE Operation — None.

f. ON (manual) Operation — ON (manual) Operation requires the following steps be taken by operator(s):

(1) Operator(s) shall place landfill leak detection pump's ON-OFF-AUTO control switch (located at MCC) to ON mode.

g. Interlocks — Interlocks shall prevent operation of leachate leak detection pump in the event of a leachate storage tank high-high level alarm condition, or a leak alarm condition in either the landfill crest pad building sump, leachate storage tank, or combined sump.

h. Alarms — Program PLC to monitor process and alarm for the following minimum conditions:

(1) Landfill leak detection system high-high level

(2) Landfill leak detection system high level

(3) Landfill leak detection system pump fail

(4) Landfill leak detection system pump flow fail

(5) Landfill leak detection system level signal fail

(6) Landfill leak detection system flow signal fail

i. Runtime and Flow Totaling — Program PLC to implement runtime and flow totals for landfill leak detection pump. PLC increments equipment runtime and process flows when respective pump ON status and minimum flow is confirmed. PLC control logic shall be programmed to allow runtime and flow value reset and adjustment.

3. Landfill Crest Pad Building Sump System (Loops 105, 205). Reference P&ID Drawing H-2-830854 sheet 1 of 4.

a. General — Landfill crest pad building sump system consists of a building sump, sump pump, level floats, leak detection sensor, and pump discharge piping. Sump pump extracts and pumps liquids from building sump to an above ground leachate storage tank. Landfill crest pad building sump pump operates ON/OFF based upon actuation of level floats inside the landfill crest pad building sump. PLC shall monitor leak detection sensor. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

b. Program — Program PLC to monitor sump float switches and provide automatic operation of landfill crest pad building sump pump between high and low level status. In the event of high-high level condition, PLC shall alarm. In the event of a leak alarm condition PLC shall prevent operation of landfill leachate collection and leak detection pumps.

c. AUTO Operation — Automatic operation requires operator(s) place sump pump's ON-OFF-AUTO control switch (located at MCC) to AUTO mode. The sump pump shall operate between start and stop levels. Operator(s) shall place sump leak detection ENABLE/DISABLE control switch (located at local sump control panel) to ENABLE leak detection control logic.

d. Process Control Set-points — None

e. REMOTE Operation — None

f. ON (manual) Operation — ON (manual) Operation requires the following steps be taken by operator(s):

(1) Operator(s) shall place sump pump's ON-OFF-AUTO control switch (located at MCC) to ON mode.

g. Interlocks — Interlocks shall prevent operation of landfill crest pad building sump pump in the event of a leachate storage tank high-high level alarm condition, or a leak alarm condition in either the leachate storage tank, or combined sump.

h. Alarms — Program PLC to monitor process and alarm for the following minimum conditions:

(1) Landfill crest pad building sump level high

(2) Landfill crest pad building sump level high-high

(3) Landfill crest pad building sump leak detected

(4) Landfill crest pad building sump pump fail.

i. Runtime — PLC shall provide runtime for sump pump. PLC increments equipment runtime when respective pump ON status is confirmed. PLC control logic shall be programmed to allow runtime value reset and adjustment.

4. Leachate Storage Tank System (Loops 300, 301). Reference P&ID Drawing H-2-830854 sheet 2 of 4.

a. General — Leachate storage tank system consists of an above grade tank with an outer steel wall, an interstitial leak detection chamber, floating cover, level sensors, leak detection sensors, and a transfer pump suction connection. Liquid is pumped to leachate storage tank from landfill leachate collection and leak detection pumps, landfill crest pad building sump pump, and combined sump. A level sensor located inside a stilling well - mounted inside the storage tank - provides continuous liquid levels measurements to PLC. This level sensor is backed-up by additional discrete level switches. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

b. Program — Program PLC to implement continuous monitoring of liquid levels inside leachate storage tank. Level measurements shall be displayed at control panel inside landfill crest pad building and local control panel inside leachate transfer building. Program PLC to monitor level high-high and low-low switches which provide backup safety measurement and control for the continuous level sensor.

c. AUTO Operation — None.

d. Process Control Set-points:

(1) Leachate storage tank high-high level in inches

(2) Leachate storage tank high level in inches

(3) Leachate storage tank low level in inches

(4) Leachate storage tank low-low level in inches.

e. REMOTE Operation — None.

f. ON (manual) Operation — None.

g. Interlocks — Interlocks shall prevent operation of landfill leachate collection and removal and leak detection pumps, crest pad sump pump, and combined sump pump in the event of a leachate storage tank high-high level condition alarm condition. Interlocks shall prevent operation of transfer pump in the event of a storage tank low-low level condition.

h. Alarms — Program PLC to monitor process and alarm for the following minimum conditions:

(1) Leachate storage tank high-high level

(2) Leachate storage tank high level

i. Runtime – None.

5. Combined Sump Pump System (Loops 107, 207). Reference P&ID Drawing H-2-830854 sheet 2 of 4.

a. General — Combined sump pump system consists of a sump assembly with dual chambers (pump chamber and leak detection chamber), sump pump, level floats, and a leak detection sensor. Liquids from truck loading station, gravity drain to the sump pump chamber. Liquids from containment piping, gravity drain to leak detection chamber. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

b. Program — Program PLC to implement automatic operation of combined sump pump. Combined sump pump shall operate ON/OFF based upon actuation of discrete floats mounted inside sump: sump high-high alarm level, sump pump high (start) level, sump pump low (stop) level and sump pump low-low (alarm) level. Program PLC to alarm when high-high level float switch is activated or low-low level float is actuated and sump pump ON status exists. Program PLC to monitor operation of leak detection sensor. Sump floats and leak detection sensor shall be hardwired to intrinsic safety relay modules.

c. AUTO Operation — Automatic operation requires operator(s) place combined sump pump ON-OFF-AUTO control switch (located inside transfer building) to AUTO mode. Sump pump shall operate between sump pump start and stop levels.

d. Process Control Set-points — None.

e. REMOTE Operation — None.

f. ON (manual) Operation — ON (manual) Operation requires the following steps be taken by operator(s):

(1) Operator(s) shall place sump pump ON-OFF-AUTO control switch (located inside transfer building) to ON mode

(2) Pump selected to ON mode shall continue to operate until sump pump low-low level is reached.

g. Interlocks — Interlocks shall prevent operation of combined sump pump in the event of a leachate storage tank high-high level alarm condition. Interlocks shall prevent operation of landfill leachate collection and leak detection pumps, and landfill crest pad building sump pump in the event of a combined sump leak alarm condition.

h. Alarms — Program PLC to monitor process and alarm for the following minimum conditions:

(1) Combined sump high-high level

(2) Combined sump low-low level

(3) Combined sump pump fail

(4) Combined sump leak detected.

i. Runtime — Program PLC to provide runtime. PLC shall increment equipment runtime when pump ON status is confirmed. Implement PLC control logic necessary to allow local runtime value reset and adjustment.

6. Leachate Transfer Pump System (Loop 302). Reference P&ID Drawing H-2-830854 sheet 2 of 4.

a. General — Leachate transfer pump system consists of a transfer pump with its suction line connected to leachate storage tank, discharge piping, flow meter, and a truck loading quick disconnect. System allows operator(s) to pump liquids from leachate storage tank to storage trucks. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

b. Program — Program PLC to monitor totalized flow from leachate storage tank to truck loading station for the purpose of determining amount of liquids being trucked off-site. Transfer pump operation is manual, with interlocks preventing transfer pump operation during a storage tank low-low level condition.

c. AUTO Operation — None

d. Process Control Set-points — None

e. REMOTE Operation — None

j. ON (manual) Operation — ON (manual) Operation requires the following steps be taken by operator(s):

(1) Operator(s) shall place transfer pump ON-OFF control switch (located inside transfer building) to ON mode. Operator(s) shall monitor totalized flow as a means of determining duration of transfer operation.

f. Interlocks — Interlocks shall prevent transfer pump operation during a storage tank low-low level condition.

g. Alarms— Program PLC to monitor process and alarm for the following minimum conditions:

(1) Truck Loading Station flow signal fail.

h. Flow Totaling — PLC shall provide flow totals for truck loading station. PLC control logic shall allow for flow reset and value adjustment.

7. Control Panel Power Monitoring System (Loop 219). Reference P&ID Drawing H-2-830854 sheet 1 of 4.

a. General — Control panel power monitoring system consists of a control relay mounted inside landfill crest pad building control panel. Power to landfill crest pad building control panel is monitored by this control relay. In the event of a power failure, control relay drops out removing input status to PLC. The PLC (which is powered by a UPS) senses the loss of signal, and prevents automatic operation of process equipment. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

b. Program — Program PLC to monitor power to control panel. In the event of a power failure, PLC program shall remove run command from all process equipment so as to prevent nuisance alarming and equipment failure. Program PLC to stagger start equipment after control power returns to normal.

c. AUTO Operation — None.

d. Process Control Set-points — None.

e. REMOTE Operation — None.

f. ON (manual) Operation — None.

g. Interlocks — Interlocks prevent operation of equipment in the event of loss of power to control panel.

h. Alarms — Program PLC to monitor and alarm control panel power for following minimum conditions:

(1) Control Panel Power fail.

i. Runtime — None.

8. Crest Pad and Leachate Transfer Building Temperature Monitoring System (Loops 219, 220). P&ID drawings H-2-830854 sheets 1 & 2 of 4.

a. General — Crest pad and leachate transfer building temperature monitoring system consists of an ambient temperature transmitter which monitors the effective operation of building heating and cooling equipment. All process variables and equipment status shall be displayed locally via panel mounted OIU and digital indicators.

b. Program — Program PLC to monitor crest pad and leachate transfer building temperature levels and alarm in the event of temperature alarm condition signifying heating and cooling equipment failure.

c. Automatic Operation — None.

d. Process Control Set-points:

(1) Landfill crest pad building temperature level high alarm in degrees C

(2) Landfill crest pad building temperature level low alarm in degrees C

(3) Leachate transfer building temperature level high alarm in degrees C

(4) Leachate transfer building temperature level low alarm in degrees C

e. REMOTE Operation — None.

f. ON (manual) Operation — None.

g. Interlocks — None.

h. Alarms — Program PLC to monitor process and alarm for the following minimum conditions:

(1) Landfill crest pad building temperature level high alarm

(2) Landfill crest pad building temperature level low alarm

(3) Landfill crest pad building temperature signal fail alarm

(4) Leachate transfer building temperature level high alarm

(5) Leachate transfer building temperature level low alarm

(6) Leachate transfer building temperature signal fail alarm.

i. Runtime — None.

9. Building General Alarm System (Loops 219, 220). Reference P&ID Drawing H-2-830854 sheet 1, 2 of 4.

a. General — Building general alarm system consists of alarm lights installed on the exterior wall of the landfill crest pad building, and on the local control panel inside the leachate transfer building which are operated by the PLC. Alarm light provides a visual method of notifying operator(s) of a general alarm condition.

b. Program — Program PLC to monitor all process loops and initiate general alarm in the event of an alarm condition. General alarm shall continue until process alarm condition is acknowledged by operator(s). Acknowledge shall be initiated at pushbutton or OIU on landfill crest pad building control panel. Program PLC to receive acknowledgement during an alarm condition, to turn off general alarm light, and be able to initiate a new general alarm in the event of a new and subsequent alarm condition.

c. AUTO Operation — None.

d. Process Control set-points – None.

e. REMOTE Operation — None.

f. ON (manual) Operation — None.

g. Interlocks — None.

h. Alarms — (See previous loops).

i. Runtime — None.

OIU Displays and Layout

1. General — OIU shall be configured with process displays, data entry, runtime, and alarm screens. Process set-points and control modes shall be one-shot commands from the OIU.

2. Process display screens shall have a P&ID style of presentation. Displays shall include text for equipment and process identification. Data entry points and screens shall have a TABLE style of presentation.

3. Program OIU to enable secured access to process set-points and control modes of operation. OIU shall be configured with process status display screens, set-point entry, equipment control mode, equipment runtime, flow totaling, alarm status, and alarm enable/disable screens. Process set-point and equipment control mode shall be implemented using RETURN ENTRY at the control panel mounted OIU.

4. Program OIU with three (3) security levels: engineer, operator, and system administrator. Engineer shall have access to all displays. Operator shall have access to all process status and alarm display screens but not control mode, alarm enable/disable, and set-point screens. Administrator shall have access to process status, and alarm enable/disable screens.

5. Configure and link OIU Main Menu, Sub-Menu and Data screens in a logical fashion allowing operator(s) to logically move through each process control loop, with the ability to access data entry set-point and control modes as described in this document.

6. Program and configure alarm screens for each alarm as described in this document. OIU alarm screens shall enable operator(s) to visually identify and acknowledge all alarm conditions for

each process control loop. Alarms shall be acknowledged at local alarm display ONLY. Acknowledge shall not be broadcast across network from OIUs.

7. Alarm Identifications:

   a. Process in Alarm and Unacknowledged: Flashing

   b. Process in Alarm and Acknowledged: Steady

8. Configure and link displays in a logical fashion allowing operator(s) to logically access all processes and select the following:

   a. IDF Process System Overviews (Displaying process levels, flows, and temperature for each system)

   b. Disposal Facility Equipment Runtime and Runtime Reset Display

   c. Disposal Facility Process Control Set-point Display(s)

   d. Disposal Facility Process Alarm Set-point Display(s)

   e. Disposal Facility Process Flow Totalization and Flow Totalization Reset Display

   f. Integrated Disposal Facility Alarm Display.

REFERENCE MANAGEMENT DIRECTIVE TFC–034, Rev. A

USQ #04-0016-AA

CH2M HILL Hanford Group, Inc.	**Manual**	**Management Directive**
	Revision	**TFC-MD-034, REV A**
GRAPHIC PROCESS DISPLAY CRITERIA FOR HUMAN-MACHINE INTERFACES	**Page**	**18 of 3**
	Issue Date	**January 9, 2004**
	Effective Date	**January 12, 2004**
	Expiration Date	**March 1, 2004**
FUNCTIONAL AREA MANAGER:		**D. C. Lowe**
DOCUMENT OWNER:		**R. E. Larson**

1.0 PURPOSE AND SCOPE

The purpose of this management directive (MD) is to establish the requirements for standardized criteria for new graphic process displays (human-machine interfaces) that are being designed or acquired for process monitoring and control systems of CH2M HILL Hanford Group, Inc. (CH2M HILL) facilities and managed projects.

The requirements of this MD are applicable to new monitoring and control system designs (Human-Machine Interfaces) for CH2M facilities and to projects that have not completed an Acceptance Test Procedure (ATP). Application of the MD requirements to existing human-machine interfaces systems and human-machine interfaces systems with a completed ATP will be determined, planned, and performed in accordance with the resolution of PER-2003-4039.

2.0 IMPLEMENTATION

This management directive is effective on the date shown in the header and will remain in effect until a new Graphic Process Display Criteria for Human-Machine Interface Standard is issued.

3.0 DIRECTIVE

The following requirements that are based on the national standard ISA-S5.5-1985, "Graphic Symbols for Process Displays," are the Tank Farm Contractors (TFC) design requirement for new process monitoring and control systems (Human-Machine Interfaces).

3.1 General

The following general symbol usage standards apply:

1. The graphic process display will follow requirements specified in ISA-S5.5 standard.

2. The use of outline and solid (filled) symbol forms to indicate status is as follows:

- An outline symbol form indicates an off, stopped, or nonactive state.
- A solid (filled) symbol form indicates an on, running, or active state.
- Status designation by use of solid or outline forms are particularly applicable to the rotating equipment and valves and actuators. In depicting valve position, use solid to show open (material flowing or active) and outline to show closed (material stopped or nonactive).
- A symbol may be partially filled or shaded to represent the characteristic of the contents of a vessel, e.g. level, temperature, etc.

3.2 Color

The following standards are to be applied to the application of color to process displays:

1. The following color application guidelines are to be followed:
    - The number of colors in one display should be limited to the minimum necessary (typically 4 or less) to satisfy the process interface objectives of the display.
    - Compatible color combinations should be used.
    - Use color as a redundant indictor along with text, symbol, shape, size, reverse video, blinking, and intensity coding to preserve communication with individuals having limited color perception.
    - Colors are not to be used to indicate quantitative value.
2. Colors are to be assigned consistent with Tables 1-4.

Table 1. Unique Component Colors (e.g., Leak Detectors, Tanks).

(Outline colors and text shall be black (unless otherwise noted), display background to be tan or light blue)	
State	**Fill Color**
Out of Service	Black
In Service – Unselected	White
In Service – Selected (No Alarm)	Green
Alarming (Unacknowledged)	Flash Red
Alarm (Acknowledged)	Solid Red
Caution Alarm (Unacknowledged)	Flash Yellow (Amber)
Caution Alarm (Acknowledged)	Solid Yellow (Amber)
Not Used (e.g., bypassed)	Border is white, fill color as noted above

Table 2. Pipe Colors.

(Outline colors and text shall be black (unless otherwise noted), display background to be tan or light blue)	
State	**Fill Color**
Out of Service	Black
In Service – Unselected	White
In Service – Selected (No Alarm)	Grey
In Service – Selected (with Air or Fluid Flow)	Green
Encasement Leak Detector Alarming (Unacknowledged)	Red with Flashing Text
Encasement Leak Detector Alarm (Acknowledged)	Solid Red
Caution Alarm (Unacknowledged)	Flash Yellow (Amber)
Caution Alarm (Acknowledged)	Solid Yellow (Amber)
Not Used (e.g., bypassed)	Border is white, fill color as noted above

Table 3. Valves Port Colors.

(Outline colors and text shall be black (unless otherwise noted), display background to be tan or light blue)	
State	**Fill Color**
Out of Service	Black
In Service – Unselected	Grey*
In Service – Selected/Operable: Open Port (No Alarm)	Green
In Service – Selected/Operable: Shut Port (No Alarm)	White*
In Service – Operating: Transition	Yellow (All Ports)
Valve Position Alarm (Unacknowledged)	Flash Red
Valve Position Alarm (Acknowledged)	Solid Red
Caution Alarm	Flash Yellow (Amber)
Not Used (e.g., bypassed)	Border is white, fill color as noted above

* The grey color used for the unselected valve is for contrast with an unselected pipe (white), which assists the operator in distinguishing the pipe from the valve (operator influence from display screen tests). The white color used to identify a shut port on a valve is in contrast with the valve open ports (green) and with the selected pipe (grey) which assists the operator in distinguishing the pipe from the valve.

Table 4. Pump Colors.

(Outline colors and text shall be black (unless otherwise noted), display background to be tan or light blue)		
State	**Fill Color**	**Text**
Out of Service	Black	--
In Service – Unselected	White	--
In Service – Selected: Pump Off and Power Off (No Alarm)	Grey	Stopped

(Outline colors and text shall be black (unless otherwise noted), display background to be tan or light blue)		
State	**Fill Color**	**Text**
In Service – Selected: Pump Off and Power On (No Alarm)	Yellow	Stopped
In Service – Selected: Pump On (Rotating)	Green	Running
Pump Alarm (Unacknowledged)	Flash Red	Stopped
Pump Alarm (Acknowledged)	Solid Red	Stopped
Caution Alarm (Unacknowledged)	Flash Yellow (Amber)	Caution

4.0 RECORDS

No records are generated in the performance of this management directive.

5.0 REFERENCES

1. Instrument Society of America (ISA) S5.5-1985, "Graphic Symbols for Process Displays."

SECTION 15021--HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART 1--GENERAL

SUMMARY:

This section is for furnishing and installing leachate piping and associated components.

REFERENCES:

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only. Recognizing some requirements of the references cited below may not be applicable, the Engineer shall judge the applicability of compliance with the references not specifically addressed herein. In the event of a conflict between the text of this Specification and the references cited herein, the text of this Specification shall take precedence or as directed by the Engineer.

ASTM INTERNATIONAL (ASTM)

ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
ASTM D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D2513	Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fitting Materials.
ASTM F714	Standard Specification for Polyethylene Plastic Pipe (SDR-PR) Based on Outside Diameter.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192.285	Plastic pipe; qualifying persons to make joints.

DESCRIPTION:

Pipe: This section includes all high density polyethylene (HDPE) pipe used in the cells including but not limited to:

Leachate collection piping on floor and cleanout access pipes on the slopes of the trench.

Leachate discharge piping, leak detection piping, and associated riser pipes.

Double containment piping outside the cell (e.g., leachate force main and drain lines) and elsewhere as shown on the Drawings.

<u>SUBMITTALS–APPROVAL REQUIRED:</u>

See Section 01300, SUBMITTALS, for submittal procedures.

Manufacturer's certificates of compliance for all pipe and fittings. Certificates shall acknowledge that pipe and fittings meet the requirements of the Specifications.

<u>SUBMITTALS–APPROVAL NOT REQUIRED:</u>

<u>Information/Record (IR):</u>

Catalog and manufacturer's data sheets for HDPE pipe and fittings.

Descriptive literature about the fusion equipment to be used and certification from the pipe supplier or manufacturer that the joining technician(s) is certified and experienced in heat fusion joining of HDPE pipe. Certification shall contain the following minimum information:

Name of technician.

Date of certification.

Statement by the pipe supplier that the technician is certified in the means and methods of joining the supplier's pipe and fittings using butt fusion techniques.

Make(s) and model(s) of fusion equipment the technician is certified to join pipe with.

Catalog and manufacturer's data sheets, electrofusion couplers, mechanical cutters, and appurtenances.

<u>PART 2--PRODUCTS</u>

All HDPE pipe and fittings shall conform with additional applicable requirements defined in the Piping Schedule in Section 15060, PIPING-GENERAL.

<u>HDPE PIPE:</u>

<u>Resin:</u> HDPE pipe shall be manufactured from first quality extra-high molecular weight, high density polyethylene resin containing no more than 2 percent clean recycled polymer by weight. Resin shall meet or exceed the requirements of ASTM D3350 for PE3408 material with a cell classification of 345434C or higher. Alternate cell classifications are acceptable if

one or more of the 6 numbers in the cell classification is greater than the minimum. Pipe shall be rated PE3408. Pipe and fittings shall be in compliance with schedule attached as supplement (see Attachment 1, HIGH DENSITY POLYETHYLENE (HDPE) PIPE) or as shown on the Drawings.

Quality: The pipe shall have uniform wall thickness and shall be uniform in color, opacity, density, and other physical properties. Pipe shall be homogeneous throughout and free of visible cracks, holes, blisters, bubbles, undispersed raw materials, or any contamination by foreign matter. Any pipe with nicks, scrapes, or gouges deeper than 10 percent of the nominal wall thickness shall be rejected.

Form: Pipe may be supplied in a continuous extruded seamless piece or in sections.

Manufacturer's Certificates of Compliance: The manufacturer shall submit a Certificate of Compliance of the HDPE pipe supplied for the IDF project, which will include that the pipe is grade PE3408 and the identity of the cell classification per ASTM D3350.

HDPE pipe SDR shall be as indicated on the Piping Schedule in Section 15060, PIPING-GENERAL.

Fittings: Fittings shall conform to the requirements of Article HDPE PIPE of this section, shall be compatible with components of the double containment system, and HDPE manholes where required.

Polyethylene fittings shall be from the same manufacturer as the pipe, molded or fabricated from polyethylene pipe and shall have the same or numerically smaller SDR than pipe connecting to the fitting. Fittings shall follow requirements in Attachment 1.

All reducing tees shall be factory molded if available as a standard item by any manufacturer having pipe meeting this section. If not available as a standard item, branch saddle reducing tees shall be used. Reducers shall be shop manufactured. Fabricated branch connections will not be allowed if branch saddle connections are listed in the manufacturer's catalog.

All molded polyethylene fittings shall have the same or higher pressure rating as the pipe when installed in accordance with the latest technical specifications. All fabricated polyethylene fittings shall have the same or higher pressure rating as the adjoining pipe when installed in accordance with the manufacturer's recommendations.

DOUBLE CONTAINMENT PIPE:

Pipe Materials: Both carrier pipe and containment pipe shall meet the requirements of Article HDPE PIPE of this section.

Configuration: Double containment pipe shall consist of a carrier pipe installed within a containment pipe. All pipe and fittings shall provide an annular space between the carrier and containment pipes to accommodate possible flow of fluid from the carrier pipe.

Support Spacers: Support spacers shall be manufactured from nonmetallic, corrosion-resistant material with the same or better chemical compatibility properties as the HDPE pipe. Spacers shall be secured to the carrier pipe at maximum 8-foot intervals. Spacing shall be reduced if required to maintain the annulus between the carrier and containment pipes and shall be positioned to allow for unrestricted passage of possible flow of fluid from the carrier pipe. Spacers shall be chamfered at both ends to allow for removal of carrier pipe. Materials and systems used to secure the spacers to the pipe shall have the same or better chemical compatibility properties as the HDPE pipe.

Fittings: Fittings shall conform to the requirements of Article HDPE PIPE of this section and shall be compatible with components of the single wall HDPE pipe where required.

SLOTTED PIPE:

Leachate Collection Piping: Leachate collection and leak detection piping on the floor of the cells and elsewhere as shown on the Drawings shall be slotted. Cleanout access pipes and leachate transmission piping shall not be slotted.

In addition to meeting all other requirements of this section, slotted pipe shall have slots 0.128 inch wide and 1.25 inches long, in five places equidistant around the pipe. Slots shall provide a minimum of 9 square inches of open area per linear foot of pipe. Slotted pipes shall be free of cutting debris from the slot cutting process.

Perforated pipe with circular drill holes is not allowed.

PART 3--EXECUTION

GENERAL:

All HDPE pipe and fittings shall be installed in conformance with applicable code requirements referenced in Section 15060, PIPING-GENERAL.

DIMENSIONS:

Piping dimensions shown on the Drawings are approximate. It is the Construction General Contractor's responsibility to furnish and install piping of the proper dimensions, which will properly fit with the connecting elements, pipes, fittings, pumps, etc.

INSTALLATION:

Pipe shall be handled and stored in such a manner as to ensure a sound, undamaged condition.

Pipe shall be cut in a neat, workmanlike manner using a mechanical cutter that will not damage the pipe.

Joining of HDPE pipe to HDPE pipe shall be accomplished by thermal butt fusion joint; no solvent welding or adhesive welding shall be allowed. Electrofusion couplings shall only be allowed when access to piping is restricted and only as approved by the Engineer. Slotted leachate collection piping shall be joined with thermal butt fusion joints. Pipe shall be joined per ASTM D2657 and manufacturer's recommendations.

Single butt fusion welds shall be used to create pipe sections as long as practicable. Fabricated pipe sections and fittings may be joined by the double butt fusion process.

During installation, the pipe shall not be pulled across sharp projections that could cause gouges, kinks, or other types of damage. To minimize "snaking" due to thermal expansion, protect pipe from direct sunlight, or limit unrestrained length of pipe during installation.

Allowance for Thermal Expansion/Contraction:

HDPE has a coefficient of thermal expansion of 1.2 x 10-4 ft/ft/deg F. Buried HDPE pipe shall be installed with excess length between anchor points such that contraction caused by temperature drop to 40 degrees F will produce the length of pipe between two points shown on the Drawings. Amount of excess pipe depends on temperatures of pipe at the time of installation, according to Table 1 for buried piping:

TABLE 1

Installation Temperature (degrees F)	Excess Pipe Length (in./100 ft)
50	1.4
60	2.9
70	4.3
80	5.8
90	7.2
100	8.6
120	11.5

Installation temperature is of the pipe material and not ambient air temperature. Measure installation temperature with a strip thermometer laid directly on the pipe. Verify temperate and excess pipe length required immediately before burial.

Placement of Buried Pipes:

Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.

The pipe shall not be dropped into the trench. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe. The full length of the pipe shall be firmly bedded on the trench bottom.

The pipe shall be bedded in such a way as to maintain grade with a tolerance of -0.0 percent, +0.5 percent with a uniform, constant grade and no localized low spots.

<u>Pipe Base and Pipe Zone:</u> As specified in Section 02320, TRENCH BACKFILL.

Keep trench dry until pipe laying and joining are completed.

Prevent foreign material from entering pipe during placement.

Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.

Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.

After joint has been made, check pipe alignment and grade.

Place sufficient pipe zone material to secure pipe from movement before next joint is installed.

Prevent uplift and floating of pipe prior to backfilling.

Place pipe along pipe runs starting at one end and moving towards the other to avoid joints that will not be feasible with butt fusion.

<u>Tolerances:</u>

Horizontal position of pipe centerline on alignment around curves maximum variation of 1.0 foot from position shown.

<u>Pipe Cover:</u> Minimum 2 feet 6 inches from finished elevation of overlying material, unless otherwise shown.

Temporarily close pipe ends as required to avoid introducing dirt or other foreign material into the pipe.

Trenching and backfilling operations shall be conducted in accordance with the requirements of Section 02320, TRENCH BACKFILL, for utility trenching. If trenching is used, underlying materials shall not be disturbed or damaged in anyway. Backfilling operations shall ensure that no voids are present under or at the sides of the pipe. Backfill shall initially be placed to the top of the pipe, then hand compacted. The remainder of the trench shall then be backfilled and compacted by hand or with a power tamper only.

On the floor of the cell, pipe may be placed directly on geosynthetic layers prior to placing drainage gravel. Placement of gravel around pipes shall be by hand unless otherwise approved by the Engineer. Placement operations shall ensure that no voids are present under or at the sides of the pipe. Placement operations shall not disturb the position of the pipe.

Where flanged joints are used, the bolts shall be evenly torqued using a crossing pattern to gradually tighten the lug nuts. Torque values shall be as recommended by the flange manufacturer. Flanged joints shall be retorqued after one hour or more has passed. Apply anti-seize compound on all threaded surfaces before tightening.

Flaws (minor imperfections, damaged areas, etc.) in HDPE pipe with a depth of 10 percent or less of the nominal wall thickness will not require repair or replacement. In double containment systems, carrier pipe with flaws deeper than 10 percent of the wall thickness shall be replaced. Single pipe or containment pipe with flaws between 10 and 25 percent of the wall thickness shall be repaired in accordance with the pipe manufacturer's recommendations. The Construction General Contractor shall certify in writing that the repaired area will have material properties that meet or exceed those of intact pipe. Any pipe with flaws deeper than 25 percent of the nominal wall thickness shall be rejected.

All valves and equipment shall be supported independently from pipe. Anchor valves such that turning moment resulting from their operation will not be transmitted to pipe.

> Special Precautions at Flanges: Polyethylene pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between polyethylene pipe at flanged joint and rigid structures is possible.

Butt-fusion shall be performed in accordance with pipe manufacturer's recommendations as to equipment and technique.

Weld Beads: Remove internal weld beads from the side slope risers and horizontal sections of slotted pipe where the LCRS and LDS pumps will be placed. Remove all plastic debris from inside pipe.

Slotted Pipe. Slotted pipe shall be cut and joined so that full contact is made around the entire circumference of the weld. Partial weld contact because of joints through a slot row is not acceptable.

LOCATOR RIBBON:

Locator ribbon shall be installed as specified in Section 02320, TRENCH BACKFILL.

IDENTIFICATION RIBBON:

Underground pipelines, except for pipelines inside the Phase I liner limits, shall be identified by use of a plastic ribbon or stencil no less than 3 inches in width with a message printed on the ribbon which identifies the actual pipeline contents. Marking tapes or stencils shall be placed on existing lines where they are exposed by trenching operations. The ribbon shall be wrapped around the pipeline at no less than 1 wrap per 3 feet of run. The plastic ribbon/ stencil shall be color coded in accordance with the Piping Schedule.

CLEANING:

Clean all piping as required in Section 15060, PIPING-GENERAL, to remove all foreign materials including dirt, grease, and other matter.

CONSTRUCTION QUALITY CONTROL (ACCEPTANCE TESTING):

Per Section 15992, PIPING LEAKAGE TESTING, and the Piping Schedule in Section 15060, PIPING-GENERAL.

END OF SECTION 15021

ATTACHMENT 1
HIGH DENSITY POLYETHYLENE (HDPE) PIPE

Item	Size	Description
General	All	Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
Pipe		Pipe SDR shall be AS INDICATED ON THE Piping Schedule in Section 15060, PIPING-GENERAL. Protection shall be provided against ultraviolet light degradation using carbon black, not less than 2 percent well dispersed in the resin. Pipe wall thickness shall reflect the required SDR* and diameter, as shown in Table 8, ASTM F714. Pressure rating shall be 100 psi minimum. *SDR: standard dimension ratio = OD/thickness
Fittings	6-inch and smaller	Molded fittings, butt fusion joined, conforming to ASTM D3261.
	8-inch and larger	Molded if manufactured as a standard item or same as pipe, butt fusion joined, conforming to ASTM D3350.
Electrofusion Couplers		Rigid, straight coupler constructed from injection-molded polyethylene with embedded heating coils as manufactured by Central Plastics; or equivalent.
Flanges		ASTM A351 Type 316/CF8M stainless steel, 150-pound, ANSI B16.5 standard, convoluted back-up ring with one-piece polyethylene molded flange adaptor ends, same rating pressure as pipe.
Bolting		Stainless steel, ASTM A193/A193M Grade B8M studs and ASTM A194/A194M Grade 8M hex head nuts. Manufacturer's recommended anti-seize compound on all threads. Washers shall be same material as bolts.
Gaskets		Flat ring, 1/8-inch Viton.

SECTION 15022--HIGH DENSITY POLYETHYLENE MANHOLES

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

ASTM INTERNATIONAL (ASTM)

ASTM D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fitting Materials.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

Product data sheets for make and model.

Complete catalog information, descriptive literature, specifications, construction drawings, and identification of materials of construction.

Provide calculations indicating diameter and wall thickness of each manhole is acceptable per design criteria specified.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Submit results of manhole leakage testing.

PART 2--PRODUCTS

HDPE MANHOLES:

The manhole shall be manufactured by the fabrication of high density polyethylene (HDPE pipe). The riser shall be made of HDPE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248. The cell classification shall be 345434C per ASTM D3350. Alternate cell classifications are acceptable if one or more of the six numbers in the cell classification are greater than the minimum. Pipe shall be rated PE3408.

Flatstock shall meet or exceed ASTM D1248 requirements for Type III, Class C, Category 3, Grade G5.

HDPE pipe and flatstock used to fabricate the HDPE manhole shall meet all product requirements of Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE. HDPE pipe for 76-inch diameter manhole shall be SIDR 39.0. HDPE pipe for 42-inch diameter manhole shall be SDR 21.

Welding rods, connecting couplings, pipe collars and other materials, as required to complete the installation, shall be of the same plastic as the flatstock.

Piping and appurtenances shall meet the requirements of Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE, and Section 15060, PIPING–GENERAL.

Access hatch shall be precast vault lid with spring-assisted galvanized plate cover with locking latch; cover shall be weathertight with channel drain. Utility Vault Model 77-2-332P; or approved equal.

Wall thickness and diameter of each manhole shall be verified assuming the following design criteria:

Dimensions specified and depth of manholes identified on Drawings.

Lateral load transmitted to 76-inch diameter manhole from concrete ring footing shown on Drawing H-2-830850.

Weight of precast utility vault equal to 4,020 pounds.

Load on utility vault equal to 100 pounds per square foot (vault will not have traffic loads).

No groundwater forces acting on 76-inch diameter manhole.

42-inch manhole full of water.

PART 3--EXECUTION

FABRICATION:

Inlet and outlet piping shall be installed as shown on Drawings by fabricator prior to delivery to site.

The manhole shall be fabricated with the minimum number of welds practical.

All welds shall be heat fused in accordance with manufacturer's recommendations on equipment specifically designed for welding thermoplastic sheets or extrusion welded by precertified welders.

INSTALLATION:

Manholes shall be handled and stored according to manufacturer's recommendations and in such a manner as to ensure a sound undamaged condition.

Excavation and backfilling operations shall be conducted in accordance with Section 02316, EXCAVATION, and Section 02315, FILL AND BACKFILL.

Joining of HDPE field piping to HDPE manhole pipe stubouts shall be done by thermal butt or socket fusion, no solvent or adhesive welding shall be allowed. HDPE welding shall be by qualified and approved welders as identified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

Install piping, appurtenances, and pipe hangers and supports in accordance with Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE, and Section 15060, PIPING-GENERAL.

Install access hatch in accordance with Drawings.

CONSTRUCTION QUALITY CONTROL – LEAKAGE TESTING

After all HDPE manhole pipe stubout connections have been completed for inner and outer HDPE manholes, and prior to backfilling, perform separate leakage tests for inner and outer manholes. Each manhole shall be completely filled with water and no leaking shall be allowed from any HDPE joints for a period of 8 hours. General Construction Contractor shall provide necessary shoring during leakage testing of outer manhole per manufacturer's recommendations to compensate for lack of backfill.

END OF SECTION 15022

SECTION 15060--PIPING-GENERAL

PART 1--GENERAL

SUMMARY:

This section is for furnishing and installing leachate piping and associated components.

REFERENCES:

The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.3	Malleable Iron Threaded Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.11	Forged Fittings, Socket-Welding and Threaded
ANSI B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ANSI B16.42	Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B36.10M	Welded and Seamless Wrought Steel Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C153/ A21.53	Ductile-Iron Compact Fittings 3 Inches Through 24 Inches and 54 Inches Through 64 Inches, for Water Service

ASTM INTERNATIONAL (ASTM)

ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM D1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2467	Standard Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Product data sheets, complete catalog information, descriptive literature, specifications, and identification of materials of construction.

Laboratory Testing Equipment: Certified calibrations, manufacturer's product data, and test procedures.

Qualifications:

Solvent Welders: List of solvent welders and current test records for solvent welder(s) for field solvent welding.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Manufacturer's Certification of Compliance.

PART 2--PRODUCTS

PIPING:

High Density Polyethylene Piping: As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

Others as specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.

Diameters Shown:

Standardized Products: Nominal size.

Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.

JOINTS:

Flanged Joints:

Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.

Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

Threaded Joints: NPT taper pipe threads in accordance with ANSI B1.20.1.

Mechanical connections of high density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of products as specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE, and bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.

GASKET LUBRICANT:

Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

DOUBLE WALL CONTAINMENT PIPING SYSTEM:

As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

FLEXIBLE HOSE:

Flexible hose required for connection of leachate pump discharge piping to crest pad piping manifold and at truck loading station shall be Royalflex, vinyl nitrile by Boston Industrial Products, or equal, rated at a minimum of 125 psi.

A male and female quick-connect coupling shall be factory or shop installed on each length of flexible hose with stainless steel banding. Quick connect couplings for flexible hose and leachate pump discharge piping within the slope riser pipe shall be fiberglass-filled polypropylene with stainless steel rings, arms, and pins.

VENT AND DRAIN VALVES:

Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

FABRICATION:

Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

FINISHES:

Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.

Galvanizing:

Hot-dip applied, meeting requirements of ASTM A153.

Electroplated zinc or cadmium plating is unacceptable.

Stainless steel components may be substituted where galvanizing is specified.

LOCATOR RIBBON:

As specified in Section 02320, TRENCH BACKFILL.

INSULATION:

Piping:

Combined Sump (Discharge Piping Only) and Piping Requiring Heat Trace:

Material: Flexible elastomeric pipe insulation, closed cell structure, 3/4 inch thick.

Temperature Rating: Minus 40 degrees F to 180 degrees F.

Nominal Density: 6 pcf.

Conductivity in accordance with ASHRAE 90.1 and minimum of 0.27 BTU-in/hr-ft^2 degrees F at 75 degrees F per ASTM C177 or ASTM C518.

Minimum water vapor transmission of 0.10 perm-inch per ASTM E96.

Seal joints with manufacturer's adhesive.

Flame Spread Rating: Less than 25 per ASTM E84.

Manufacturers and Products:

Rubatex; R-180-FS.

Armstrong; Armaflex AP.

Piping and Insulation Cover: Aluminum jacket 0.016-inch thick.

PART 3--EXECUTION

EXAMINATION:

Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

PREPARATION:

Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

INSTALLATION-GENERAL:

Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

Remove foreign objects prior to assembly and installation.

Flanged Joints:

Install perpendicular to pipe centerline.

Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.

Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.

Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.

Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.

Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.

Threaded flanged joints must be shop fabricated and delivered to jobsite with flanges in-place and properly faced.

Threaded and Coupled Joints:

Conform with ANSI B1.20.1.

Produce sufficient thread length to ensure full engagement when screwed home in fittings.

Countersink pipe ends, ream and clean chips and burrs after threading.

Make connections with not more than three threads exposed.

Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

High Density Polyethylene Piping: As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-EXPOSED PIPING:

Piping Runs:

Parallel to building or column lines and perpendicular to floor, unless shown otherwise.

Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

Piping Clearance (unless otherwise shown):

Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet 0 inches, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.

Head room in front of openings, doors, and windows shall not be less than the top of the opening.

Do not install piping containing liquids or liquid vapors in transformer vaults.

Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

INSTALLATION-DOUBLE WALL CONTAINMENT PIPING SYSTEM:

Install as specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-BURIED PIPE:

Placement: In accordance with Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

SLAB, FLOOR, WALL, AND ROOF PENETRATIONS:

Application and Installation: As shown on Drawings.

Wall Pipe Installation: Support wall pipes securely by framework to prevent contact with reinforcing steel and tie wires.

BRANCH CONNECTIONS:

Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

Threaded Pipe Tap Connections:

Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.

Limitations: Threaded taps in pipe barrel are unacceptable.

CLEANING:

Following assembly and testing, and prior to final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

The up-slope riser pipe and slotted pipe shall be cleaned internally after deburring by pulling cotton pillows attached to ropes through pipe repeatedly until no debris comes out of pipe with pillow. Water flushing shall not be permitted. Pipe ends shall be covered after fabrication and at the end of shifts to avoid foreign materials from entering pipe.

If impractical to flush large diameter pipe at 2.5 fps, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

FIELD FINISHING:

Notify Construction Manager at least 3 days prior to start of any surface preparation or coating application work.

LOCATOR RIBBON:

Locator ribbon shall be installed as specified in Section 02320, TRENCH BACKFILL.

PIPE IDENTIFICATION:

Exposed Piping:

In general, all exposed piping shall be color coded and identified in accordance with ANSI A-13-1. It is the intent of this standard that the identification method of aboveground piping is by English text that allows the contents to be readily identified. Flow direction should be also shown by arrows.

All piping and equipment shall be identified in accordance with established site standards.

In addition to the requirements specified herein, all pipelines and standard equipment shall be color coded and identified with beaded chain or steel cable stainless steel tags displaying the pipe or equipment number as shown on the Drawings. The tags shall be fabricated from 300 series austenitic stainless steel metal strips 3/4 inch wide, 24-gauge minimum thickness, with 3/16-inch high letters stamped on the metal surface. Any pipes entering or leaving a building shall be tagged adjacent to floor or wall penetration. The tags shall be attached to the pipe or austenitic equipment with austenitic stainless steel bead chain or austenitic stainless steel cable. When tagging valves, the bead chain shall be attached to the valve stem or yoke.

CONSTRUCTION QUALITY CONTROL – LEAKAGE TESTING:

As specified in Section 15992, PIPING LEAKAGE TESTING.

SUPPLEMENTS:

Supplement 1—Polyvinyl Chloride (PVC) Pipe and Fittings.

Supplement 2—Galvanized Steel Pipe and Malleable Iron Fittings.

Supplement 3—Piping Schedule.

END OF SECTION 15060

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

Item	Size	Description
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with 2 percent titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket-weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with 2 percent titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket-weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ANSI B16.1 drilling
Bolting	All	ASTM A193/A193M Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.
Thread Lubricant	All	Teflon Tape.

GALVANIZED STEEL PIPE AND MALLEABLE IRON FITTINGS

Item	Size	Description
Pipe		Galvanized carbon steel, ASTM A106, Grade B seamless or ASTM A53, Grade B seamless or ERW.
	2" and smaller	Schedule 80.
	2-1/2" through 6"	Schedule 40.
Joints	All	Threaded or flanged at valves and equipment.
Fittings		Threaded: 150- or 300-pound galvanized malleable iron, ASTM A197 or ASTM A47, dimensions in accordance with ANSI B16.3.
Flanges		Galvanized forged carbon steel, ASTM A105/A105M, ANSI B16.5 Class 150 or Class 300, threaded, 1/16-inch raised face.
Unions		Threaded malleable iron, ASTM A197 or A47, 300-pound WOG, brass to iron seat, meeting the requirements of ANSI B16.3.
Bolting		Flanges: Carbon steel ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.
Gaskets	All flanges	Flanged, Water and Sewage Service: 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ANSI B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2.
Thread Lubricant	2" & smaller	Teflon tape or joint compound that is insoluble in water.

PIPING SCHEDULE LEGEND

SERVICE CODE

LH	Leachate Handling
LHCP	Leachate Handling Containment Pipe
LT	Leachate Transfer
LTCP	Leachate Transfer Containment Pipe

SERVICE

CPB	Crest Pad Building
CS	Combined Sump
IC	In-Cell
LTB	Leachate Transfer Building
OC	Outside-Cell
TL	Truck Loading

EXPOSURE

BUR	Buried
EXP	Exposed
SUB	Submerged

MATERIAL

GSP	Galvanized Steel Pipe
HDPE	High Density Polyethylene
PVC	Polyvinyl Chloride

PRESSURE TEST

H	Hydrostatic
P	Pneumatic
NA	Not Applicable

JOINT TYPE

BF	Butt Fused
FL	Flanged
SW	Solvent Weld
TH	Threaded

PIPING SCHEDULE

Service Code	Service	Size(s) (In.)	Exposure	Piping Material	Joint Type	Specification Section	Test Type	Test Pressure	Remarks
LH	IC	All	BUR	HDPE	BF	15021	H	65* LCRS–Low Flow 100* LCRS–High Flow 65* LDS	SDR 17 for all except SDR 13.5 for LCRS-High Flow Pump Discharge
LHCP	IC	All	BUR	HDPE	BF	15021	P	8	SDR 17, slotted portion of pipe not to be tested
LH	CPB CS	All	EXP	PVC	SW, FL, TH	15060	H	65	SCHD 80
LH	OC	All	BUR	HDPE	BF	15021	H	65	SDR 21
LHCP	OC	All	BUR	HDPE	BF	15021	P	8	SDR 17
LT	LTB	All	EXP	PVC	SW, FL, TH	15060	H	65	SCHD 80
LT	OC	All	BUR	HDPE	BF	15021	H	65	SDR 21
LTCP	OC	All	BUR	HDPE	BF	15021	H	8	SDR 17
LT	TL	All	EXP	GSP	FL, TH	15060	H	65	SCHD 40

*Test pressures measured at Crest Pad Building. Isolate any appurtenances not rated for test pressure such as vacuum breakers and pressure gages.

SECTION 15100--VALVES, OPERATORS, AND FILTER

PART 1--GENERAL

SUMMARY:

This section is for furnishing and installing valves, filters, and associated components for leachate and raw water systems. Valves and accessories for raw water are identified as such. Other requirements apply to leachate and raw water systems.

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C509	Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants

ASTM INTERNATIONAL (ASTM)

ASTM A276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A351	Standard Specification for Castings, Austenitic, Austenitic-Ferric (Duplex), for Pressure-Containing Parts
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B98	Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B127	Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
ASTM B139	Standard Specification for Phosphor Bronze Rod, Bar, and Shapes
ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B194	Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications

ASTM D429	Test Methods for Rubber Property—Adhesion to Rigid Substrates
ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

Product data sheets for make and model.

Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

Manufacturer's Certificate of Compliance for butterfly valves; full compliance with AWWA C504.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Documentation of construction quality control testing as specified herein.

PART 2--PRODUCTS

GENERAL:

Valve to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories for a complete operation.

Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

Valve same size as adjoining pipe.

Valve ends to suit adjacent piping.

Size operator to operate valve for the full range of pressures and velocities.

Valve to open by turning counterclockwise.

Factory mount operator, actuator, and accessories.

Provide nametag for each valve. Nametag shall include valve tag number and be constructed of 16-Gauge Type 304 stainless steel, letters shall be 3/16-inch imposed, affix to valve with 16- or 18- gauge stainless steel wire.

MATERIALS:

Brass and bronze valve components and accessories that have surfaces in contact with liquids other than leachate to be alloys containing less than 16 percent zinc and 2 percent aluminum. Valves in service on leachate lines shall have no bronze, brass, or copper wetted parts.

Approved alloys are of the following ASTM designations:

B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.

Stainless steel Alloy 18-8 may be substituted for bronze.

FACTORY FINISHING:

Exposed Valves:

Manufacturer's standard corrosion-resistant coating suitable for intended service.

Safety isolation valves and lockout valves with handles, handwheels, or chain wheels "safety yellow."

Epoxy Lining and Coating:

Use where specified for individual valves described herein.

In accordance with AWWA C550 unless otherwise specified.

Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as "fusion" or "fusion bonded" epoxy.

Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

VALVES:

Ball Valves:

Type V330 PVC Ball Valve 2 Inches and Smaller: Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions.

Manufacturers and Products:

Nibco; True-Bloc.

ASAHI America; Duo-Bloc.

Type V331 PVC Ball Valve 3 and 4 Inches: Rated 150 psi at 73 degrees F, with ASTM D1784 Type I, Grade 1 polyvinyl chloride full port body, Teflon seat, Viton O-ring stem, face and carrier seals, end entry design with dual union, solvent-weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1.

Manufacturers and Products:

Nibco.

ASAHI America.

PVC 3-Way Ball Valve 2 Inches and Larger: Valves shall be three-way type with port option necessary to either direct flow through leachate filter or bypass flow around leachate filter. Valve configuration shall allow filter replacement simultaneously with flow through filter bypass. Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, double union design, solvent weld socket ends, or flanged ends drilled to ASME B 16.5, Class 150, elastomer seat, Viton or Teflon O-ring stem seals, full ported ball.

Manufacturers and Products:

Spears; True Union 2000.

Or approved equal.

Check and Flap Valve:

Type V609 PVC Self-Closing Check Valve 4 Inches and Smaller: ASTM D1784, Type I, Grade 1, PVC body, rated at 150 psi, Viton seats and seals, stainless steel spring.

Manufacturer and Product: PLAST-O-MATIC; Series CKS.

Self-Contained Automatic Valves:

Air Release Valve 1/2 Inch to 16 Inches:

1/2-inch through 3-inch NPT inlets and outlets, 4 inch and larger ANSI B16.1 flanged inlet with plain outlet and protective hoods.

Rated 150 psi working pressure, PVC body, EPDM seals.

Manufacturer and Product: IPEX; Series VAFV.

Vacuum Breaker Valve: 1/2-inch NPT inlet and outlet, PVC body, EPDM diaphragm, working pressure 100 psi.

Manufacturer and Product: PLAST-O-MATIC; Series VBM.

Gate Valves:

Type V100 Gate Valve 3 Inches and Smaller (Raw Water): All-bronze, screwed bonnet, single solid wedge gate, nonrising stem, rated 125-pound SWP, 200-pound WOG.

Manufacturers and Products:

Stockham; B103, threaded end.

Crane; 438, threaded end.

Type V130 Resilient Seated Gate Valve, 2 Inches to 12 Inches (Combined Sump and Truck Loading Station):

Iron body, resilient seat, bronze mounted, ANSI Class 125 flanged ends, nonrising stem in accordance with AWWA C509, design working water pressure 200 psig for 2 inches through 12 inches, full port, fusion-epoxy coated inside and outside per AWWA C550.

Provide 2-inch operating nut and operator extensions for the gate valves on the secondary containment piping that drains into the combined sump. Provide handwheel operators for the gate valves at the truck loading station.

Manufacturers and Products:

M&H Valve; AWWA C509.

U.S. Pipe; Metroseal.

Type V130 Resilient Seated Gate Valve, 4 Inches to 12 Inches (Raw Water):

Iron body, resilient seat, bronze mounted, ANSI Class 125 flanged ends, nonrising stem in accordance with AWWA C509, design working water pressure 200 psig for 2 inches through 12 inches, full port, fusion-epoxy coated inside and outside per AWWA C550.

Provide post indicating assembly with detachable crank handle for 12-inch gate valve at raw water tie-in.

Manufacturers and Products:

U.S. Pipe; Metroseal.

Clow Corp; Model F-61XX.

Butterfly Valves:

General: Valves specified as AWWA C504 to be in full compliance with AWWA C504 and following requirements:

Suitable for throttling operations and infrequent operation after periods of inactivity.

Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B.

Bubble-tight with rated pressure applied from either side.

No travel stops for disc on interior of body.

Self-adjusting V-type or O-ring shaft seals.

Isolate metal-to-metal thrust bearing surfaces from flowstream.

Valve actuators to meet the requirements of AWWA C504.

Type V530 Butterfly Valve 4 Inches to 24 Inches for Fire Protection Service (Raw Water):

UL Listed and FM Approved, flanged style, AWWA C504 Class 150B valve with cast iron body, aluminum-bronze disc, stainless steel stem, EPDM seat, geared operator with highly visible position indicator and detachable crank handle.

For buried service, provide post indicating assembly with detachable crank handle.

Manufacturers and Product: Pratt; PIVA.

Miscellaneous Valves:

Type V930 Fire Hydrant (Raw Water):

Hydrants shall be dry-barrel type conforming to AWWA C502 with valve opening at least 5 inches in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed, and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 8 inches above the ground grade. Hydrants shall have a 6-inch bell connection, two 2-1/2-inch hose connections, and one 4-1/2-inch pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be similar and equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with one coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25, and two finish coats of silicone alkyd paint conforming to SSPC Paint 21; color shall be safety yellow. Caps and chains shall be furnished.

Manufacturers and Products: Clow Medallion.

Type V931 Yard Hydrant (Raw Water):

Non-freeze yard hydrant with 3/4-inch hose connection. Constructed of manufacturer's standard materials, rated for minimum pressure of 125 psi.

Manufacturers and Products: Wade 8610; or equal.

ACCESSORIES:

Operating Wrenches (Raw Water):

Two each T-handled galvanized operating wrenches for 2-inch square nut operator, 6 feet long.

Manufacturers and Products:

Mueller; No. A-24610.

Clow No.; F-2520.

Two each T-handled galvanized forked operating keys for cross handled valves, 7 feet long.

Cast Iron Valve Box (Raw Water): Designed for traffic loads, sliding type, with minimum of 6-inch ID shaft.

Box: Cast iron with minimum depth of 9 inches.

Lid: Cast iron, minimum depth 3 inches, marked WATER.

Extensions: Cast iron.

OPERATORS:

Manual Operator:

General:

Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds.

Operator self-locking type or equipped with self-locking device.

Position indicator on quarter-turn valves.

Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threader steel reach rods with internally threaded bronze or ductile iron nut.

Exposed Operator:

Galvanized and painted handwheels.

Lever operators allowed on quarter-turn valves 8 inches and smaller.

Valve handles to take a padlock, and wheels a chain and padlock.

Buried Operator:

Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.

Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the FULLY OPEN or FULLY CLOSED positions, grease packed and gasketed to withstand a submersion in water to 10 psi.

Buried valves shall have extension stems, bonnets, and valve boxes.

LEACHATE FILTERS:

Stainless steel filter housings rated for 150 psi minimum at 120 degrees F and 160 gpm shall be installed as shown on the piping details. Each filter housing shall be installed with (12) 5 micron filter cartridges, each cartridge shall be 40 inches long. The filter housing shall have a mill finish and include installation of a vent valve with drain tubing, drain valves with drain tubing, and filter housing stand. The filter assembly shall have no more than a 10 psi pressure drop across the housing and clean filter cartridges when operating at 160 gpm of water flow. The filter inlet and outlets shall be ASME B16.5, Class 150 flanges. Furnish and install filter cartridges within filter housing, in addition provide a minimum of 72 additional filter cartridges for future filter changeouts.

The filter assembly shall include a wall mounted differential pressure indicator. The differential pressure indicator shall tie-in to the filter housing drain ports. The differential pressure indicator shall include a resettable drag pointer for indication of maximum differential pressure achieved, 4.5-inch dial, and a range of 0-15 psid.

Copper tubing shall be used for differential pressure indicator. Tubing shall be 1/4-inch seamless copper tubing conforming to ASTM B75. Wall thickness, diameter tolerances, and compression type brass fittings shall be in accordance with ASTM B251.

Manufacturers and Products:

Filter Assembly: GE Osmonics; NDV Series w/Hytrex Filter Cartridges (5 micron, 40-inch length).

Differential Pressure Indicator: Wika; 700.05.

PART 3--EXECUTION

INSTALLATION:

Flange Ends:

Flanged valve boltholes shall straddle vertical centerline of pipe.

Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly; do not overtighten.

Screwed Ends:

Clean threads by wire brushing or swabbing.

Apply joint compound.

Valve Orientation:

Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.

Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above finish floor, unless otherwise shown.

Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

CONSTRUCTION QUALITY CONTROL:

Valve may be either tested while testing pipelines, or as a separate step.

Construction General Contractor shall perform test that valves open and close smoothly under operating pressure conditions.

Construction General Contractor shall count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.

END OF SECTION 15100

SECTION 15140--PIPING SUPPORT SYSTEMS

PART 1--GENERAL

SUMMARY:

This section is for furnishing and installing leachate piping support systems.

REFERENCES:

The following is a list of standards which may be referenced in this section:

ASTM INTERNATIONAL (ASTM)

ASTM A525	Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

BUILDING OFFICIALS AND CODE ADMINISTRATORS (BOCA)

Basic Building Code

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

Uniform Building Code

MANUFACTURERS' STANDARDIZATION SOCIETY (MSS)

SP 58	Pipe Hangers and Supports-Materials, Design and Manufacture
SP 69	Pipe Hangers and Supports-Selection and Application
SP 89	Pipe Hangers and Supports-Fabrication and Installation

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

Drawings of each piping support system to scale shown, locating each support, brace, hanger, guide, component, and anchor. Identify support, hanger, guide, and anchor type by catalog number and shop drawing detail number.

Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

DEFINITIONS:

Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.

Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

DESIGN REQUIREMENTS:

General:

Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.

Meet requirements of MSS SP 58, MSS SP 69, and MSS SP 89.

Pipe Support Systems:

Support Load: Dead loads imposed by weight of pipes filled with water, except air and gas pipes, plus insulation.

Seismic Load: Seismic performance category forces with seismic loads in accordance with local codes.

Safety Factor: Minimum of 5.

Maximum Support Spacing and Minimum Rod Size:

Steel or Ductile Iron Piping:

Pipe Size	Maximum Support/ Hanger Spacing	Minimum Rod Size Single Rod Hangers
1-inch and smaller	6 feet	1/4-inch
1-1/2-inch thru 2-1/2-inch	8 feet	1/4-inch
3-inch and 4-inch	10 feet	3/8-inch

Plastic and Fiberglass Piping:

Maximum Support Spacing: As recommended by manufacturer for flow temperature in pipe. Pipe insulation shall be included in the selection of maximum pipe support spacing.

Minimum Hanger Rod Sizing: Same as listed for steel pipe.

Framing Support System:

Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.

Column Members: Size in accordance with manufacturer's recommended method.

Support Loads: Calculate using weight of pipes filled with water.

Maximum Spans:

Steel and Ductile Iron Pipe, 3-Inch Diameter and Larger: 10-foot centers, unless otherwise shown.

Other Pipelines and Special Situations: May require supplementary hangers and supports.

Electrical Conduit Support: Include in design of framing support system.

Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

Vertical Sway Bracing: 10-foot maximum centers, or as shown.

PART 2--PRODUCTS

GENERAL:

When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

Materials:

Wetted and Submerged: Stainless steel.

Atmospheric Exposed: Galvanized or painted steel.

HANGERS:

Clevis Type: MSS SP 58, Type 1 or 6.

Grinnell; Figure 104 or 260.

B-Line; Figure B3198 or B3100.

Hinged Split-Ring Pipe Clamp: MSS SP 58, Type 6 or 12.

Grinnell; Figure 104.

B-Line; Figure B3198H.

Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

Attachments:

I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, 28, 29, or 30, which engage both sides of flange.

Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.

SADDLE SUPPORTS:

Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.

Nonadjustable Saddle: MSS SP 58, Type 37 with U-bolt.

Grinnell; Figure 259.

B-Line; Figure B3090.

Adjustable Saddle: MSS SP 58, Type 38 without clamp.

Grinnell; Figure 264.

B-Line; Figure B3093.

WALL BRACKETS:

Welded Steel Bracket: MSS SP 58, Type 33 (heavy-duty).

Grinnell; Figure 199.

B-Line; Figure B3607.

One-Hole Clamp: Grinnell; Figure 126.

Channel Type:

Unistrut.

Kin-Line.

PIPE CLAMPS:

Riser Clamp: MSS SP 58, Type 8.

Grinnell; Figure 261.

B-Line; Figure B3373.

CHANNEL TYPE SUPPORT SYSTEMS:

Material:

Galvanized: Pre-galvanized in accordance with ASTM A525, Class G90, or hot-dip galvanized after fabrication.

Stainless Steel: Type 304 stainless steel.

Channel Size: 12-gauge, 1-5/8-inch wide series minimum.

Members and Connections: Design for all loads with safety factor of 5.

Manufacturers and Products:

Kin-Line; Series CI3812.

Unistrut; Series P3200.

ANCHORING SYSTEMS:

Material:

Wetted and Submerged: Stainless steel.

Atmospheric Exposed: Galvanized.

Size: Sized by equipment manufacturer, 1/2-inch minimum diameter.

SHOP/FACTORY FINISHING:

Prepare, prime, and finish coat in accordance with:

Surface preparation with abrasive blast or centrifugal wheel blast (SP10).

Paint with:

One coat, 2.5 minimum dry film thickness (MDFT) of Epolon rust inhibitor primer.

One coat, 2.5 MDFT Epolon Multi-Mill Epoxy.

One coat, 1.5 MDFT Acrolon II, No. 2200 Series.

PART 3--EXECUTION

INSTALLATION:

General:

Install support systems in accordance with MSS SP 69, Pipe Hangers and Supports-Selection and Application and MSS SP 89, Pipe Hangers and Supports-Fabrication and Installation, unless shown otherwise.

Support piping connections to equipment by pipe support and not by the equipment.

Support large or heavy valves, fittings, and appurtenances independently of connected piping.

Support no pipe from the pipe above it.

Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.

Do not install pipe supports and hangers in equipment access areas or bridge crane runs.

Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

Install lateral supports for seismic loads at all changes in direction.

Repair mounting surfaces to original condition after attachments are made.

Standard Pipe Supports:

Horizontal Suspended Piping:

Single Pipes: Adjustable swivel-ring, splint-ring, or clevis hangers.

Grouped Pipes: Trapeze hanger systems.

Furnish galvanized steel protection shield and oversized hangers for all insulated pipe.

Furnish precut sections of rigid insulation with vapor barrier at hangers for all insulated pipe.

Horizontal Piping Supported From Walls:

Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.

Stacked Piping:

Wall-mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.

Piping clamps which resist axial movement of pipe through support not acceptable.

Wall-mounted piping clips not acceptable for insulated piping.

Horizontal Piping Supported From Floors:

Stanchion Type:

Pedestal type; adjustable with stanchion, saddle, and anchoring flange.

Use yoked saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.

Floor Mounted Channel Supports:

Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.

Attach channel framing to floors with anchor bolts.

Attach pipe to channel with clips or pipe clamps.

Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.

Standard Attachments:

To Steel Beams: I-beam clamp or welded attachments.

To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.

FIELD FINISHING:

Paint atmospheric exposed surfaces of black and hot-dip galvanized steel components as specified in Article SHOP/FACTORY FINISHING.

END OF SECTION 15140

SECTION 15500--HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AIR MOVING AND CONDITIONING ASSOCIATION (AMCA)

AMCA 99	Air Movement and Control Association Standards Handbook
AMCA 210	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	Reverberant Room Method for Sound Testing of Fans
AMCA 2401	Impeller Diameters and Outlet Areas for Centrifugal Fans and Metric Equivalents

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52	Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 90A	Energy Conservation in New Building Design

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1-12.53a	Motors and Generators

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

Guidelines for Seismic Restraints of Mechanical Systems

HVAC Testing, Adjusting, and Balancing Manual

UNDERWRITERS LABORATORIES INC. (UL)

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

Complete specifications, descriptive drawings, catalog cuts, and descriptive literature that include make, model, dimensions, weight of equipment, and electrical schematics for the following products:

Air conditioning units.

Unit heaters.

Motorized dampers.

Complete performance data that indicate full compliance with the Specifications.

Recommended procedures for protection and handling of equipment and materials prior to installation.

Manufacturer's certification of factory testing to establish conformance with specified requirements for the unit heater and air conditioning unit.

For motors specified to be energy efficient type, certified copy of test report for identical motor tested, in accordance with NEMA MG 1-12.53a and IEEE Standard 112, Test Method B, showing full load efficiency.

Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt the arrangement or details shown to the equipment furnished.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

List of recommended spare parts for equipment and materials specified.

Manufacturer's warranty.

EXTRA MATERIALS:

Furnish, tag, and box for shipment and storage the following spare parts:

Filters: Four complete sets per unit.

SPECIAL GUARANTEE:

Manufacturer shall provide standard warranty.

PART 2--PRODUCTS

GENERAL:

Heating Equipment: Minimum operating efficiencies as specified in Chapter 6 of ASHRAE Standard 90A, and the State of Washington Energy Code.

WALL-MOUNTED AIR-COOLED PACKAGED AIR CONDITIONING UNITS (FOR EQUIPMENT IDENTIFICATION NUMBERS SEE SUPPLEMENT):

General:

Packaged through-the-wall air conditioning unit.

Cooling section.

Heating section.

Controls.

Fans.

Filters.

All contained in a standard weatherproof enclosure.

UL listed.

Enclosure:

Zinc-coated steel finished with manufacturer's standard baked enamel paint.

Adjustable discharge grille.

Return grille.

Permanent filter.

Internal sound attenuation.

Controls with adjustable thermostat.

Fan speed switch with HIGH/LOW manual selections.

Heating Section:

Low-density electric heating elements.

Built-in overheat protection.

Cooling Section:

Hermetic compressor.

Air-cooled condenser coil.

Evaporator coil.

Drain pan with drain line connections.

Direct-drive evaporator.

Condenser fans.

Fan motors with integral overload protection.

Operating and safety controls.

Operating charges of refrigerant and oil.

Capacity (219A-LH-AC-001 and 219E-LH-AC-001): 600 cfm at fan medium speed, at 0.3 inch of water column static pressure, minimum outside air 100 cfm, cooling capacity 25,110 Btuh total, 17,530 Btuh sensible, 85/72 degrees F DB/WB entering air temperature, and 100 degrees F ambient, 208-volt, single-phase power supply, MCA17, breaker size 20 amps.

Capacity (219A1-LH-AC-002 and 219E1-LH-AC-002): 360 cfm at 0.3 inch of water column static pressure, minimum outside air 100 cfm, cooling capacity 11,840 Btuh total, 8,130 Btuh sensible, 85/72 degrees F DB/FB entering air temperature, and 100 degrees F ambient, 208-volt, single-phase power supply, MCA 8 amps, breaker 15 amps.

Manufacturers and Products:

Bard:

Model (219A-LH-AC-001 and 219E-LH-AC-001): WA241-A-00-EXXXXA.

Model (219A1-LH-AC-002 and 219E1-LH-AC-002): WA121-A-00-EXXXXJ.

Or approved equal.

ELECTRIC UNIT HEATER (FOR EQUIPMENT IDENTIFICATION NUMBERS SEE SUPPLEMENT):

General:

Heater shall be installed and wired in accordance with the manufacturer's recommendations.

Unit heater shall be UL listed.

Casing:

Fabricated of die-formed, heavy-gauge steel and finished in high gloss, baked enamel.

Supply air shall be drawn through a stamped louver periphery evenly across the heating element.

Discharge air shall be through an outward drawn Venturi.

Cabinet shall have adjustable discharge louvers.

Cabinet shall be furnished with an access door.

Wiring diagram shall be permanently attached to the inside at the access door.

Elements:

Elements shall be high mass, all steel tubular finned type, copper brazed.

Elements shall be centrally located and installed in fixed element banks.

Motor:

Motor shall be totally enclosed, all angle industrial rated.

Bearings shall be sealed and permanently lubricated.

Fan:

Fan blades shall be of the axial flow type.

Fan speed shall not exceed 1,600 rpm.

Wiring:

Unit heater shall be factory prewired.

Unit heater shall have balanced phases.

Unit heater shall be equipped with automatic reset thermal overload.

Controls: Wall-mounted thermostat.

Manufacturers and Products:

Capacity: 3.3 kW, 460 volts, three-phase, horizontal discharge.

Trane; UHEC-033DACA.

RELIEF LOUVER (FOR EQUIPMENT IDENTIFICATION NUMBERS SEE SUPPLEMENT):

Extruded aluminum frame.

Double drainable blades.

Bird screen.

Size: Louver size as shown on Drawings.

Manufacturer and Product: Ruskin; Model ELF 375DD.

DAMPER ACTUATOR (FOR EQUIPMENT IDENTIFICATION NUMBERS SEE SUPPLEMENT):

Line voltage actuator.

Spring return.

UL listed.

NEMA 2 housing.

60-inch-pound torque.

Sequence of Operation: Actuator shall be interlocked with an economizer. Actuator shall be energized when economizer is on, and shall be closed when economizer is off.

Manufacturer and Product: Belimo; NF120US, 120 volts, single-phase, less than 60 seconds return time.

SEQUENCE OF CONTROL:

Air Conditioning Units:

Air conditioning unit shall be started by the signal from wall-mounted thermostat if the room temperature rises above 85 degrees F.

Thermostat set point is 80 degrees F.

If the room temperature drops below 70 degrees F, the modulating type return, outside and exhaust air dampers will be adjusted to maintain room temperature.

When outside air temperature is between 50 degrees F and 65 degrees F, air conditioning unit will provide a free cooling.

Unit Heaters: Unit heater will be operating in the ON-OFF sequence to maintain 50 degrees F temperature.

PART 3--EXECUTION

INSTALLATION:

Install equipment and systems in accordance with manufacturers' instructions.

<u>Packaged Wall-Mounted Air Conditioning Units:</u>

Mount unit in accordance with manufacturer's instructions.

Provide access for maintenance.

Seal watertight to wall.

<u>Electric Unit Heater:</u> Install in accordance with recommendations of NFPA 90A.

<u>SUPPLEMENTS:</u>

The supplement listed below, following "END OF SECTION," is a part of this Specification.

Equipment Identification Numbers.

END OF SECTION 15500

EQUIPMENT IDENTIFICATION NUMBERS

Location	Equipment Name	Equipment Number
Cell No. 1 Crest Pad Building	Air Conditioning Unit	219A-LH-AC-001
	Unit Heater	219A-LH-UH-001
	Relief Louver With Motorized Damper	219A-LH-MD-001
Cell No. 1 Leachate Transfer Building	Air Conditioning Unit	219A1-LH-AC-002
	Unit Heater	219A1-LH-UH-002
	Relief Louver With Motorized Damper	219A1-LH-MD-002
Cell No. 2 Crest Pad Building	Air Conditioning Unit	219E-LH-AC-001
	Unit Heater	219E-LH-UH-001
	Relief Louver With Motorized Damper	219E-LH-MD-001
Cell No. 2 Leachate Transfer Building	Air Conditioning Unit	219E1-LH-AC-002
	Unit Heater	219E1-LH-UH-002
	Relief Louver With Motorized Damper	219E1-LH-MD-002

SECTION 15992--PIPING LEAKAGE TESTING

PART 1--GENERAL

SUMMARY:

This section is for leak testing (construction quality control) leachate piping and associated components.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Testing Plan: Submit prior to testing and include at least the information that follows.

Testing dates.

Piping systems and section(s) to be tested.

Test type.

Method of isolation.

Sample of test report form.

Certifications of Calibration: Testing equipment.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Certified Test Report.

PART 2--PRODUCTS (NOT USED)

PART 3--EXECUTION

PREPARATION:

Notify Construction Manager in writing 5 days in advance of testing. Perform testing in presence of Construction Manager.

Pressure Piping:

Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.

Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

Items that do not require testing include: Piping between wetwells and wetwell isolation valves, tank overflows to atmospheric vented drains, tank atmospheric vents, and slotted piping.

Test section may be filled with water and allowed to stand under low pressure prior to testing.

Other Piping:

Perform testing of other pipe service types using the same methods outlined for pressure piping.

HYDROSTATIC TEST:

General: Hydrostatic testing shall be performed on all single-wall pipe, inner carrier pipes, and all PVC piping.

Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

Test Pressure:

Per Section 15060, PIPING–GENERAL.

Exposed Piping:

Perform testing on installed piping prior to application of insulation.

Maximum Filling Velocity: 0.25 feet per second, applied over full area of pipe.

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.

HDPE Piping:

Test Procedure: The test procedure consists of an initial expansion phase and then the test phase. Prior to the test procedure the test medium and pipe test section shall be allowed time to equalize in temperature. Testing shall not be allowed if temperatures of the test medium or pipe test section exceed 100 degrees F.

Maintain the test pressure for a period of 3 hours during the initial expansion phase by adding water as needed.

At the beginning of the test phase after the initial expansion phase, reduce pressure by 10 psi. Maintain this test pressure for a period of 1 hour.

Under no circumstances shall the testing be allowed to exceed 8 hours.

Acceptance Criteria: The test phase is passed and the pressure test is acceptable if the pressure remains steady (within 5 percent of the test phase beginning pressure) for 1 hour and there are no indications, visible or otherwise, of leakage.

If acceptance criteria is not met, any leakage points shall be fixed and any other changes made to the piping system as necessary. Retest and repeat until acceptance criteria is met.

Empty pipe of water prior to final cleaning.

Buried Piping: Test piping using the same procedure as outlined for exposed piping as described above.

PVC and Non-HDPE Piping:

Perform testing on installed piping prior to application of insulation.

Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.

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.

Maintain hydrostatic test pressure continuously for 30 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage. No fluid shall be added to the system, and system shall not drop below 95 percent of the test pressure during the test period.

Examine exposed joints and connections for leakage.

No loss of fluid allowed. Find any leakage points, fix, and retest as specified.

Empty pipe of water prior to final cleaning or disinfection.

PNEUMATIC TEST:

General: Pneumatic testing shall be performed for outer pipe of double-wall HDPE piping and atmospheric drains.

Double-Wall Pipe: Inner carrier pipe shall be full of water when outer containment pipe is tested to prevent damage to carrier pipe.

Equipment:

Calibrate gauges with standardized test gauge at start of each testing day. Construction Manager will witness calibration.

Install gauges, air piping manifolds, and valves at ground surface.

Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 5 psi or less.

Restrain plugs used to close lines to prevent blowoff.

Procedure:

Slowly introduce air into pipe section until internal air pressure reaches required test pressure.

Allow 2 minutes minimum for air temperature to stabilize.

Examine exposed joints and connections for leakage.

No loss in pressure allowed. Find any leakage points, fix, and retest as specified.

Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.

END OF SECTION 15992

SECTION 16005--ELECTRICAL

PART 1--GENERAL

UL AND NRTL COMPLIANCE:

Materials manufactured within the scope of UL or another nationally recognized testing laboratory (NRTL) shall conform to UL or NRTL standards and have an applied UL or NRTL listing mark. References to UL throughout this section imply conformity with UL or NRTL standards and guidelines.

Electrical system process control panels shall be manufactured, assembled, tested, approved, and clearly labeled in accordance with UL 508A, prior to delivery to construction site.

APPROVAL BY AUTHORITY HAVING JURISDICTION (AHJ):

Provide all work in accordance with NFPA 70, National Electrical Code, ANSI C2 National Electrical Safety Code (NESC), and where required by Hanford CH2M HILL authority having jurisdiction (AHJ), as defined under Division 1, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to AHJ, in order to provide a basis for approval under NEC.

All material and equipment shall be tested after installation by a qualified testing firm (as specified in Section 16080, ELECTRICAL TESTING), or other organization acceptable to AHJ, in order to provide a basis for approval under NEC. Construction General Contractor is responsible for providing qualified testing firm and shall coordinate with the Construction Manager for NEC inspection services.

All material and equipment shall be provided with a visibly attached label by a nationally recognized testing laboratory or other organization acceptable to AHJ, prior to delivery to construction site.

All motor control panels shall be provided in accordance with UL 508 and with a visibly attached label by a nationally recognized testing laboratory or other organization acceptable to AHJ, prior to delivery to construction site.

All equipment shall be installed per manufacturer's instructions, with NFPA 70, NESC, and with other applicable requirements.

All electrical work including conduit, wiring, and terminal and splice connections shall be accomplished by a state-registered and approved electrical journeyman or a state-registered and approved electrical apprentice under supervision of state-registered and approved electrical journeyman.

ELECTRICAL DESCRIPTION OF WORK:

Schedule A Work:

Provide and install primary aerial cables, power poles, fuse-cutouts, supports, primary riser conductors, and ancillary equipment as needed to extend existing primary power circuit C8–L6 from 4th street to new IDF pad mount service transformer as shown on Drawings and in accordance with Section 16312, OVERHEAD ELECTRICAL DISTRIBUTION.

Provide and install IDF pad mount service transformer as shown on Drawings and in accordance with Section 16270, Oil-Filled Pad Mounted Transformer.

Provide site preparation, pad mount slab and concrete work, and grounding as necessary to facilitate utility vault and pad mount service transformer installation.

For primary (15kV) conductors which route from riser pole fuse cut-outs to pad mount service transformer, reference CONDUCTOR OVER 600 VOLTS this Section.

Fluor Hanford Electrical Utilities will make final aerial conductor connections to existing primary circuit C8–L6, and primary connections to pad mount service transformer.

Coordinate installation of all primary service equipment, testing, and secondary metering with Construction Manager, who will contact Fluor Hanford Electrical Utilities (FH EU).

Schedule B Work:

Provide and install power conduits and cables to electrical service gear for each crest pad and leachate transfer building. Power conduits and cables shall route from crest pad building electrical service gear to power handhole(s) and service transformer as shown on Drawings.

FH EU will make final secondary conductor connections within low voltage compartment of pad mount service transformer after cables are routed under this schedule of work.

Coordinate with FH EU installation of secondary cables and energizing of secondary service equipment.

Provide and install communication conduits and cables for each crest pad and leachate transfer building communication service. Communication conduits and cables shall route below grade from crest pad building to communication handhole(s) as shown on Drawings.

Provide and install electrical service gear for each crest pad and leachate transfer building including: motor control center (MCC), MCC integrally mounted lighting panel and transformer, and grounding electrode system.

Motor control center shall provide 480V, three-phase, three-wire power to pump motors, power outlets, building heaters, air monitoring transformer and panel assemblies, and motor starters.

Lighting panel and transformer shall provide 208/120V, three-phase, four-wire power for instruments, lighting, receptacles, small motor loads, and miscellaneous panels.

Lighting panel and transformer(s) shall provide 120/240V, single-phase, three-wire power for air monitoring equipment and ancillary lighting and receptacles.

Provide and install grounding electrode system at each crest pad and leachate transfer building. Bond service gear, lighting transformer, power and communication panels, and metal structures (i.e., leachate storage tank, buildings) to grounding electrode system.

Provide and install power conduits and cables to the following three-phase equipment:

Building unit heaters.

Leachate collection and removal and leak detection system pumps.

Combined sump pumps.

Leachate transfer pumps.

Portable generator power outlets.

Provide and install power conduits and cables to the following single-phase equipment:

Building interior and exterior lighting.

Building receptacles.

Building control panels.

Building air conditioning units.

Heat tracing.

Air monitoring equipment.

Provide and install control and signal conduits and cables to the following instrumentation:

Process local control panels.

Building temperature transmitters.

Building sump level floats and panels.

Building ventilation thermostats.

Leachate collection and removal and leak detection system pump flow meters and submersible pressure transmitters.

Storage tank level transmitters and switches.

Leachate collection carrier pipe leak detection level switches, mounted in combined sumps' interstitial spaces.

Combined sump level floats.

Leachate transfer flow meters and transmitters.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Product Data:

Primary and secondary service entrance and metering equipment.

Boxes and device plates.

Junction and pullboxes.

Precast utility vaults, manholes and handholes.

Wiring devices.

Panelboards and mini-power centers.

Circuit breakers and switches.

Motor-rated switches.

Control devices, terminal blocks, and relays.

Contactors.

Transformers.

Support and framing channels.

Nameplates and nameplate schedule.

TVSS equipment.

Volt and current meters.

Conduit, fittings, and accessories.

Wireways.

Conductors, cable, and accessories.

Motors: Nameplate data, detailed information on any special features.

Grounding materials.

Motor Controls: Arrangement drawings, ratings, schematic and wiring diagrams, bill-of-materials, nameplate schedule, manufacturer information on components.

Local Control Panels: Arrangement drawings, schematic and wiring diagrams, bill of materials, nameplate schedule, manufacturer information on components.

Luminaires.

Factory test reports.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Field test reports.

Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.

Operation and Maintenance Data:

Provide for all equipment, as well as each device having features that can require adjustment, configuration, or maintenance, in accordance with Division 1.

Minimum information shall include manufacturer's preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.

ENVIRONMENTAL CONDITIONS:

Provide equipment and conduit systems approved for installing in the following environmental conditions:

Climatic and Geographic Site Conditions:

Site Elevation: 1,000 feet.

Relative Humidity: 90 percent maximum at 30 degrees F dry bulb, 15 percent minimum at 60 degrees F dry bulb.

Uniform Building Code: Seismic Zone 2B.

Temperature: 105 degrees F max. 0 degrees F min.

Enclosures and Environmental Conditions:

Provide and install NEMA 250 Type 4X, Type 304 stainless steel (corrosion resistant, wash down protection) enclosures in process mechanical and wash down indoor locations unless otherwise noted within this section.

Provide and install NEMA 250 Type 3 (dust, rain and ice protection) enclosures in outdoor locations unless otherwise noted in this section.

Provide NEMA 250 Type 12 (dust protection) enclosures for indoor dry protected locations unless otherwise noted in this section.

Labeling: Install permanent labels on all electrical panels, cabinets, disconnects, motor starters, major equipment or components, receptacles, and switches.

PART 2--PRODUCTS

GENERAL:

Products shall comply with all applicable provisions of NFPA 70.

Like Items of Equipment: End products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's service.

Equipment and Devices Installed Outdoors or in Unheated Enclosures: Capable of continuous operation within ambient temperature ranges identified under ENVIRONMENTAL CONDITIONS in this section.

Hazardous Areas: Products shall be acceptable to the regulatory authority having jurisdiction for the interior of the combined sumps. Class 1, Division 2, Groups C and D.

Equipment Finish: Manufacturer's standard finish color, except where specific color is indicated.

SERVICE ENTRANCE:

Coordinate all service entrance work with Construction Manager, who will in turn coordinate with Fluor Hanford Electrical Utilities, contact person: Cris Carlson, P.E., 509-521-2823.

UTILITY METERING:

Watt-hour Meter: Socket type, for three-phase, 4-wire wye service, self contained, with relay option board having output for watt KYZ pulses, 480 volt, class 200, form 16S, Elster alpha plus, type A1D+.

Meter Socket: Provide with manual circuit closing blocks, 7 terminal, 200 amp, 600 volt, Milbank type U3517-XL.

Meter Base Hub: Provide for standard RL opening, 2-inch, Milbank type A7517.

LIGHTING AND POWER DISTRIBUTION PANELBOARD:

NEMA PB 1, NFPA 70, and UL 67.

Panelboards and Circuit Breakers: Suitable for use with 75 degrees C copper wire at full NFPA 70, 75 degrees C ampacity.

Short-Circuit Current Equipment Rating: Fully rated; series connected unacceptable.

Rating: Applicable to a system with available short-circuit current of 10,000 amperes rms symmetrical at 208/120 volts and 120/240 volts.

Ground Fault Circuit Interrupter (GFCI): UL Class A GFCI, 5-mA trip, 10,000-amp interrupting capacity circuit breakers.

Ground Fault Equipment Protection (GFEP): 30-mA trip, 10,000-amp interrupting capacity circuit breaker, UL listed for equipment ground fault protection.

Interior Panelboard:

NEMA 250, Type 12 unless otherwise noted.

Material: Code-gauge, hot-dip galvanized sheet steel, with reinforced steel frame.

Wiring Gutter: Minimum 4 inches square; both sides, top and bottom.

Front: Fastened with adjustable clamps.

Interior:

Factory assembled; complete with circuit breakers.

Capable of circuit breaker replacement without disturbing adjacent circuit breakers or without removing main bus.

Spaces: Cover openings with easily removable metal cover.

Circuit Directory: Metal frame with transparent plastic face and enclosed card on interior of door.

Bus Bar:

Material: Copper and/or tin-plated copper full sized throughout length.

Provide for mounting of future circuit breakers along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.

Neutral bus with at least two (neutral and ground) terminal screws for each circuit.

Note: Do not install multiwire branch circuits that share common neutral. Install neutral for each 120-volt branch circuit.

Lugs and Connection Points:

Suitable for copper conductors.

Solderless main lugs for main, neutral, and ground bus bars.

Bolt together and rigidly support bus bars and connection straps on molded insulators.

Circuit Breakers:

NEMA AB 1 and UL 489.

Thermal-magnetic, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.

Noninterchangeable, in accordance with NFPA 70.

Locking: Provisions for handle padlocking, unless otherwise shown.

Type: Bolt-on circuit breakers in all panelboards.

Multipole circuit breakers designed to automatically open all poles when an overload occurs on one pole.

Do not substitute single-pole circuit breakers with handle ties for multipole breakers.

Do not use tandem or dual circuit breakers in normal single-pole spaces.

Ground Fault Circuit Interrupter (GFCI):

Equip with conventional thermal-magnetic trip and ground fault sensor rated to trip in 0.025 second for a 5-mA ground fault (UL 943, Class A sensitivity).

Sensor with same rating as circuit breaker and a push-to-test button.

Manufacturers:

Square D.

Cutler-Hammer.

General Electric.

Allen-Bradley.

MINI-POWER CENTER (MPC):

General: Transformer, primary and secondary main circuit breakers, and secondary panelboard section enclosed in NEMA 250, Type 3 enclosure.

Transformer:

Type: Dry, self-cooled, encapsulated.

Insulation: Manufacturer's standard, with UL 1561 temperature rise.

Full Capacity: 2-1/2 percent voltage taps, two above and two below normal voltage.

Primary Voltage: 480, three-phase; 480 single-phase as shown.

Secondary Voltage: 208/120 volts, three-phase, four-wire; 120/240 volts, single-phase, three-wire as shown.

Size: 6 kVA and 15 kVA as shown.

Panelboard: UL 489, fully rated.

Type: Thermal-magnetic, quick-make, quick-break, indicating, with noninterchangeable molded case circuit breakers.

Number and Breaker Ampere Ratings: Refer to Panelboard Schedule.

Manufacturers:

Square D Co.

Cutler-Hammer.

General Electric Co.

LIGHTING AND POWER DISTRIBUTION STEPDOWN TRANSFORMER (0-600 VOLTS):

Type: Self-cooled, two-winding.

UL 1561 and NEMA ST 20.

Insulation Class/Temperature Rise: 115 Degrees F.

Core and Coil:

30 kVA or Less: Encapsulated.

Voltage Taps: Full capacity, 2-1/2 percent, two above and two below normal voltage rating.

Sound Level: Not to exceed NEMA ST 20 levels.

Vibration isolators to minimize and isolate sound transmission.

Manufacturers:

Square D.

Cutler-Hammer/Westinghouse.

General Electric.

LOCAL CONTROL PANELS:

Enclosure:

Reference ENVIRONMENTAL CONDITIONS in this section.

Minimum Metal Thickness: 14 gauge.

Doors: Rubber gasketed with continuous hinge.

Incandescent Light: Hand switch controlled, 100-watt.

Receptacle: Breaker protected 120-volt, 15-amp duplex.

Finish: Internal and external surfaces (NEMA 250, Type 12 only):

Sand panel; remove mill scale, rust, grease, and oil.

Fill imperfections and sand smooth.

Paint with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.

Sand surfaces lightly between coats.

Final Dry Film Thickness: Minimum 3 mils.

Size panels to adequately dissipate heat generated by equipment mounted in or on panel.

Manufacturers:

Hoffman.

H. F. Cox.

Wiring:

Power and Control Wiring: 600-volt class, insulated, stranded copper.

Size: Minimum No. 14 AWG enclosed in either sheet metal raceway or plastic wiring duct.

Signal Circuit Wiring: Twisted shielded pairs minimum No. 16 AWG, separated at least 6 inches from power wiring.

Identification: Permanent heat impregnated polyvinyl chloride (PVC) alpha-numeric labels.

SAFETY SWITCHES:

UL 98 listed for use and location of installation.

Type: Visible blade, fusible.

Class: Heavy-duty.

Enclosures: Reference ENVIRONMENTAL CONDITIONS in this section.

CIRCUIT BREAKER, INDIVIDUAL, 0 TO 600 VOLTS:

UL 489 listed for use at location of installation.

Minimum Interrupt Rating: As shown.

Thermal-magnetic, quick-make, quick-break, indicating type, showing ON/OFF and TRIPPED indicating positions of operating handle.

Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

Locking: Provisions for padlocking handle.

Enclosure: Reference ENVIRONMENTAL CONDITIONS in this section.

Interlock: Enclosure and switch shall interlock to prevent opening cover with breaker in the ON position.

Manufacturers:

Square D Co.

Cutler-Hammer.

General Electric Co.

Allen-Bradley.

FUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS:

UL 98 listed for use and location of installation.

NEMA KS 1 and UL 98 Listed for application to system with available short-circuit current as shown.

Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

Fuse mountings shall reject Class H fuses and accept only current-limiting fuses specified.

Enclosure: Reference ENVIRONMENTAL CONDITIONS in this section.

Interlock: Enclosure and switch to prevent opening cover with switch in ON position.

Manufacturers:

Square D Co.

Cutler-Hammer.

General Electric Co.

FUSE, 0 TO 600 VOLTS:

Current-limiting, with 42,000 max ampere rms interrupting rating.

Provide to fit mountings specified with switches and features to reject Class H fuses.

Motor and Transformer Circuits, 0 to 600 Volts:

Amperage: 0 to 600.

UL 198E, Class RK-1, dual element, with time delay.

Manufacturers and Products:

Bussmann; Type LPS-RK.

Littelfuse, Inc.; Type LLS-RK.

Motor and Transformer Circuits, 0 to 250 Volts:

Amperage: 0 to 600.

UL 198E, Class RK-1, dual element, with time delay.

Manufacturers and Products:

Bussmann; Type LPN-RK.

Littelfuse, Inc.; Type LLN-RK.

Feeder and Service Circuits, 0 to 600 Volts:

Amperage: 0 to 600.

UL 198E, Class RK-1, dual element, with time delay.

Manufacturers and Products:

Bussmann; Type LPS-RK.

Littelfuse, Inc.; Type LLS-RK.

MAGNETIC CONTROL RELAYS:

NEMA ICS 2, Class A600 (600 volts, 10 amperes continuous, 7,200VA make, 720VA break), machine tool type with field convertible contacts.

Smaller Magnetic Control Relays: Reference Section 13401, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS).

TIME DELAY RELAY:

Industrial Relay Rated: 150 volts, 5 amps continuous, (3600 VA make, 360 VA break).

Solid-state electronic, field convertible ON/OFF delay.

Two Form-C contacts (minimum).

Repeat accuracy plus or minus 2 percent.

Timer Adjustment: Multiple adjustable ranges, including 1 to 60 seconds, unless otherwise shown.

Manufacturers:

- Omron.
- Cutler-Hammer.
- General Electric Co.
- Allen-Bradley.

ELAPSED TIME METERS:

Type: Synchronous motor driven, 0 to 99,999.9 hours range, nonreset, suitable for semiflush, panel mounting.

Manufacturers:

- General Electric Co.
- Veeder-Root.

PHASE MONITOR RELAY:

Voltage and phase monitor relay shall drop out on loss of phase, or phase reversal.

Contacts: Single-pole, double-throw, 10 amperes, 120/240V ac. Where additional contacts are shown or required, provide magnetic control relays.

Adjustable trip and time delay settings.

Transient Protection: 1,000V ac.

Mounting: Multipin plug-in socket base.

Accessories: Provide properly sized and rated line isolating switches and fuses for each phase monitored.

Manufacturer:

Square D Co.

Cutler-Hammer.

General Electric Co.

Allen-Bradley.

TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS) EQUIPMENT:

General:

Units shall be suitable for the service voltage and configuration (phases and wires) shown.

Protection Modes:

Normal, differential, and common.

Bipolar or bi-directional.

Ratings: Short-circuit current rating shall equal or exceed that of protected distribution equipment. Surge Voltage Rating (SVR) shall not exceed those specified under UL 1449 for the associated nominal system voltage. Maximum Allowable Continuous Operating Voltage (MCOV) shall be at least 115 percent of the nominal system voltage.

Unit shall be UL-listed.

Provide status indicators for unit ON-LINE and unit operation NORMAL.

Provide common alarm contact output.

Provide fusible disconnect switch (integral with TVSS unit, where available) where not shown connected via branch circuit device of protected distribution equipment.

Minimum Enclosure Rating: NEMA 250, Type 12.

Type 2 TVSS:

Requirements: Designed for critical loads at service equipment (Category C3/B3) or distribution panelboard (Category C2/B3) locations. Unit shall utilize voltage-matched Silicon Avalanche Suppressor Diode (SASD) technology. Unit shall utilize modular, plug-in suppressor design.

Manufacturer and Product: Transtector; Model Apex III (nonservice entrance distribution panelboard) or Apex IV (service equipment).

VOLT AND CURRENT METERS:

Voltmeter, Panel Type:

NEMA 250 Type 12.

Nominal 3-1/2 inch model.

90 degree scale; accuracy of plus or minus 2 percent.

Manufacturer: Same as Manufacturer of Motor Control Center.

Voltmeter Switch:

NEMA 250 Type 12.

Rotary cam type with pistol grip handle engraved escutcheon.

Four-position, phase-to-phase, and OFF.]

Manufacturer: Same as Manufacturer of Motor Control Center.

Ammeter, Panel Type:

NEMA 250 Type 12.

Nominal 3-1/2-inch model.

90 degree scale; accuracy of plus or minus 2 percent.

Manufacturer: Same as Manufacturer of Motor Control Center.

Ammeter Switch:

NEMA 250 Type 12.

Rotary cam type with pistol grip handle engraved escutcheon.

Four-position, three-phase currents, and OFF.

Manufacturer: Same as Manufacturer of Motor Control Center.

CONDUIT AND FITTINGS:

Rigid Galvanized Steel Conduit (RGS):

ANSI C80.1.

Fittings: Threaded type.

Galvanize by hot-dipping, electroplating, sherardizing, or metalizing process, including fittings.

Polyvinyl Chloride Conduit (PVC):

Rigid, Schedule 40, NEMA TC 2.

UL 651 listed for concrete encased, direct burial, concealed and direct sunlight exposed use.

UL 651 listed and marked for use with conductors having 90 degrees C insulation.

Fittings: NEMA TC 3, for intended use.

Flexible Metal Liquid-Tight Conduit:

UL 1 listed for liquid-tight service.

Galvanized steel, flexible conduit covered with extruded PVC jacket.

Termination: Nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.

Conduit Sealing Fitting:

Restrict the passage of gasses, vapors, or flames from one portion of the electrical installation to another at atmospheric pressure and normal ambient temperatures.

In conduit systems when leaving Class 1, Division 2 hazardous locations.

Manufacturers and Products:

Appleton; Type EYF, EYM, or ESU.

Crouse-Hinds; Type EYS or EZS.

Fitting Sealing Compound: Form a seal around each electrical conductor and between them and inside of the sealing fitting to restrict the passage of gases, vapors, or flames through the sealing fitting.

Manufacturers and Products:

Appleton; Kwiko.

Crouse-Hinds; Chico.

Identification Devices:

Conduit tags.

Material: Permanent, nylon.

Shape: Round.

Conduit Designation: Pressure stamped, embossed or engraved.

SUPPORT AND FRAMING CHANNELS:

Carbon Steel Framing Channel:

Material: Rolled, mild strip steel, 12-gauge, ASTM A570, Grade 33.

Finish: Hot-dip galvanized after fabrication.

Paint-Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.

Manufacturers:

B-Line Systems, Inc.

Unistrut Corp.

Aickinstrut.

PRECAST UTILITY VAULTS, MANHOLES AND HANDHOLES:

Concrete Strength: Minimum 3,000 psi compressive, in 28 days.

Loading: AASHTO H-20, in accordance with ASTM C857.

Drainage: Slope floors toward drain points, leaving no pockets or other nondraining areas.

Raceway Entrances:

Provide on all four sides along with pulling eyes.

For raceways to be installed under this Contract, provide knockout panels or precast individual raceway openings.

At entrances where raceways are to be installed by others, provide minimum 12-inch high by 24-inch wide knockout panels for future raceway installation.

Handhole Frames and Covers:

Material: Steel, hot-dipped galvanized.

Cover Type: Solid, torsion spring of checkered diamond design.

Cover Loading: AASHTO H-20.

Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:

Above 600 Volts: ELECTRIC HV.

600 Volts and Below: ELECTRIC LV.

Instrumentation, Communication: Signal.

Hardware: Steel, hot-dip galvanized.

Furnish knockout for ground rod in each handhole.

Manufacturers:

Utility Vault Co.

Penn-Cast Products, Inc.

Concrete Conduit Co.

Associated Concrete Products, Inc.

Pipe, Inc.

CONDUCTORS 600 VOLTS AND BELOW:

Material: Annealed copper.

Insulation:

No. 8 AWG and Smaller: Type THW, THWN or XHHW conductors may be utilized at Construction General Contractor's option, subject to code requirements.

No. 6 AWG and Larger: Type XHHW.

Direct Buried: Type XLPE-USE.

Flexible Cord and Cable: Type SO, 600 volts.

Signal: Type 3, No. 16 AWG twisted, shielded pair instrumentation cable, 45-mil PVC outer jacket, 600-volt rating.

Type:

Control Conductor No. 14 AWG and Smaller: Stranded.

Power Conductors No. 10 AWG and Smaller: Solid or stranded.

Power Conductors No. 8 AWG and Larger: Stranded.

Type 3: No. 16 AWG stranded (copper seven-stranded)

CONDUCTORS ABOVE 600 VOLTS (SCHEDULE A WORK ONLY):

Ethylene-Propylene Rubber (EPR) Insulated Cable:

Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.

Type: 15kV, tape shielded UL 1072, Type MV-90.

Conductors: Copper concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B263.

Conductor Screen: Extruded, semi-conducting ethylene-propylene rubber in accordance with NEMA WC 71 and AEIC CS 6.

Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR), containing no polyethylene in accordance with NEMA WC 71, and AEIC CS 6.

Insulation Thickness: 220-mil, 15 kV, nominal.

Insulation Screen: Thermosetting, semi-conducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 74, and AEIC CS 6.

Metallic Shield: Uncoated, 5-mil, copper shielding tape, helically applied with [17-1/2] percent minimum overlap.

Jacket: Extruded polyvinyl chloride (PVC) compound applied over the metallic shield in accordance with NEMA WC 71.

Operating Temperature: 90 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.

Manufacturers:

Okonite Co.

Pirelli Wire and Cable.

BICC.

Southwire Co.

ACCESSORIES FOR CONDUCTORS ABOVE 600 VOLTS (SCHEDULE A WORK ONLY):

Termination Kits:

Capable of terminating 15 kV, single-conductor, polymeric-insulated tape shielded cables plus a shield ground clamp.

Capable of producing a termination with a current rating equal to, or greater than, the cable ampacity, meeting Class 1 requirements of IEEE 48.

Capable of accommodating any form of cable shielding or construction without the need for special adapters or accessories.

Manufacturers:

Raychem.

3M Co.

Elbow Connector Systems:

Molded, peroxide-cured, EPDM-insulated, Class 15 kV, 95kV BIL, 200A, 10,000A rms load-break elbows as shown having all copper current-carrying parts in accordance with ANSI 386.

Protective Caps: Class 15 kV, 95 kV BIL, 200 amperes, with molded EPDM insulated body.

Insulated Standoff Bushings: Class 15kV, 95kV BIL, 200 amperes, complete with EPDM rubber body, stainless steel eyebolt with brass pressure foot, and stainless steel base bracket.

Bushing Inserts: 15kV, 95kV BIL, 200A, load-break with EPDM rubber body and all-copper, current-carrying parts.

Manufacturers:

Cooper Industries.

Elastimold.

Cable Lugs:

In accordance with NEMA CC1.

Rated 15kV of same material as conductor metal.

Manufacturers and Products, Uninsulated Compression Connectors and Terminators:

Burndy, Hydent.

Thomas & Betts; Color-Keyed.

ILSCO.

TERMINAL BLOCKS AND ENCLOSURES:

Provide enclosures for all indoor and outdoor terminal block applications in accordance with ENVIRONMENTAL CONDITIONS in this section..

Type: Compression screw clamp, with current bar providing direct contact with wire and yoke, with individual rail mounted terminals.

Yokes and Clamping Screws: Zinc-plated, hardened steel.

Rating: 600V ac.

PUSHBUTTONS AND SELECTOR SWITCHES:

NEMA ICS 2, Type 600.

Type: Heavy-duty, oiltight.

Lockout: Pushbuttons and selector switches shall lock in OFF position wherever lockout provisions are indicated.

Nameplates:

Individual, large, laminated plastic.

Function indicated.

Pushbutton station nameplates shall indicate the drive controlled.

Manufacturers and Models:

Square D; Type T.

Cutler-Hammer; Type 10250T.

General Electric.

LUMINAIRES:

Specific requirements relating to fixture type, lamp type, poles, and mounting hardware are located in the Luminaire Schedule attached to this section.

RECEPTACLES:

NEMA WD 1 and FS W-C-596.

Specification Grade:

Type: Three-wire grounding, with screw type terminals suitable for No. 10 AWG wire. Contact to be made on two sides of each inserted blade without detent.

Number of Poles: Two.

Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.

Base: Phenolic composition.

Color: Gray.

SPECIAL OUTLETS:

Weatherproof outdoor heavy duty circuit breaking receptacle assembly and housing.

One matching plug with cord-grip features for each special purpose outlet.

Rating: 100-amp rating, 600 volts, three-phase, three-wire with ground (four-pole) as required for anticipated purpose.

Manufacturer and Model:

Crouse-Hinds, Arktite Style 2 AREA10425.

Or equal.

SWITCHES:

NEMA WD 1 and FS W-S-896E.

Totally enclosed, ac type, quiet tumbler switches, with screw terminals.

Capable of control of 100 percent tungsten filament and fluorescent lamp loads.

Rating: 20 amps, 120/277 volts (single and double-pole as required).

Color: Gray.

BOXES:

Small Standard Boxes:

NEMA 250, Type 1, minimum 2 inches deep, unless shallower required by structural conditions.

Large Galvanized Steel Boxes:

NEMA 250, Type 12 unless otherwise noted.

14-gauge, with full access screw covers mounted with corrosion-resistant machine screws.

Large Cast Metal Boxes:

NEMA 250, Type 4, (Type 7 for combined sumps), cast malleable iron, with hot-dip galvanized finish.

Neoprene gasketed, watertight, with cast metal covers, stainless steel screws, and drilled and tapped conduit entrances.

Handholes:

Reinforced cast concrete boxes sized to provide adequate working space as required by standard procedures and NFPA 70.

Nonmetallic:

Box: PVC.

Cover: PVC, weatherproof, with stainless steel screws.

Manufacturer and Product: Carlon; Type FS or FD, with Type E98 or E96 covers.

Large Nonmetallic Box:

NEMA 250, Type 4X.

Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.

Cover: Hinged with clamps.

Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

Conduit hubs and mounting lugs.

Manufacturers and Products:

Crouse-Hinds; Type NJB.

Carlon; Series N, C, or H.

Robroy Industries.

METAL WIREWAYS:

Meet requirements of UL 870.

Type: Steel-enclosed, with removable, hinged cover.

Rating: Reference ENVIRONMENTAL CONDITIONS in this section.

Finish: Gray, baked enamel.

Manufacturers:

Circle AW.

Hoffman.

Square D.

COVER PLATES:

Metal:

Material: Specification grade, one-piece, stainless steel.

Thickness: Minimum 0.40-inch nominal.

Finish: No. 302/304 satin.

Mounting Screws: Oval head, stainless steel, to match plate.

Cast Metal:

Material: Malleable ferrous, with gaskets.

Mounting Screws: Oval head, stainless steel.

Weatherproof Device Plates:

Material: Cast metal, gasketed, weatherproof, with individual cap over each opening held with stainless steel springs.

Finish: Stainless steel or fiberglass reinforced plastic.

Mounting Screws: Stainless steel.

GROUNDING:

General:

Grounding shall be in compliance with NFPA 70 and ANSI C2.

Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.

Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, metal piping systems, and metal structures which may become energized by attached electrical devices (i.e., leachate storage tank, metal frame of buildings).

Shielded Instrumentation Cables:

Ground shield of instrumentation cables at PLC end only, using drain wire connected to terminal block that is connected to an isolated instrument ground. Isolated instrument ground terminals block is located inside PLC control panel enclosure.

Insulate ungrounded end of all shielded instrumentation cables' shield with shrink tubing for a distance of 1/2 inch either side of the end of the outer jacket.

Wire Connections:

Ground Conductors: Install in conduit containing power conductors and control circuits.

Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor and bond at both ends.

Connect ground conductors to raceway grounding bushings.

Bond all equipment grounding conductors to equipment ground bus and equipment enclosures as required by the NEC.

Bolt connections to equipment ground bus.

Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

Motor Grounding:

Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor and bond at both ends.

Motors Less Than 10 hp: Furnish compression, spade-type terminal connected to conduit box mounting screw.

Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

Grounding Conductors:

Equipment: Solid or stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

Direct Buried: Bare stranded copper.

Isolated Instrument Ground: Stranded copper with green insulation with yellow stripe or yellow phasing tape at all ends.

Ground Rod:

Material: Copper.

Diameter: Minimum 3/4 inch.

Length: 10 feet.

Connectors:

Exothermic Weld Type:

Outdoor Weld: Suitable for exposure to elements or direct burial.

Indoor Weld: Utilize low-smoke, low-emission process.

Manufacturers: Erico Products, Inc., Cadweld and Cadweld Exolon.

Compression Type:

Compress-deforming type; wrought copper extrusion material.

Single indentation for conductors 6 AWG and smaller.

Double indentation with extended barrel for conductors 4 AWG and larger.

Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.

Manufacturers:

Burndy Corp.

Thomas and Betts Co.

ILSCO Corp.

Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

Manufacturers:

Burndy Corp.

Thomas and Betts Co.

ILSCO Corp.

Grounding Wells:

Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

Manufacturers and Products:

Christy Co.; No. G5.

Lightning and Grounding Systems, Inc.; I-R Series.

PART 3--EXECUTION

GENERAL:

All work shall be performed in a neat and workman-like manner and shall comply with all applicable provisions of NECA 5055 standards and practices.

Install materials and equipment in hazardous areas in a manner acceptable to regulatory authority having jurisdiction for the hazardous area indicated.

Ground equipment, enclosures, and complete conduit system securely in accordance with applicable sections of NFPA 70.

PANELBOARDS AND MINI-POWER CENTERS

Install securely, plumb, in-line and square with walls.

Install top of cabinet 6 feet above floor, unless otherwise shown.

Provide typewritten circuit directory for each panelboard.

Cabinet Location/Type:

Industrial Use in Areas Not Otherwise Classified: Reference ENVIRONMENTAL CONDITIONS in this section.

TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) EQUIPMENT

Install in accordance with manufacturer's instructions, including lead length, overcurrent protection, and grounding.

MOTOR STARTER:

Field adjust trip settings of motor starter magnetic, trip-only circuit breakers in accordance with manufacturer's instructions.

CONDUIT AND FITTINGS:

General:

Conduit system shall be carefully planned with proper attention to details before starting the work.

Do not install crushed or deformed raceways. Replace any raceway that has been damaged after installation.

Raceways that are installed so as to form a moisture trap are not allowed.

Prevent plaster, dirt, or trash from lodging in raceways, boxes, fittings, and equipment during the course of construction. Clear clogged raceways of obstructions.

All conduit runs shall be made parallel to or perpendicular to the lines of the building.

Secure conduits entering cabinets, pull boxes or outlet boxes with galvanized locknuts and bushings, on both sides of box wall.

Identify conduits at each terminus using conduit and cable schedule designations.

Applications:

Exposed Exterior: Type RGS.

Concrete Embedded: Type PVC.

Direct Buried: Type PVC inside concrete duct bank.

Vertical Runs Through Slab on Grade: Convert PVC conduit to RGS wrapped with watertight adhesive plastic tape.

PVC Bends: Bends in PVC runs shall be incorporated using RGS. RGS wrapped with watertight adhesive plastic tape.

Final Connection to Motors:

Conduit Size 4 Inches or Less: 18-inch minimum, 60-inch maximum length of flexible liquid-tight metal conduit.

Penetrations:

Conduits penetrating fire-rated walls shall be sealed with a compound approved by UL and appropriate to the fire rating of the wall.

Flash and counterflash conduits penetrating roofing membrane.

Seal penetrations with oakum or expandable plastic compound.

Provide sleeves and chases where conduits pass through floors or walls. Finish to match adjacent surfaces.

Provide escutcheon plates where exposed conduits pass through walls, floors or ceilings.

Conduits from the combined sump area shall be sealed with a compound approved by UL, and appropriate for conduits in hazardous areas entering nonhazardous areas.

Slab-On-Grade or Direct Buried:

Install horizontal runs below floor slab. Horizontal runs within slab shall not be permitted.

Field wrap RGS conduit and joints installed below slab or direct buried with 0.010-inch thick pipe wrapping plastic tape applied with a 50 percent overlay, or factory apply a plastic resin, epoxy, or coal-tar coating system.

Exposed Raceways:

Install parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.

Underground Duct Banks:

All underground duct banks shall be installed in locations shown on drawings, enclosed in a red concrete casing as specified in Section 03301, CONCRETE. The concrete casing shall also enclose all standard conduit bends or elbows. All underground ducts shall have steel reinforcement in sizes as shown on the drawings.

Excavate the trenches as specified in Section 02316, EXCAVATION, to provide elevation on top of concrete envelope as shown on drawings. After trenches are excavated and graded, the duct shall be laid in rows on plastic spacers or approved equals.

Spacers shall be placed so that each section of duct is supported at intervals as specified in NFPA 70 (NEC). Concrete shall then be placed per Section 03301, CONCRETE, until the ducts are covered to the required depth and leveled, leaving NOT less than 4 inches of concrete over top tier of ducts. Backfill shall be in accordance with Section 02320, TRENCH BACKFILL.

Changes in Direction of Runs:

Make with symmetrical bends or cast metal fittings.

Bends and offsets shall be made with a hickey or conduit bending machine.

Supports:

Provide pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps with retainers, or ceiling trapeze.

Install suitable braces for conduit, junction boxes, light fixtures and other electrical equipment as needed for seismic support.

Securely and rigidly fasten in place.

Maximum Interval: 10 feet.

PRECAST UTILITY VAULTS, MANHOLES AND HANDHOLES:

Excavate, shore, brace, backfill, and final grade in accordance with Section 02316, EXCAVATION and Section 02320, TRENCH BACKFILL.

Do not install until final raceway grading has been determined.

Install such that raceways enter at nearly right angles and as near as possible to one end of wall, unless otherwise shown.

CONDUCTORS:

Conduit system shall be complete prior to drawing conductors.

Lubricate prior to drawing into conduit. Lubrication type shall be as approved by conductor manufacturer.

Connections: Pressure type solderless, complete with insulator and security ring.

Control Circuits:

Where multiple units perform parallel operations, do not group all devices on same branch circuit.

Do not exceed the ampacity of the branch circuit, or 12 amperes continuous.

Terminate feeder and interconnecting conductors between panel mounted equipment and external equipment at numbered terminal blocks.

Identification:

Where two or more conduits run to a single outlet box, color code each circuit as a guide in making connections.

Carry colors continuously throughout the system.

Do not install multiwire branch circuits that share a common neutral.

Identify conductors, cables at each terminus, and handhole using conduit and cable schedule designations.

Colors:

Confirm and utilize the existing Hanford field center color coding system as shown below:

Conductor Origin: 480Y/277-volt, three-phase system. Transformers, panels, switchboard, etc.

Phase A	Red
Phase B	Yellow
Phase C	Blue
Neutral	White or Gray
Equipment Ground	Green (or bare)

Conductor Origin: 208Y/120-volt, three-phase system. Transformers, panels, switchboard, etc.

Phase A	Black
Phase B	Purple
Phase C	Brown
Neutral	White or Gray
Equipment Ground	Green (or bare)

Conductor Origin: 120/240-volt, single-phase system. Transformers, panels, switchboard, etc.

Hot Number 1	Black
Hot Number 2	Brown
Neutral	White or Gray
Equipment Ground	Green (or bare)

Conductor Origin: DC system. Instruments, control panels, etc.

DC +	Red
DC-	Black

CONDUCTORS ABOVE 600 VOLTS (SCHEDULE A WORK ONLY):

Do not splice conductors.

Single Conductor Cable Terminations:

Coordinate all terminations with FH EU.

Make terminations with termination kits, in accordance with kit manufacturer's instructions. Install terminations as continuous operation in accessible locations under clean, dry conditions.

Provide heat shrinkable stress control and outer nontracking insulation tubings, high relative permittivity stress relief mastic for insulation shield cutback treatment, and a heat-activated sealant for environmental sealing plus a ground braid and clamp.

Install terminals or connectors acceptable for type of conductor material used.

Provide shield termination and grounding for all terminations.

Provide necessary mounting hardware, covers, and connectors.

Where elbow connectors are specified, install in accordance with manufacturer's instructions.

Connections and Terminations:

Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.

Give 2 working days notice to FH EU prior to making terminations.

TERMINAL BLOCKS:

Install for termination of all control circuits leaving or entering equipment, panels, or boxes.

LUMINAIRES:

Install luminaires and poles in accordance with manufacturer's recommendations.

Install plumb and true.

Provide swivel type hangers and canopies to match pendant mounted fixtures.

Furnish all lamps and clean the reflectors, the diffusers, and the lamps before closing up the fixtures.

BOXES:

Support to the structure, independent of conduit attachment.

Boxes installed belowgrade shall be installed flush with finished grade.

Boxes and covers in paved areas, roadways, or walkways shall be suitable for weights to which they may be subjected.

Box Extensions: Not permitted.

Classified Hazardous Areas: Boxes shall be applicable for location.

COVER PLATES:

Shall fit tightly to box.

Shall not extend beyond sides of box on surface mounted boxes, unless covers have no sharp corners or edges.

TRENCH BACKFILL:

In accordance with Section 02320, TRENCH BACKFILL.

PROTECTION FOLLOWING INSTALLATION:

Protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation.

Cap conduit runs during construction with manufactured seals.

Close openings in boxes or equipment during construction.

Energize space heaters furnished with equipment.

CONSTRUCTION QUALITY CONTROL:

In accordance with Section 16080, ELECTRICAL TESTING, and as specified herein.

Circuit Balance:

Confirm the balance of electrical load between phases on three-phase panelboards and motor control centers after installation. Notify Construction Manager of current unbalances 10 percent and greater.

Voltage Testing:

When installation is complete and facility is in operation, check voltage at point of termination of electric supply system to project.

Check voltage amplitude and balance between phases for loaded and unloaded conditions.

Record supply voltage for 24 continuous hours. If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to Tank Farm Contractor to correct condition.

Equipment Line Current:

Check line current in each phase for each piece of equipment.

If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

Inspection of Low Voltage Cables, 600 Volts Maximum (Note: FH EU shall inspect and test all cables rated above 600 volts):

Inspect each individual exposed power cable for physical damage, proper connections in accordance with Section 16080, ELECTRICAL TESTING.

Electrical Tests for Conductors (600 Volts and Below):

Prior to final connection and energizing of power and control circuits, conduct an insulation resistance test to determine insulation integrit in accordance with Section 16080, ELECTRICAL TESTING.

Ground Electrode Test:

Inspect grounding connections prior to any backfill of cables in accordance with Section 16080, ELECTRICAL TESTING.

Maximum ground electrode resistance shall be 3 ohms. Add maximum 2 additional ground rods spaced 6 feet apart if 3 ohms is not achieved.

SUPPLEMENTS:

The supplement listed below, following "END OF SECTION," is a part of this Specification.

Supplement 1—Luminaire Schedule.

END OF SECTION 16005

LUMINAIRE SCHEDULE

Type	Voltage	Description	Manufacturer	Catalogue No.	Lamp	Mounting Type
1	120	Heavy duty industrial 4-foot fluorescent fixture with 2 lamps with low temp electronic starting ballast(s).	Holophane	7200-4-12-LT Fluorescent Prismatite or equal.	2-40W R.S. T12, 0°F starting (48″)	Pendant with chains and surface mount
2	120	Standby light NiCaD battery operated.	Holophane	C1-6N-25-W-WCHY-2 Cortez A1	2-12 watts 6-volt Halogen	Wall mount
3	120	WallPack wall mount HPS with integral photocell.	Holophane	WallPack WL2K-070HP-12-BK—F1-LAMP-PC	1-70W HPS	Wall mount
4	120	Pole mount outdoor flood wet location duty. Single and double 2U configuration as indicated.*	Holophane	Predator Floodlight PF-250HP-12-K-W-1-B-CR[2]	250-watt HPS	Pole mount round tapered steel poles, single and 2U configurations SPRT20J/1/SG SPRT20J/2/SG
5	120	Crestwood outdoor post light with HPS fixture and cover*	Holophane	Crestwood CW-24-15AHP-12-GR-CA	1-150W HPS	Round tapered steel galvanized pole 10 foot SPRT10J/SG

Note: *Install added vertical light cutoff "shades."

SECTION 16055--PIPE HEAT TRACING

PART 1--GENERAL

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Product Data:

Manufacturer's descriptive literature.

Plastic Pipe Installations: Output adjustment factors for heating tape for the services indicated.

Pipe heat loss calculations for each pipe size to be heat traced.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Field Testing: Submit inspection/test report on insulation resistance per CONSTRUCTION QUALITY CONTROL section of this Specification.

PART 2--PRODUCTS

SYSTEM DESIGN REQUIREMENTS:

Design Heating Load:

Heating load to be calculated based upon a 100-degree F delta, 20 mph wind if pipes are located outdoors, insulation as specified in Section 15060, PIPING-GENERAL, and shall include a 10 percent safety factor.

Heat loss calculations shall be based on IEEE 515, Equation 1, Page 19.

ELECTRICAL HEATING TAPE:

Cable: Auto-trace, self-limiting, parallel circuit construction consisting of continuous inner core of variable resistance conductive heating material between two parallel copper bus wires. Provide tinned copper braid for PVC, FRP, and stainless steel pipe applications.

UL Listing: Listed as self-limiting pipe tracing material for pipe freeze protection application in ordinary conditions.

Maximum Maintenance Temperature: 150 degrees F (65 degrees C).

Maximum Intermittent Temperature: 185 degrees F (85 degrees C).

Minimum Maintenance Temperature: Minus 40 degrees F (-40 degrees C).

Service Voltage: As indicated by branch circuits provided for heat tracing on the Drawings. All heat trace circuits shall be powered by ground fault interrupter type (GFEP) circuit breakers (30 mA).

Manufacturers and Products:

Raychem; Chemelex BTV or BRV-C.

Thermon; FLX-BC or FLX-OJ.

Nelson; CL1-J1 or L1-J1.

CONNECTION SYSTEM:

Rating: NEMA 250, Type 4 and Factory Mutual approved.

Operating Monitor Light: Furnish with each circuit power connection kit to indicate when heat tracing is energized.

Manufacturers and Products:

Power Connection Kit:

Raychem; Chemelex AM-BC.

Thermon; PCA-COM.

Nelson; PLT-BC.

Splice Kit:

Raychem; Chemelex AM-BS.

Thermon; PCS-COM.

Nelson; PLT-BS.

Tee Kit:

Raychem; Chemelex AM-B4.

Thermon; Tee Snap.

Nelson; PLT-BY.

End Seal Kit:

Raychem; Chemelex AM-E.

Thermon; ET-6C or ET-8C.

Nelson; LT-ME.

Pilot Light:

Raychem; Chemelex AM-L.

Thermon; VIL-4C.

Nelson; LT-L.

Pipe Adapter Kit:

Raychem; Chemelex AM-P or AM-T.

Thermon; included with power connection kit.

Nelson; LT-P.

SECURING TAPE:

Plastic Piping Systems:

Type: Aluminum foil coated adhesive tape.

Manufacturers and Products:

Raychem; Chemelex AT-180.

Thermon; AL-20P.

Nelson; AT-50.

Metallic Piping Systems:

Type: Glass or polyester cloth pressure sensitive tape.

Manufacturers and Products:

Raychem; Chemelex GS54 or GT66.

Thermon; PF-1.

Nelson; GT-6 or GT-60.

AMBIENT THERMOSTAT:

Type: Adjustable setting (15 to 140 degrees F), set to 40 degrees F, so as to switch cable off when ambient temperature exceeds 40 degrees F.

Sensor: Fluid-filled probe.

Enclosure: Epoxy-coated NEMA 250, Type 4X aluminum enclosure with exposed hardware of stainless steel.

Switch: SP-DT, UL or FM listed, rated 22 amps, 125 to 250V ac.

Manufacturers and Products:

Raychem; Chemelex Model AMC-1A.

Thermon; B4X-15140.

Nelson; TX-4X140.

PART 3--EXECUTION

INSTALLATION:

General:

Install in accordance with the manufacturer's instructions and recommended practices.

Provide insulation as specified in Section 15060, PIPING-GENERAL, over all pipe heat tracing.

Ground metallic structures or materials used for support of heating cable or on which it is installed in accordance with applicable codes.

Wiring between power connection points of heat tracing cable branch lines shall be provided by heat tracing system supplier.

Provide end of circuit pilot lights on heat tracing circuits for buried piping.

Electrical Heating Tape:

Determine required length of electrical heating tape by considering length of circuit, number and type of fittings and fixtures, design heating load, and heating tape output.

Where design heating load exceeds heating tape capacity, install by spiraling.

Derate heating tape capacity when installed on plastic piping.

Install on services as follows (reference Drawings H-2-830854, Sheets 2 and 4):

Service	Piping Material	Placement	Location
Cell No. 1 3″ LH-030-HDPE Cell No. 2 3″ LH-030-HDPE	HDPE	Heat trace and insulate exposed portion of piping from tank inlet connection to about 2 feet below grade.	Cell No. 1 and Cell No. 2 Leachate Storage Tank(s) Process Inlet Connections.
Cell No. 1 4″ LT-034-PVC Cell No. 2 4″ LT-034-PVC	PVC	Heat trace and insulate exposed portion of piping from tank inlet connection to about 2 feet below grade.	Cell No. 1 and Cell No. 2 Leachate Storage Tank(s) Process Outlet Connections.
Cell No. 1 4″ LH-045-HDPE Cell No. 2 4″ LH-045-HDPE	HDPE	Heat trace and insulate exposed portion of piping from tank inlet connection to about 2 feet below grade.	Cell No. 1 and Cell No. 2 Leachate Storage Tank(s) Process Inlet Connections.
Cell No. 1 4″LT-037-HDPE Cell No. 2 4″LT-037-HDPE	HDPE	Heat trace and insulate exposed portion of piping from above grade connection fittings to about 2 feet below grade, including 8″ containment piping.	Cell No. 1 and Cell No. 2 Truck Loading Station(s) Process to Truck Connections.

Wrap heat trace cable once every 33 inches under pipe insulation. Install additional heating tape at bolted flanges, valves, pipe supports, and other fittings and fixtures as recommended by supplier, but not less than the following:

Item	Heating Tape Length (min. feet)
Bolted flanges (per pair)	Two times pipe diameter
Valves	Four times valve length
Pipe hanger or support penetrating insulation	Three times pipe diameter

Heat Tracing Circuits: Limit individual lengths of heat tracing circuits such that maximum single circuit capacity is 20 amps when starting the circuit at 40 degrees F. Provide multiple 20-amp circuits as required at individual heat tracing locations.

Thermostats:

Install in accordance with manufacturer's instructions and as approved by Engineer.

For each group of heat traced circuit, install one ambient thermostat.

CONSTRUCTION QUALITY CONTROL:

In accordance with Section 16080, ELECTRICAL TESTING, and as specified herein.

Test each circuit with 500-volt insulation tester between circuit and ground with neutrals isolated from ground.

Insulation Resistance: Minimum 1,000 megohms per 1,000 feet.

END OF SECTION 16055

SECTION 16080--ELECTRICAL TESTING

PART 1--GENERAL

Fluor Hanford Electrical Utilities (FH EU) shall test pad mounted transformer and conductors rated above 600 volts. Construction General Contractor shall coordinate FH EU testing with Construction Manager.

Onsite testing shall be required for each major electrical system as specified herein in the presence of representatives for the authority having jurisdiction (AHJ). Tests shall be performed to demonstrate that each function is implemented and operational. These tests are electrical component tests to be performed in advance of facility-wide construction acceptance testing (CAT). CAT shall be performed in accordance with Division requirements.

Provide personnel and equipment in support of Section 13401, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS), Operation Readiness (ORT) and Performance Acceptance (PAT) testing.

APPROVAL BY AUTHORITY HAVING JURISDICTION (AHJ):

As specified in Section 16005, ELECTRICAL.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Qualifications: Submit Testing Firm Qualifications as specified herein.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR)

Submit 30 days prior to performing inspections or tests:

Schedule for performing inspection and tests.

List of references to be used for each test.

Sample copy of equipment and materials inspection form(s).

Sample copy of individual device test form.

Sample copy of individual system test form.

Submit within 30 days after completion of test:

Test or inspection reports and certificates for each electrical item tested.

Operation and Maintenance Data:

After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in operation and maintenance manual.

TESTING FIRM QUALIFICATIONS:

Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.

Supervising engineer accredited as Certified Electrical Test Technologist by National Institute for Certification of Engineering Technologists (NICET), or International Electrical Testing Association and having a minimum of 5 years' testing experience on similar projects.

Technicians certified by NICET or NETA.

Registered professional engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.

In compliance with OSHA Title 29, Part 1907 criteria for accreditation of testing laboratories.

SEQUENCING AND SCHEDULING:

Perform inspection and electrical tests after equipment has been installed. Construction General Contractor shall coordinate NEC required inspections and Fluor Hanford Electrical Utilities (FH EU) required testing and inspections with Construction Manager. Tank Farm Contractor will provide services of an NEC inspector.

Perform tests with apparatus de-energized whenever feasible.

Inspection and electrical tests on energized equipment are to be:

Scheduled with Construction Manager prior to de-energization.

Minimized to avoid extended period of interruption to the operating plant equipment.

Notify Construction Manager at least 24 hours prior to performing tests on energized electrical equipment.

PART 2--PRODUCTS

TEST EQUIPMENT/INSTRUMENTATION REQUIREMENTS:

Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.

Test instrument calibration shall be in accordance with NETA ATS.

PART 3--EXECUTION

GENERAL:

Tests and inspection shall establish that:

Electrical equipment is operational within industry and manufacturer's tolerances.

Installation operates properly.

Equipment is suitable for energization.

Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, and ANSI C2.

Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

Adjust mechanisms and moving parts for free mechanical movement.

Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

Verify nameplate data for conformance to Contract Documents.

Realign equipment not properly aligned and correct unlevelness.

Properly anchor electrical equipment found to be inadequately anchored.

Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.

Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

Provide proper lubrication of applicable moving parts.

Inform Construction Manager of working clearances not in accordance with NFPA 70.

Investigate and repair or replace:

Electrical items that fail tests.

Active components not operating in accordance with manufacturer's instructions.

Damaged electrical equipment.

Electrical Enclosures:

Remove foreign material and moisture from enclosure interior.

Vacuum and wipe clean enclosure interior.

Remove corrosion found on metal surfaces.

Repair or replace, as determined by Construction Manager, door and panel sections having dented surfaces.

Repair or replace, as determined by Construction Manager, poor fitting doors and panel sections.

Repair or replace improperly operating latching, locking, or interlocking devices.

Replace missing or damaged hardware.

Finish:

Provide matching paint and touch up scratches and mars.

If required due to extensive damage, as determined by Construction Manager, refinish the entire assembly.

Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents.

DRY TYPE TRANSFORMERS:

Visual and Mechanical Inspection:

Physical and insulator damage.

Proper winding connections.

Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.

Defective wiring.

Proper operation of fans, indicators, and auxiliary devices.

Removal of shipping brackets, fixtures, or bracing.

Free and properly installed resilient mounts.

Cleanliness and improper blockage of ventilation passages.

Verify that tap-changer is set at correct ratio for rated output voltage under normal operating conditions.

Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

Electrical Tests:

Insulation Resistance Tests:

Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7.2.3 for each:

Winding-to-winding.

Winding-to-ground.

10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.

Results temperature corrected in accordance with NETA ATS, Table 7.2.4.

Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

Insulation resistance test results to compare within 1 percent of adjacent windings.

Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM:

Visual and Mechanical Inspection:

Inspect Each Individual Exposed Power Cable No. 8 and Larger For:

Physical damage.

Proper connections in accordance with single-line diagram.

Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.

Color coding conformance with specifications.

Proper circuit identification.

Mechanical Connections For:

Proper lug type for conductor material.

Proper lug installation.

Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.

Shielded Instrumentation Cables For:

Proper shield grounding.

Proper terminations.

Proper circuit identification.

Continuity test by ohmmeter method to ensure proper cable connections.

Control Cables For:

Proper termination.

Proper circuit identification.

Continuity test by ohmmeter method to ensure proper cable connections.

Cables Terminated Through Window Type CTs: Verify that neutrals and grounds are terminated for correct operation of protective devices.

Electrical Tests for Conductors No. 8 and Larger:

Insulation Resistance Tests:

Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.

Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for 1 minute.

Evaluate ohmic values by comparison with conductors of same length and type.

Investigate values less than 50 megohms.

Continuity test by ohmmeter method to ensure proper cable connections.

SAFETY SWITCHES, 600 VOLTS MAXIMUM:

Visual and Mechanical Inspection:

Proper blade pressure and alignment.

Proper operation of switch operating handle.

Adequate mechanical support for each fuse.

Proper contact-to-contact tightness between fuse clip and fuse.

Cable connection bolt torque level in accordance with NETA ATS, Table 10.1.

Proper phase barrier material and installation.

Verify that fuse sizes and types correspond to one-line diagram.

Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

Electrical Tests:

Insulation Resistance Tests:

Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.

Phase-to-phase and phase-to-ground for 1 minute on each pole.

Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

Contact Resistance Tests:

Contact resistance in microhms across each switch blade and fuse holder.

Investigate deviation of 50 percent or more from adjacent poles or similar switches.

MOLDED AND INSULATED CASE CIRCUIT BREAKERS:

General: Inspection and testing limited to circuit breakers rated 70 amperes and larger and to motor circuit protector breakers rated 30 amperes and larger.

Visual and Mechanical Inspection:

Proper mounting.

Proper conductor size.

Feeder designation according to nameplate and one-line diagram.

Cracked casings.

Connection bolt torque level in accordance with NETA ATS, Table 10.1.

Operate breaker to verify smooth operation.

Compare frame size and trip setting with circuit breaker schedules or one-line diagram.

Verify that terminals are suitable for 75 degrees C rated insulated conductors.

Electrical Tests:

Insulation Resistance Tests:

Utilize 1,000-volt dc megohmmeter for 480- and 600-volt circuit breakers and 500-volt dc megohmmeter for 240-volt circuit breakers.

Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute

Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

Test values to comply with NETA ATS, Table 10.2.

Contact Resistance Tests:

Contact resistance in microhms across each pole.

Investigate deviation of 50 percent or more from adjacent poles and similar breakers.

Current Injection Test to Verify:

Long-time minimum pickup and delay.

Short-time pickup and delay.

Instantaneous pickup by run-up or pulse method.

Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.

Trip times shall be within limits established by NEMA AB 4, Table 5-3.

Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4.

INSTRUMENT TRANSFORMERS:

Visual and Mechanical Inspection:

Visually Check Current, Potential, and Control Transformers For:

Cracked insulation.

Broken leads or defective wiring.

Proper connections.

Adequate clearances between primary and secondary circuit wiring.

Verify Mechanically That:

Grounding and shorting connections have good contact.

Withdrawal mechanism and grounding operation, when applicable, operate properly.

Verify proper primary and secondary fuse sizes for potential transformers.

Electrical Tests:

Current Transformer Tests:

Insulation resistance test of transformer and wiring-to-ground at 1,000 volts dc for 30 seconds.

Polarity test.

Potential Transformer Tests:

Insulation resistance test at test voltages in accordance with NETA ATS, Table 7.1.1 for 1 minute on:

Winding-to-winding.

Winding-to-ground.

Polarity test to verify polarity marks or H1-X1 relationship as applicable.

Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 7.1.1.

UTILITY METERING:

Testing to be conducted by FH EU.

GROUNDING SYSTEMS:

Visual and Mechanical Inspection:

Equipment and circuit grounds in motor control center and panelboard assemblies for proper connection and tightness.

Ground bus connections in motor control center and panelboard assemblies for proper termination and tightness.

Effective transformer core and equipment grounding.

Accessible connections to grounding electrodes for proper fit and tightness.

Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

Electrical Tests:

Fall-Of-Potential Test:

In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.

Main ground electrode system resistance to ground to be no greater than 3 ohms.

Two-Point Direct Method Test:

In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.

Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohm.

AC INDUCTION MOTORS:

General: Inspection and testing limited to motors rated 1/3 hp and larger.

Visual and Mechanical Inspection:

Proper electrical and grounding connections.

Shaft alignment.

Blockage of ventilating air passageways.

Operate Motor and Check For:

Excessive mechanical and electrical noise.

Overheating.

Correct rotation.

Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.

Excessive vibration.

Check operation of space heaters.

Electrical Tests:

Insulation Resistance Tests:

In accordance with IEEE 43 at test voltages established by NETA ATS, Table 10.2 for:

Motors 200 hp and less for 1-minute duration with resistances tabulated at 30 and 60 seconds.

Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.

Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.

Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

LOW VOLTAGE MOTOR CONTROL:

Visual and Mechanical Inspection:

Proper barrier and shutter installation and operation.

Proper operation of indicating and monitoring devices.

Proper overload protection for each motor.

Improper blockage of air cooling passages.

Proper operation of drawout elements.

Integrity and contamination of bus insulation system.

Check Breaker and Kirk Key Interlocking System By:

Closure attempt of breaker when associated Kirk key is in place.

Open attempt of breaker when associated Kirk key is in place.

Closure attempt of breaker when associated Kirk key is not in place.

Open attempt of breaker when associated Kirk key is not in place.

Check Door and Device Interlocking System By:

Closure attempt of device when door is in OFF or OPEN position.

Opening attempt of door when device is in ON or CLOSED position.

Check Nameplates for Proper Identification Of:

Equipment title and tag number with latest one-line diagram.

Control switches.

Pilot lights.

Control relays.

Circuit breakers.

Verify that fuse and circuit breaker sizes and types conform to Contract Documents.

Verify that current and potential transformer ratios conform to Contract Documents.

Check Bus Connections for High Resistance by Low Resistance Ohmmeter: Ohmic value to be zero.

Check Operation and Sequencing of Electrical and Mechanical Interlock Systems By:

Closure attempt for locked open devices.

Opening attempt for locked closed devices.

Key exchange to operate devices in OFF-NORMAL positions.

Verify performance of each control device and feature furnished as part of the motor control center.

Control Wiring:

Compare wiring to local and remote control, and protective devices with elementary diagrams.

Check for proper conductor lacing and bundling.

Check for proper conductor identification.

Check for proper conductor lugs and connections.

Exercise active components.

Inspect Contactors For:

Correct mechanical operations.

Correct contact gap, wipe, alignment, and pressure.

Correct torque of all connections.

Compare overload settings and voltage ratings with full-load current for proper size.

Compare fuse motor protector and circuit breaker with motor characteristics for proper size.

Electrical Tests:

Insulation Resistance Tests:

Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.

Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.

Contactor phase-to-ground and across open contacts for 1 minute on each phase.

Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.

Test values to comply with NETA ATS, Table 10.2.

Overpotential Tests:

Maximum applied ac or dc voltage in accordance with NETA ATS, Table 7.1.2.

Phase-to-phase and phase-to-ground for 1 minute for each phase of each bus section.

Test results evaluated on pass/fail basis.

Current Injection Through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:

Trip time in accordance with manufacturer's published data.

Investigate values in excess of 120 seconds.

Control Wiring Tests:

Apply secondary voltage to control power and potential circuits.

Check voltage levels at each point on terminal boards and each device terminal.

Insulation resistance test at 1,000 volts dc on control wiring except that connected to solid state components.

Insulation resistance to be 1 megohm minimum.

Operational test by initiating control devices to affect proper operation.

LOW VOLTAGE SURGE ARRESTORS:

Visual and Mechanical Inspection:

Adequate clearances between arrestors and enclosures.

Ground connections to ground bus and electrode.

Electrical Tests:

Varistor Type Arrestors:

Clamping voltage test.

Rated RMS voltage test.

Rated dc voltage test.

Varistor arrestor test values in accordance with ANSI C62.33, Sections 4.4 and 4.7.

END OF SECTION 16080

SECTION 16270--OIL-FILLED PAD MOUNTED TRANSFORMERS

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.12.00	Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI C57.12.22	Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2,500 kVA and Smaller
ANSI C57.12.26	Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High Voltage Connectors
ANSI C57.12.28	Switchgear and Transformers - Pad-Mounted Equipment, Enclosure Integrity
ANSI C57.12.90	Standard Test Code for Liquid Immersed Distribution, Power, and Regulating Transformers
ANSI 386	Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE C62.11	Metal-Oxide Surge Arrestors for Alternating-Current Power Circuits (>1 KV)

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Product Data:

Descriptive information.

Dimensional drawings.

Transformer nameplate data.

Schematic and connection diagrams.

Factory test reports certified.

SUBMITTALS–APROVAL NOT REQUIRED:

Information/Record (IR):

Operation and maintenance data.

Material Safety Data Sheet (MSDS) for Envirotemp FR3™ Fluid.

Submit documentation and test results from construction quality control testing.

EXTRA MATERIALS:

Furnish, tag, and box for shipment and storage and deliver prior to 30 percent Project completion the following spare parts, special tools, and materials:

One quart of paint to match color and quality of equipment final shop finish.

Two spare fuse links for each fuse size.

PART 2--PRODUCTS

SOURCE QUALITY CONTROL (FACTORY TESTS):

Design, test, and assemble in accordance with applicable standards of ANSI C57.12.00, C57.12.22, C57.12.26, and C57.12.90.

Production tests in accordance with ANSI C57.12.90 and C57.12.00, Section 8 and Table 16.

Dielectric test in accordance with ANSI C57.12.26.

MANUFACTURERS:

Cooper Power System.

Cutler-Hammer.

Square D Co.

General Electric.

GENERAL:

Integral Unit: Compartmental type unit consisting of transformer, oil-filled tank, and high and low voltage terminating compartments, assembled on a common structural base.

Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05500, METAL FABRICATIONS AND CASTINGS.

TRANSFORMER:

kVA Rating: 112.5.

Primary Voltage: 13.8 kV line-to-line, three-phase, 60 Hz.

Secondary Voltage: 480/277 volts, three-phase, four-wire, 60 Hz.

BIL Rating:

95 BIL for 15 kV insulation class transformers.

30 BIL for secondary.

Temperature Rise: 65 degrees C above 30 degrees average ambient with maximum ambient not to exceed 40 degrees C.

Impedance: 3.2 percent.

Coolant: Normally formulated, hydro-refined oil free of PCB chemical, FMRC approved, UL classified less-flammable Envirotemp FR3, in accordance with FMRC 3990. Fluid shall have a minimum open cup fire point of 350 degrees C and a minimum 5-day BOD (SM5210B) of 200 ppm. Manufacturer is to provide information on the transformers nameplate that it is "NON-PCB" along with "manufacturer's name and type of insulating fluid."

Primary Taps:

Full capacity, two 2-1/2 percent below and two 2-1/2 percent above, rated voltage.

Externally operated no-load tap changer.

Provisions for locking handle in any position.

Coil Conductors: Copper windings.

Delta-wye transformers wound on triplex cores.

Sound Level: In accordance with manufacturer's standards.

ENCLOSURE:

In accordance with ANSI C57.12.28 requirements.

Welded carbon steel transformer tank, with cooling panels when required, and lifting eyes.

12-gauge sheet steel terminal compartment enclosure having no exposed screws, bolts, or other fasteners that are externally removable.

Corrosion Protection and Color: Base(s) and cabinet(s) of the transformer shall be corrosion resistant and shall be fabricated of steel. Provide insulating and corrosion resistance undercoating on base of transformer. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. The Munsell color notation is specified in ASTM D1535.

TERMINAL COMPARTMENTS:

General: ANSI C57.12.28, enclosed high and low voltage compartments side by side, separated by steel barrier, bolted to transformer tank.

Doors:

Individual, full-height, air-filled.

Low voltage door with three-point latching mechanism, vault type handle, and single padlocking provision.

High voltage door fastenings inaccessible until low voltage door has been opened.

Door Bolts: Hex-head type.

Lift-off, stainless steel hinges and door stops.

Removable front sill to facilitate rolling or skidding over conduit stub ups.

Recessed lock pocket, with steel door release bolt adjacent to secondary compartment door handle.

High Voltage Compartment:

Deadfront in accordance with ANSI C57.12.26 type construction.

Protective fuses.

High voltage bushings.

Transformer grounding pad.

Surge arrestors with barriers.

Four-position, oil-immersed type switch to permit closed transit in loop feed and sectionalizing position sectionalizing load-break switch.

Parking stands.

<u>Low Voltage Compartment:</u>

Livefront in accordance with ANSI C57.12.26 type construction.

Low voltage bushings.

Grounding pad.

Stainless steel equipment nameplate.

Liquid level gauge.

1-inch upper filter press and filling plug.

Drain valve with sampling device.

Dial type thermometer.

Pressure relief valve.

Pressure relief device, self-resealing with indicator.

Pressure-vacuum gauge.

Mounting provision for current and potential transformers.

Nameplate per Nameplate C, Table 9, IEEE C57.12.00.

BUSHINGS:

High Voltage:

Deadfront Termination:

Universal bushing well rated at 15 kV in accordance with ANSI 386.

Bushings externally clamped and front removable.

Rated for 200 amperes continuous, 95 kV BIL.

Standoff brackets located adjacent to bushings.

Low Voltage:

Molded epoxy bushing clamped to tank with 4 hole spade type terminals.

Rated 150 percent of continuous full-load current, 30 BIL, 600 volts.

Internally connected neutral extending to neutral bushing.

HIGH VOLTAGE SWITCHING:

Internal, oil-immersed, gang-operated load-break, manually operated switches.

Hot stick operated handle located in high voltage compartment.

Capable of operating at full-load current.

Feed Switch: Four-position, oil-immersed type switch to permit closed transition loop feed and sectionalizing. Switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. The switch handle shall be located in the high-voltage compartment and lockable in the ON/OFF position. Switch shall be similar to the Cooper Power Systems, Electrical Apparatus 800-64, Sectionalizing Switches, "T" blade switch.

HIGH VOLTAGE PROTECTION:

Combination Oil-Immersed Bayonet Expulsion and Current Limiting Fuses:

Accessibility:

Bayonet expulsion fuse accessible through primary compartment.

Current-limiting fuse accessible through tank handhole.

Expulsion Fuse for Low Current Faults: Interrupting capacity of 1,800 amperes rms asymmetrical.

Current Limiting for High Current Faults: Interrupting capacity of 50,000 amperes rms symmetrical.

Bayonet fuse externally replaceable with hot stick.

Bayonet fuse links shall be dual sensing for both high currents and high oil temperature in order to provide thermal protection to the transformer.

Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse.

In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing, which closes when the fuse holder is removed and an external drip shield.

Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the OPEN position and the tank pressure has been released.

Bayonet Fuse Assembly: 150 kV BIL.

Oil-Immersed Current-Limiting Fuses: NEMA C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

SURGE ARRESTORS:

Metal-Oxide, Varistor Type:

Insulated body, elbow type, 18 kV in accordance with IEEE C62.11.

Installed in high voltage compartment.

Connected to transformer high voltage bushing wells.

TANK GROUNDING PADS:

Low Voltage Compartments:

Connected together with bare No. 2/0 stranded copper conductors.

Wye low voltage neutral internally connected with link and brought out to insulated low voltage bushing externally grounded to tank.

Low voltage neutral connected to externally mounted insulating bushing in low voltage compartment and grounded to tank with removable strap.

TAP CHANGER WARNING SIGN:

Red laminated plastic, engraved to white core.

Engrave to read DO NOT OPERATE WHEN TRANSFORMER ENERGIZED.

Mount above tap changer handle.

PART 3--EXECUTION

GENERAL:

Prepare subgrade for utility vault for pad mounted transformer as specified in Section 02319, SUBGRADE PREPARATION, paragraph "Prepared Subgrade for Roadway, Embankment and Structures."

Secure to mounting pads with anchor bolts.

Install plumb and longitudinally in alignment with pad or adjacent building wall.

Ground neutrals and enclosures in accordance with applicable codes and as shown on the Drawings.

CONSTRUCTION QUALITY CONTROL:

In accordance with Section 16080, ELECTRICAL TESTING.

ADJUSTMENTS:

Adjust voltage taps to obtain rated output voltage under normal operating load conditions.

END OF SECTION 16270

SECTION 16312--OVERHEAD ELECTRICAL DISTRIBUTION

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	National Electrical Safety Code
ANSI C12.7	Watthour Meter Sockets
ANSI C12.10	Watthour Meters
ANSI C12.11	Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV (0.6 kV NSV Through 69 kV NSV)
ANSI C12.13	Electronic Time-of-Use Registers for Electricity Meters
ANSI C12.15	Electricity Metering Solid-State Demand Registers for Electromechanical Watthour Meters
ANSI C12.16	Solid-State Electricity Meters
ANSI C29.2	Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.3	Wet Process Porcelain Insulators - Spool Type
ANSI C29.4	Wet-Process Porcelain Insulators - Strain Type
ANSI C29.5	Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types
ANSI C29.6	Wet-Process Porcelain Insulators, High-Voltage Pin Type
ANSI C29.7	Wet Process - Porcelain Insulators - High-Voltage Line-Post Type
ANSI C37.42	High Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches and Fuse Links
ANSI C57.12.20	Transformers – Overhead Type Distribution Transformers, 500 kVA and Smaller: High-Voltage, 34500 Volts and Below; Low-Voltage, 7970/13800Y Volts and Below
ANSI C57.12.28	Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity
ANSI O5.1	Wood Poles

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME D3487	Mineral Insulating Oil Used in Electrical Apparatus

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	All Timber Products - Preservative Treatment by Pressure Processes
AWPA C4	Poles - Preservative Treatment by Pressure Processes
AWPA C25	Crossarms, Pressure Treatment

ASTM INTERNATIONAL (ASTM)

ASTM A53	Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless
ASTM A153/A153M	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A475	Zinc-Coated Steel Wire Strand
ASTM B1	Hard-Drawn Copper Wire
ASTM B2	Medium-Hard-Drawn Copper Wire
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B228	Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM B231/231M	Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B232/B232M	Concentric-Lay-Stranded Aluminum Conductors, Coated Steel-Reinforced (ACSR)
ASTM B397	Concentric-Lay-Stranded Aluminum-Alloy 5005-H19 Conductors
ASTM B399/B399M	Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors
ASTM D117	Electrical Insulating Oils of Petroleum Origin

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 48	Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765kV
IEEE C37.30	High-Voltage Switches
IEEE C37.60	Overhead, Pad Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems
IEEE C37.63	Overhead, Pad Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems

IEEE C57.12.00	General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.90	Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE C57.13	Instrument Transformers
IEEE C62.11	Metal-Oxide Surge Arrestors for Alternating Current Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 70	Standard for Non-shielded Power Cables Rated 2000V or Less for the Distribution of Electrical Energy

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

RURAL UTILITIES SERVICE (RUS)

RUS 202-1	List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers
RUS 1728F-700	Wood Poles, Stubs, and Anchor Logs
RUS 1728H-701	Wood Crossarms (Solid and Laminated Transmission Timbers and Pole Keys)

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	Rigid Metal Conduit
UL 510	Polyvinyl Chloride Polyethylene and Rubber Insulating Tape

<u>SUBMITTALS–APPROVAL REQUIRED:</u>

See Section 01300, SUBMITTALS, for submittal procedures.

<u>Product Data:</u>

Conductors.

Insulators.

Wood poles and crossarms.

Utility vault (reference Section 16005, ELECTRICAL).

Cutouts.

Surge arrestors.

Guy strand and guards.

Anchors and anchor rods.

Ground rods.

Conduit.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Test Reports:

Acceptance checks and tests.

Ground resistance test reports.

Certificates:

Wood poles.

Wood crossarms.

DELIVERY, STORAGE, AND HANDLING:

Pole Line Material Storage:

Poles that will be stored longer than 2 weeks shall be stored on supports at least 1 foot aboveground in accordance with ANSI O5.1. Strength and spacing of supports, and manner of stacking shall produce no noticeable distortion in poles.

Construction hooks, tongs, or other sharp tools shall not be used on the treated portion of poles. Do not use pointed tools capable of producing indentations of more than 1 inch in depth. Nails and holes are not permitted in the top of poles.

Cable Inspection: Upon delivery to construction site, cable and reels shall be inspected for shipping damage such as:

Marks caused by improper lifting equipment or techniques.

Breaks or cuts in outer covering.

Damaged jacket or insulation.

Reel damage from mishandling.

Cable Testing: Upon delivery to construction site and prior to installation, Construction General Contractor shall perform DC over-potential tests on new cable.

Cable Reel Storage:

Reels shall be stored with flanges resting on hard surface or pallets to prevent sinking into the ground.

Reel flanges shall not touch cable on other reels.

Reels shall not be stored on their sides; they shall be stored with reel axis horizontal.

Cable ends shall be taped or capped to prevent entrance of moisture.

Material stored at construction site shall be located to prevent damage from weather and adjacent construction operations.

Cable Reel Handling:

Slings and forklifts shall not contact cable or protective covering.

A spreader bar shall be used when lifting reel with bar and sling.

Reels shall not be dropped.

PART 2--PRODUCTS

MATERIAL AND EQUIPMENT:

Consider materials specified herein or shown on Drawings which are identical to materials listed in RUS 202-1 as conforming to requirements.

WOOD POLE:

Machine trimmed by turning western red cedar, cut from live timber in accordance with ANSI O5.1.

Poles shall be butt-treated by manufacturer in accordance with AWPA C7, using AWPA P8 and P9 preservatives.

Each pole shall be given single top cut at 30-degree angle with normal to axis of pole and at right angles to sweep. Gains shall be cut so roof will be at right angles to line and sweep of pole will be in line. Roofs and gains shall be brush-treated by manufacturer with specified preservative. Each gain shall fit crossarm tightly. Boltholes shall not be more than 1/16 inch oversize.

Quality of each pole shall be ensured with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

WOOD CROSSARM:

Conform to RUS 1728H-701. Straight-gained Douglas fir, free from twists to within 0.1 inch per foot length, with bends and twists in one direction.

Pressure treat crossarms with pentachlorophenol, chromated copper arsenate (CCA), or ammoniacal copper arsenite (ACA).

Treatment shall conform to AWPA C25.

Crossarm Braces: Provide flat steel or steel angle as indicated.

HARDWARE:

Hot-dip galvanized, conforming to ASTM A153/A153M.

INSULATOR:

Provide wet-process porcelain insulators, which are radio interference free.

Line Post Type Insulators: ANSI C29.7, Class 4.

Suspension Insulators: ANSI C29.2, Quantity one per cable connection assembly, Class 4.

Spool Insulators: ANSI C29.3, Class 53-2.

Guy Strain Insulators: Porcelain, ANSI C29.4, Class 4, except provide fiberglass type when used with underground terminal or when other interference problems exist.

Pin Insulators: ANSI C29.5.

OVERHEAD CONDUCTOR:

Conductor of bare copper, ASTM B1, ASTM B2, and ASTM B3, hard-drawn, medium-hard-drawn, and soft-drawn, ASTM B8, stranded, aluminum conductor steel reinforced (ACSR), ASTM B232/B232M, of size and type indicated.

GUYS:

Guy Strands: ASTM A475, extra-high strength, Class A or B, galvanized strand steel cable. Guy strand shall be 3/8 inch in diameter with ultimate breaking strength as shown on the Drawings. Provide guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

Round Guy Guard: Vinyl or PVC material, yellow colored, 8-feet long, and shatter resistant at sub-zero temperatures.

Guy Attachment: Thimble eye.

ANCHOR AND ANCHOR ROD:

Anchor shall be concrete cone anchor presenting holding area indicated on Drawings as a minimum. Anchor rod shall be twin thimble-eye, 3/4-inch diameter by 9-feet long. Anchor and anchor rod shall be hot-dip galvanized.

GROUNDING:

Rod:

Copper clad steel at least 3/4 inch in diameter and 10 feet long.

Hard, clean, smooth, continuous, surface throughout length of rod.

Die-stamp each near top with name or trademark of manufacturer and length of rod in feet.

Wire:

Soft drawn copper wire ground conductor, minimum No. 4 AWG.

Ground wire protector may be either PVC or half round wood molding. Wood molding shall be fir, pressure treated in accordance with AWPA C25, or shall be cypress or cedar.

SURGE ARRESTOR:

IEEE C62.11, metal oxide, porcelain housed, surge arrestor arranged for equipment mounting. RMS voltage rating shall be 18 kV. Arrestor shall be Heavy-Duty Distribution class.

FUSED CUTOUT:

Nonloadbreak open type construction rated 100 amperes, 15 kV, 110 kV BIL, with a minimum 10,000 amperes symmetrical interrupting rating conforming to ANSI C37.42.

Fuses shall be of "6T" Link type, size as specified by Fluor Hanford Electric Utility (FHEU). Fuse cutouts shall be equipped with mounting brackets suitable for the indicated installations.

CONDUIT RISER AND CONDUCTOR:

Rigid galvanized steel conduit conforming to UL 6. Provide conductors (600 volts and above) as specified in Section 16120, CONDUCTORS.

Porcelain Insulator Type Terminator:

Comply with requirements of IEEE 48, Class 1, except that requirements of design tightness test need not be met.

Shall not exude any insulating filler compound under either test or service.

Consist of porcelain insulator, copper cable connector-hoodnut assembly and copper aerial lug as required, metal body and supporting bracket, sealed cable entrance, internal stress relief device for shielded cable, and insulating filler compound or material.

ELECTRICAL TAPES:

Tapes shall be UL listed for electrical insulation and other purposes in wire and cable splices. Termination, repair, and miscellaneous purpose electrical tapes shall comply with UL 510.

CAULKING COMPOUND:

Compound for Sealing Conduit Risers:

Puttylike consistency, workable with hands at temperatures as low as 35 degrees F.

Shall not slump at 300 degrees F and shall not harden materially when exposed to air.

Shall readily caulk or adhere to clean surfaces of material with which it is designed to be used.

Shall have no injurious effects upon workmen or upon materials.

PART 3--EXECUTION

INSTALLATION:

General: Provide overhead pole line installation conforming to requirements of ANSI C2 for Grade C construction of overhead lines in medium loading districts and NFPA 70 for overhead services. Consider street, alleys, roads and drives "public." Pole configuration shall be as indicated on Drawings.

Pole Setting: Provide pole holes at least as large at top as at bottom and large enough to provide 4 inch clearance between pole and side of hole.

Setting Depth of Pole:

Pole Setting Depths

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
20	5.0	3.0
25	5.5	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0

Setting in Soil, Sand, and Gravel: Applying where the following occurs:

Where pole holes are in soil, sand, or gravel or any combination of these.

Where soil layer over solid rock is more than 2 feet deep.

Where hole in solid rock is not substantially vertical.

Where diameter of hole at surface of rock exceeds twice the diameter of pole at same level. At corners, dead ends, and other points of extra strain, poles 40 feet or more long shall be set 6 inches deeper.

Backfill: Thoroughly tamp pole backfill for full depth of hole and mound excess fill around pole.

Setting Poles: Set poles so that alternate crossarm gains face in opposite directions, except at terminals and dead ends where gains of last two poles shall be on side facing terminal or dead end. On unusually long spans, set poles so that crossarm comes on side of pole away from long span. Where pole top pins are used, they shall be on opposite side of pole from gain, with flat side against pole.

Alignment of Poles: Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against strain. Set not less than 2 inches for each 10 feet of pole length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at required tension. When average ground run is level, consecutive poles shall not vary more than 5 feet in height. When ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid highest and lowest ground points. If it becomes necessary to shorten pole, a piece shall be sawed off top and shall be treated and capped. Holes shall be dug large enough to permit proper use of tampers to full depth of hole.

Pole Cap: Provide plastic pole caps with 1/4-inch sealing rings and 4 nailing tabs. Fill sealing area with either a bituminous, elastigum roof cement, or an acceptable preservative paste to level of sealing ring to eliminate possibility of condensation. Place on pole top and nail each tab down with 1-1/4-inch nail. Pole caps are not necessary for ACA/CCA treated poles, unless they are shortened.

Cutting of Wood Poles: Where new gains or holes are required, paint gains with preservative compound as recommended by the pole manufacturer. Plug unused or abandoned holes using treated wood dowel pins.

Do not cut the tops of wood poles, except under very exceptional conditions, and only upon approval of Construction Manager. If cutting is deemed necessary, pole top shall be capped. Do not cut butt of wood poles.

Anchor and Guy: Place anchor in line with strain. Length of guy lead (distance from base of pole to top of anchor rod) shall be as indicated.

Setting Anchor: Set anchor in-place with anchor rod aligned with, and pointing directly at, guy attachment on pole with anchor rod projecting 6 to 9 inches out of ground to prevent burial of rod eye.

Setting Guy Strand:

Complete anchor and guy installation, dead end to dead end, and tighten guy before wire stringing and sagging is begun on that line section.

Provide strain insulator at a point on guy strand 8 feet, minimum, from ground and 6 feet, minimum, from surface of pole.

Hardware: Provide hardware with washer against wood and with nut and lock nut applied wrench tight. Provide locknut on threaded hardware connection. Locknut shall be M-F style and not palnut style.

Grounding:

Conform to ANSI C2. Ground fused switches and lightning arrestors. Bond together pole line hardware separated by less than 2 inches.

Ground Rod Connection:

On pole lines by exothermic weld or by using compression connector for ground wire or wire to rod connection.

Exothermic welds strictly in accordance with manufacturer's written recommendations.

Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable.

No mechanical connectors are required at exothermic weldments.

Compression connector shall be type that uses hydraulic compression tool to provide correct pressure.

Provide tools and dies recommended by compression connector manufacturer.

Embossing die code or similar method shall provide visible indication that connector has been fully compressed on ground wire.

Grounding and Grounded Connections:

Where no primary or common neutral exists, surge arrestors and frames of equipment operating at over 750 volts shall be bonded together and connected to a dedicated grounding electrode.

Where no primary or common neutral exists, transformer secondary neutral bushing, secondary neutral conductor, and frames of equipment operating at under 750 volts shall be bonded together and connected to a dedicated grounding electrode.

When a primary or common neutral exists, connect all grounding and grounded conductors to common grounding electrode.

Protective Molding: Protect grounding conductors that are run on surface of wood poles by wood molding or plastic molding of equal mechanical strength extending from ground line throughout communication and transformer spaces.

Conductors: Prevent nicking, kinking, gouging, flattening, or otherwise deforming or weakening conductor or impairing its conductivity. Remove damaged sections of conductor and splice conductor.

Splices: Conductor splices, as installed, shall exceed ultimate rated strength of conductor and shall be of type recommended by conductor manufacturer. No splice shall be permitted within 10 feet of a support.

Ties: Provide ties on pin insulators tight against conductor and insulator and ends turned down flat against conductor so that no wire ends project.

Reinstalling: Existing conductors to be reinstalled or resagged shall be strung to "final" sag table values indicated for particular conductor type and size involved.

New Installation: String new conductors to "initial" sag table values indicated for conductor type and size of conductor and ruling span indicated.

Aluminum Protection: Protect ACSR conductors by armor rod at pin insulators and by flat aluminum wire at attachments made of galvanized or coated iron or steel.

Fittings: Dead end fittings, clamp or compression type, shall conform to written recommendations of conductor manufacturer and shall develop full ultimate strength of conductor.

Aluminum Connections: To copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose.

Riser: Secure conduit on pole by two hole galvanized steel pipe straps spaced no more than 10 feet apart and within 3 feet of any outlet or termination. Ground metallic conduit.

CONSTRUCTION QUALITY CONTROL:

Wood Crossarm Inspection: Furnish inspection report from independent inspection agency, approved by the Tank Farm Contractor, stating that offered products comply with applicable AWPA and RUS standards. The RUS approved Quality Mark "WQC" on each crossarm will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

Acceptance Checks and Tests:

Notify Fluor Hanford Electrical Utility (FHEU) 5 working days prior to start of checking and testing. FHEU will test 15 kV cables and transformers.

Perform in accordance with manufacturer's recommendations and include the following visual and mechanical inspections, and electrical tests, performed in accordance with NETA ATS.

Grounding System:

Visual and Mechanical Inspection: Inspect ground system for compliance with Drawings and Specifications.

Electrical Tests: Perform ground-impedance measurements utilizing fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of single ground rod, perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. Instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate ground value of ground rod or grounding systems under test.

Report:

Before energizing electrical equipment, submit the measured ground resistance of grounding system.

Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at time measurements were made.

Devices Subject to Manual Operation: Operate at least three times, demonstrating satisfactory operation each time.

Follow-Up Verification: Upon completion of acceptance checks and tests, show, by demonstration in service, that circuits and devices are in operating condition and properly performing intended function.

END OF SECTION 16312

SECTION 16440--LOW VOLTAGE MOTOR CONTROL

PART 1--GENERAL

UL COMPLIANCE:

Products manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL Listing Mark.

APPROVAL BY AUTHORITY HAVING JURISDICTION (AHJ):

As specified in Section 16005, ELECTRICAL.

ELECTRICAL DESCRIPTION OF WORK:

Provide the following 480-volt, three-phase, four-wire with ground, 600-amp service rated motor control centers in accordance with this Specification and Contract Drawings:

219A-LH-MCC-001 to be installed inside the Cell No. 1 Crest Pad Building 219A.

219E-LH-MCC-001 to be installed inside the Cell No. 2 Crest Pad Building 219E.

MCC(s) shall be provided with the following minimum features in accordance with this Specification and Contract Drawings:

Main Incoming Service Breaker, with service neutral terminal connection in main breaker section only.

Portable Generator Power Outlet Feeder Breaker and Kirk Key (ed) arrangement with main incoming service breaker.

Phase Loss and Reversal Protection Relay and Alarm Lighting.

Transient Voltage Surge Suppressor (TVSS).

Volt and Current Meters and Selector Switches.

Lighting Panel.

Lighting Panel Transformer.

NEMA 1 Size Motor Starters (incorporating: breaker, control power transformer, fuses, contactor, overloads, indicators, control switches, elapsed time meter, terminal strips, wiring, and locking mechanism).

NEMA Feeder Breakers.

Three Sections.

Time Delay and Magnetic Control Relays.

Interlocking control relays, terminals, and lining assembled together in unit compartment.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Product Data:

Itemized bill-of-material.

Descriptive information.

Dimensional drawings.

Conduit entrance locations.

Bus data.

Protective Devices: Copies of time-current characteristics.

Operational description.

Anchoring instructions and details.

Typed Tabulation:

Motor name; tag (equipment) numbers as shown on Drawings.

Motor horsepower.

Nameplate full load current.

Measured load current and voltage.

Heater catalog number.

Protective device trip settings.

Attach above typed, tabulated data to a copy of starter manufacturer's overload selection tables for the starters provided.

Control Diagrams:

NEMA ICS 2, Section 322.08 Type I.

Wiring Type B.

In addition to standard NEMA control diagrams, provide the following:

Remote control devices.

Remote indication and/or pilot lights.

Interconnections and interlocking circuits between starter and remote equipment.

Remote sensors.

Tag numbers associated with all control devices and equipment.

One-line diagrams.

Schematic (elementary) diagrams.

Outline diagrams.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Manufacturer's installation instructions.

Operation and maintenance data.

Submit documentation and test results for construction quality control testing.

PACKING AND SHIPPING:

Shipping Splits: Established by Construction Subcontractor to facilitate ingress of equipment to final installation location within the building.

PART 2--PRODUCTS (Reference Section 16005, ELECTRICAL)

MANUFACTURERS:

Square D.

Cutler-Hammer.

General Electric.

Allen-Bradley.

MOTOR CONTROL:

General:

Like Items of Equipment: End product and responsibility of one manufacturer.

Make adjustments as necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

Controllers: NEMA ICS 2, Class B.

Electronic Overload Protection:

Programmable solid-state electronic overload relay with integral CT(s) for monitoring three-phase current and voltage, thereby providing motor overload, phase reversal and phase loss protection. In the event of an alarm condition, electronic overload relay will de-energize fail safe alarm contact to motor control circuit.

Ratings:

Voltage Range (L1, L2-L3): 480 volts 50/60 Hz.

Current Range: Specific range compatible with motor FLA operation.

Power Consumption: 10 watts.

Trip Circuit: Form C SPDT (N.O and N.C) contacts, 5 amps 120 volts.

Measurements: Voltage, current, and timing.

Relay Trip: Standard Class 20.

Manual Reset.

Mount within starter unit.

Manufacturer:

Square D.

Allen-Bradley.

General Electric.

Cutler-Hammer.

Control Transformer:

Two winding, 120-volt secondary, primary voltage to suit.

Two current-limiting fuses for primary circuit.

One fuse in secondary circuit.

Mount within starter unit.

Suitable for use with 75 degrees C copper wire at full NFPA 70, 75 degrees C ampacity.

Lifting lugs on all equipment and devices weighing over 100 pounds.

Operating Conditions:

Ambient Temperature: Maximum 40 degrees C.

Equipment to be fully rated without any derating for operating conditions listed in Section 16005, ELECTRICAL.

Enclosures: In accordance with NEMA 250 and ANSI C57.12.28.

Equipment Finish:

Electrocoating process applied over a rust-inhibiting phosphated base coating.

Exterior Color: Manufacturer's standard.

Manually Operated Starter, Fractional Horsepower:

Rating: 16 amperes continuous at 277 volts maximum, or horsepower rated for the voltage and horsepower of the load served.

Single-phase, nonreversing, full voltage with overload protection.

Toggle operated.

Enclosure: Reference Section 16005, ELECTRICAL, Article ENVIRONMENTAL CONDITIONS.

Pilot LED Light: Red.

Handle guard/lock-off attachment.

Combination Full-Voltage, Magnetic Starter:

Rating: Hp rated at 600 volts, UL labeled for 42,000 amperes fault current withstand capacity with overload protection.

Three-phase, nonreversing, full voltage.

Control: HAND/OFF/AUTO selector switch.

Disconnect Type: Motor circuit protector.

Enclosure: Reference Section 16005, ELECTRICAL, Article ENVIRONMENTAL CONDITIONS.

Pilot LED Lights: Red—ON and Green—OFF.

Padlockable operating handle.

KIRK KEY INTERLOCKS:

Provide Kirk Key interlocks for one main and one portable generator plug breaker arrangement in each MCC.

Provide engraved plate on MCC which describes Kirk Key breaker arrangement and operation as described herein.

Operation:

One unique key available for MCC main and portable generator breaker locks (i.e., Kirk keys for additional MCC(s) shall not be identical).

One of the two breakers CLOSED at any one time.

Breaker must be opened before key can be removed and inserted.

Key must be inserted and operated before breaker can be CLOSED.

MOTOR CONTROL CENTERS:

General:

Motor Control Center to be manufactured and provided as a complete UL-approved assembly that includes the following major components specified under this section and Section 16005, ELECTRICAL:

Motor starters with electronic overload protection relays.

Feeder and main breakers.

Power monitoring.

Lighting and power distribution panelboard.

Lighting and power distribution stepdown transformer.

Transient Voltage Surge Suppressor (TVSS).

Interlocking control relays.

In accordance with NEMA ICS 2, UL 845, and UL 508/508A.

Voltage Rating: 600 volts.

Short Circuit Rating: 42,000 minimum amperes rms symmetrical for entire motor control center as a complete assembly.

All controllers, main and branch circuit breakers, wire connections, and other devices to be front mounted and accessible unless otherwise noted.

NEMA ICS 2, Section 322.08.

Class: I.

Type: B.

Wire remote control and signal circuits to separate terminal board in each motor starter compartment.

Enclosure:

Type: NEMA 250 Type 12 unless otherwise rated.

Vertical Section Dimensions: 90 inches high, 20 inches wide, 20 inches deep.

Construction:

Sheet steel reinforced with channel or angle irons.

Butt sections flush, end-to-end against similar section without bolts, nuts, or cover plates causing interference.

Removable top cover plates and bottom cover plates.

Section Mounting: Removable formed-steel channel sills and lifting angles to meet specified seismic requirements.

Horizontal Wiring Compartments: Accessible from front, full width, top and bottom.

Vertical Wiring Compartment: Full height, isolated from unit starters with separate door.

Unit Compartment: Individual compartments separated by steel barriers for each starter, feeder, or other unit capable of being wired from front without unit removal.

Compartment Doors: Separate hinged doors for each starter, feeder, or other unit.

Door Interlocking: Interlock starter and feeder doors mechanically so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access at any time.

External disconnect handles, padlockable in OFF position.

Cable Entrance: Incoming service enters from bottom; control and feeder circuits enter from top and bottom.

Bus:

Horizontal Power Bus:

Three-phase tin-plated, fully insulated, copper, entire width of control center, rated 600 amperes.

Construct to allow future extension of additional sections.

Pressure type solderless lugs for each incoming line cable.

Isolated from top horizontal wireway.

Provide Belleville washers on bus connection bolts.

Vertical Power Bus:

Three-phase tin-plated, fully insulated, copper, full height of section, rated 300 amperes.

Sandwich type bus insulation providing deadfront construction with starter units removed except for bus stab openings.

Insulated and isolated barrier complete with shutters.

Provide Belleville washers on bus connection bolts.

Neutral Bus: 50 percent neutral, copper-tin-plated main breaker section only.

Ground Bus:

Copper, tin-plated, 33 percent minimum of phase bus ampacity, entire width of control center.

Provide Belleville washers on bus connection bolts.

Bus Bracing: 42,000 minimum amperes rms symmetrical.

Motor Controller Unit:

Provide indicated individual components and control devices including pushbuttons, selector switches, indicating lights, control relays, time delay relays, and elapsed time meters as specified in this section.

Construction:

Drawout combination type with stab connections for starters NEMA ICS, Size 4 and smaller.

Readily interchangeable with starters of similar size.

Pull-apart unit control wiring terminal boards on all units.

Starters:

NEMA ICS 2, Section 322.08 standard rating, except none smaller than NEMA ICS, Size 1.

Rating: Hp rated at 600 volts, UL labeled for 42,000 amperes fault current withstand capacity with overload protection.

Three-phase, nonreversing.

Disconnect Type: Thermal magnetic as shown. Motor circuit protector may be substituted, properly sized and adjusted.

Combination Full Voltage, Magnetic Starter:

Control: ON/OFF/AUTO selector switch. As shown.

Pilot LED Lights: Red—ON; Green—OFF.

Padlockable operating handle when de-energized.

Unit door interlocked to prevent opening when disconnect is in closed position.

Mechanical interlocked to prevent placing disconnect in ON position when unit door is open.

Minimum Dimensions: 12 inches high by full section width, less vertical wireway.

Disconnecting Device:

In each starter, control circuit disconnect to de-energize circuits in unit which are not de-energized by starter power disconnect device.

Padlockable in OPEN position.

Circuit Breaker:

Meeting the requirements of NEMA AB1 and UL 489.

Molded case with manufacturer's recommended trip setting for maximum motor protection.

Thermal-magnetic trip or magnetic trip only as shown.

Tripping indicated by operating-handle position.

Interrupting capacity required for connection to system with short circuit capacity indicated.

Motor Overload, Phase Reversal and Loss Protection:

Programmable solid-state electronic overload relay with internal CTs for monitoring three-phase current and voltage, thereby providing motor overload, phase reversal, and phase loss protection.

Make overload adjustments based upon motor FLA.

Make voltage adjustments based upon incoming voltage nominal readings.

Control Unit:

Disconnecting Device: Capable of de-energizing external source control circuits in unit.

Control Devices: As indicated and as specified in Section 16005, ELECTRICAL.

Control Wiring:

Minimum wire size No. 14 AWG copper.

Permanent sleeve type markers with wire numbers applied to each end of wires.

Terminate current transformer leads on shorting type terminal blocks.

Feeder Unit and Main Protective Device:

Construction: As specified in paragraph Motor Controller Unit.

Incoming Service Feeder: Cable entering section at bottom.

Molded Case Circuit Breaker:

In accordance with NEMA AB1 and UL 489.

Main, feeder, and motor protective device.

UL labeled as suitable for service entrance.

Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.

Indicate tripping by operating-handle position.

Suitable for use with 75 degrees C copper wire at full NEC 75 degrees C ampacity.

Reset Timer:

Timing Method: Solid state with LCD display.

Mounting: Semi-flush, panel.

Contacts: 5-amp, 120-volt.

Manufacturers and Products:

Square D.

Cutler-Hammer.

General Electric.

Magnetic Contactor:

UL listed.

Electrically operated, electrically held.

Main Contacts:

NEMA B600 contacts.

Electrically held.

Silver alloy with wiping action and arc quenchers.

NEMA Size 0 or 1 as required for the motor controller.

Three-pole.

Control: Two-wire.

One normally open and one normally closed auxiliary contact rated 10 amperes at 480 volts.

Manufacturers and Products:

Allen-Bradley.

Square D Co.; Type F.

Cutler-Hammer.

Pushbutton, Indicating Light and Selector Switches:

Contact Rating: NEMA ICS 2, Type A600.

Selector Switch Operating Lever: Standard.

Indicating Lights: Push-to-test, LED, full voltage.

Pushbutton Color:

ON or START: Black.

OFF or STOP: Red.

Pushbuttons and selector switches lockable in OFF position where indicated.

Legend Plate:

Material: Aluminum.

Engraving: 11 characters/spaces on one line, 14 characters/spaces on each of two lines, as required, indicating specific function.

Letter Height: 7/64 inch.

Manufacturers:

Square D Co.

Cutler-Hammer.

General Electric.

Allen-Bradley.

Nameplates:

Provide nameplates per Hanford standards.

Laminated plastic; white, engraved to black core.

Provide for each motor control center and each unit.

Engrave with inscription shown on single-line diagram.

Provide blank nameplates on spaces for future units.

Attach with stainless steel panhead screws on face of control center.

Factory Testing: NEMA ICS 1, Section 109, or UL 486A if not specified by the manufacturer.

PART 3--EXECUTION

INSTALLATION:

Install equipment in accordance with NEMA ICS 2.3, Submittal Drawings, and Manufacturer's Instructions and Recommendations.

Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions. Reference Section 13122, METAL BUILDING SYSTEMS, Part 2, Article DESIGN LOADS, for information on seismic loading. Install suitable braces from MCC to building structural members for seismic support.

Install equipment plumb and in longitudinal alignment with pad or wall.

Coordinate terminal connections with installation of secondary feeders.

Grout mounting channels into floor or mounting pads.

Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

CIRCUIT BREAKERS (MAGNETIC-TRIP-ONLY):

Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.

Adjust to approximately 11 times motor rated current in accordance with NEC 430-52.

Determine motor rated current from motor nameplate following installation.

OVERLOAD RELAY:

Select and install overload relay settings after the actual nameplate full-load current rating of motor has been determined.

MOTOR DATA:

Provide typed, self-adhesive label attached outside each motor starter enclosure door displaying the following information with plastic black and white lettering, minimum 1/2-inch size:

Motor served by tag number and equipment name.

Nameplate horsepower.

Motor code letter.

Full load amperes.

Service factor.

Installed overload relay heater catalog number.

CONSTRUCTION QUALITY CONTROL:

In accordance with Section 16080, ELECTRICAL TESTING.

MANUFACTURER'S SERVICES:

Furnish manufacturer's representative in accordance with Section 01640, MANUFACTURERS' SERVICES, for the following services at jobsite for minimum person-days listed below, travel time excluded:

1 person-day for installation assistance, and inspection of installation.

1 person-day for functional and performance testing.

END OF SECTION 16440

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 5.0 **Groundwater Monitoring for Land Based Units**

Figures

Tables

5.0 GROUNDWATER MONITORING FOR LAND BASED UNITS [D-10]

The IDF will be a RCRA-compliant landfill (i.e., a double-lined trench with leachate collection system). This chapter describes the groundwater monitoring plan for the IDF and addresses the requirements of RCRA, as described in 40 CFR 264, Subpart F, by reference of WAC 173-303-645(3). Figure 5-1 shows the location of the IDF and surrounding groundwater wells in the 200 East Area. This chapter is designed to meet final status detection-level groundwater monitoring requirements for the IDF. This groundwater monitoring plan is based on the application of a modified data quality objectives (EPA QA/G-4) process to a conceptual model, and the most recent evaluations of groundwater hydrology and chemistry at the site.

This plan describes the characteristics of the waste to be disposed in the IDF and the site geology and hydrology used to design and operate the monitoring well network and to interpret the groundwater data. The historic groundwater chemistry from wells near the IDF site is provided. Much of the information pertaining to waste characterization is taken from HNF-4921 and that pertaining to hydrogeology from PNNL-11957, PNNL-12257, PNNL-13652, and PNNL-14029.

The plan includes a description of network well locations, well construction, sample constituents, and sampling frequency for detection-level groundwater monitoring. Procedures for determination of compliance point groundwater quality also are included. Finally, this plan provides the basis for rapid development of a compliance-monitoring plan if a validated exceedance of an indicator parameter is found. This plan controls initial baseline monitoring and subsequent detection level monitoring only for the IDF.

Source, special nuclear, and byproduct materials as defined by the *Atomic Energy Act of 1954*, as amended, are regulated at DOE facilities exclusively by DOE acting pursuant to its AEA authority. These materials are not subject to regulation by the State of Washington. All information contained herein and related to, or describing AEA-regulated materials and processes in any manner, may not be used to create conditions or other restrictions set forth in any permit, license, order, or any other enforceable instrument. DOE asserts that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear and by-product materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

5.1 EXEMPTION FROM GROUNDWATER PROTECTION REQUIREMENT [D-10a]

An exemption is not requested.

5.2 INTERIM STATUS PERIOD GROUNDWATER MONITORING DATA [D-10b]

The IDF will be a new facility constructed in the 200 East Area. Interim status groundwater monitoring is not applicable.

5.3 AQUIFER IDENTIFICATION [D-10c]

The following sections discuss geology and hydrology.

5.3.1 Geology of the IDF Site

The 200 East Area lies on the Cold Creek bar, a geomorphic remnant of the cataclysmic, glacial related floods of the Pleistocene Epoch. As the floodwaters raced across the lowlands of the Pasco Basin and Hanford Site, floodwaters lost energy and began to deposit sand and gravel. The 200 Area Plateau is one of the most prominent deposits. The 200 Area Plateau lies just southwest of one of the major flood channels across the Hanford Site that forms the topographic lowland south of Gable Mountain.

Borehole data provide the principal source of geologic, hydrologic, and groundwater information for the 200 East Area and the IDF site. Numerous boreholes (both vadose zone boreholes and groundwater monitoring wells) have been drilled in the 200 East Area for groundwater monitoring and waste management studies (Figure 5-1 shows the location of groundwater wells near the IDF site.) However, data are limited within the IDF site primarily because no previous construction or waste disposal activities have occurred in this part of the Hanford Facility. Most boreholes in the 200 East Area have been drilled using the cable tool method and either a hard tool or drive barrel to advance the hole. Some boreholes have been drilled by rotary and wire-line coring methods. More recently, boreholes in the area have been drilled, and in five cases cored, by percussion hammer methods. Geologic logs are based on examination of drill core, chips, and cuttings from these boreholes. Chip samples typically are taken at 1.5-meter intervals and routinely archived at the Hanford Geotechnical Sample Library.

5.3.1.1 Structural Framework

The IDF site will be located south of the Gable Mountain segment of the Umtanum Ridge anticline and about 3 kilometers north of the axis of the Cold Creek syncline, which controls the structural grain of the basalt bedrock and the Ringold Formation. The basalt surface and Ringold Formation trend roughly southeast-northwest parallel to the major geologic structures of the site. As a result, the Ringold Formation and the underlying Columbia River Basalt Group gently dip to the south off the Umtanum Ridge anticline into the Cold Creek syncline.

Geologic mapping on the Hanford Site and examination of drill core and borehole cuttings in the area have not identified any faults in the vicinity of the IDF site (DOE/RW-0164). The closest known faults are along the Umtanum Ridge-Gable Mountain structure north of the disposal site and the May Junction fault east of the site (Figure 5-2).

5.3.1.2 Stratigraphy

The basalt and post-basalt stratigraphy for the IDF site is shown in Figure 5-3. Approximately 137 to 167 meters of suprabasalt sediments overlie the basalt bedrock at the site.

Basalt Bedrock. Previous studies (RHO-BWI-ST-14; Reidel and Fecht 1994) have shown that the youngest lava flows of the Columbia River Basalt Group at the 200 East Area are those of the 10.5 million-year old Elephant Mountain Member. This member underlies the entire 200 East Area and surrounding area and forms the base of the suprabasalts aquifer. No erosional windows in the basalt are known or suspected to occur in the area of the IDF site.

Ringold Formation. Few boreholes penetrate the entire Ringold Formation at the IDF site so available data are limited. The Ringold Formation reaches a maximum thickness of 95 meters on the west side of the site and thins eastward. The member of Wooded Island (Figure 5-3) is the only member of the Ringold Formation in the 200 East Area. The deepest Ringold Formation unit encountered is the lower gravel, unit A. Lying above unit A is the lower mud unit and overlying the lower mud unit is upper gravel, unit E. The sand and silt units of the members of Taylor Flat and Savage Island of the Ringold Formation are not present at the IDF site. Unit A and unit E are equivalent to the Pliocene-Miocene continental conglomerates (Reidel and Fecht 1994). The lower mud unit is equivalent to the Pliocene-Miocene continental sand, silt, and clay beds (Reidel and Fecht 1994).

Only three boreholes have penetrated unit A in the area of the IDF site. Unit A is 19 meters thick on the west side of the site and thins to the northeast. Unit A is partly to well-cemented conglomerate consisting of both felsic and basaltic clasts in a sandy matrix and is interpreted as a fluvial gravel facies (Lindsey 1996). There are minor beds of yellow to white interbedded sand and silt. Green-colored, reduced-iron stain is present on some grains and pebbles. Although the entire unit appears to be cemented, the zone produced abundant high-quality water in borehole 299-E17-21 (PNNL-11957).

Nineteen meters of the lower mud unit were encountered in one borehole at the IDF site (PNNL-11957). The upper most 1 meter or so consists of a yellow mud to sandy mud. The yellow mud grades downward into about 10 meters of blue mud. The blue mud, in turn, grades down into 7 meters of brown mud with organic rich zones and occasional wood fragments. The lower mud unit is absent in the center of the site (northeast of borehole 299-E24-7 on Figure 5-4).

Unit E is described as a sandy gravel to gravelly sand. Unit E is interpreted to consist of as much as 15 meters of conglomerate with scattered large pebbles and cobbles up to 25 centimeters in size in a sandy matrix. The gravel consists of both felsic and basaltic rocks that are well rounded with a sand matrix supporting the cobbles and pebbles. Cementation of this unit ranges from slight to moderate. The upper contact of unit E is not identified easily at the IDF site. In the western part of the study area, unconsolidated gravels of the Hanford formation directly overly the Ringold Formation unit E gravels, making exact placement of the contact difficult. The dominance of basalt and the absence of cementation in the Hanford formation are the key criteria used to distinguishing these here (PNNL-11957). In the central and northeast part of the area, unit E has been eroded completely. Unconsolidated gravels and sands typical of the Hanford formation replace unit E.

Unconformity at the Top of the Ringold Formation. The surface of the Ringold Formation is irregular in the area of the IDF site. A northwest-southeast trending erosional channel or trough (the Columbia River/Missoula flood channel) is centered through the northeast portion of the site. The trough is deepest near borehole 299-E24-21 in the northern part of the site (PNNL-13652). This trough is interpreted as part of a larger trough under the 200 East Area resulting from scouring by the Missoula floods. Borehole 299-E17-21, located at the southwest corner of the IDF site, is at the west side of the channel where approximately 46 meters of Ringold Formation have been removed and replaced by Hanford formation gravels. Boreholes 299-E17-25 and 299-E17-23, located along the southeastern edge of the Site, are near the deepest portion of the channel where it is interpreted that almost all of the Ringold Formation has been eroded. At this location the water table in the channel is interpreted to be 52 meters above the basalt, which forms the floor of the channel. The surface of basalt rises to the north where the water table is approximately 27 meters above the basalt at the northeast corner of the site near borehole 299-E24-21.

Hanford formation. The Hanford formation is as much as 116 meters thick in and around the IDF site. The Hanford formation thickens in the erosional channel cut into the Ringold Formation and thins to the southwest along the margin of the channel.

At the IDF site, the Hanford formation consists mainly of sand dominated facies with lesser amounts of silt dominated and gravel dominated facies. The Hanford formation has been described as poorly sorted pebble to boulder gravel and fine- to coarse-grained sand, with lesser amounts of interstitial and interbedded silt and clay. In previous studies of the site (WHC-MR-0391), the Hanford formation was described as consisting of three units: an upper and lower gravel facies and a sand facies between the two gravelly units. The upper gravel dominated facies appears to be thin or absent in the immediate area of the IDF site (PNNL-12257, PNNL-13652, and PNNL-14029).

The lowermost part of the Hanford formation encountered in boreholes at the IDF site consists of the gravel dominated facies. Drill core and cuttings from boreholes 299-E17-21, 299-E17-22, 299-E17-23, 299-E17-25, and 299-E24-21 indicate that the unit is a clast-supported pebble- to cobble-gravel with minor amounts of sand in the matrix. The cobbles and pebbles almost are exclusively basalt with no cementation. This unit pinches out west of the IDF site and thickens to the east and northeast (Figure 5-4). The water table beneath the IDF site is located in the lower gravel unit. The lower gravel unit is interpreted to be Missoula flood gravels deposited in the erosional channel carved into the underlying Ringold Formation.

The upper portion of the Hanford formation consists of at least 73 meters of fine- to coarse-grained sand with minor amounts of silt and clay and some gravelly sands.

Holocene Deposits. Holocene, eolian deposits cover the southern part of the IDF site. Caliche coatings on the bottom of pebbles and cobbles in drill cores through this unit are typical of Holocene caliche development in the Columbia Basin. The southern part of the IDF site is capped by a stabilized sand dune. The eolian unit is composed of fine- to coarse-grained sands with abundant silt, as layers and as material mixed with the sand.

Clastic Dikes. A clastic dike was encountered in borehole C3828, adjacent to well 299-E17-25, at the IDF site. Clastic dikes also have been observed in excavations surrounding the site [e.g., US Ecology, the former Grout area, the 216-BC cribs, the Central Landfill, and the Environmental Restoration Disposal Facility (BHI-01103)]. In undisturbed areas, such as the IDF site, clastic dikes typically are not observed because these are covered by wind blown sediments. The occurrence of a clastic dike in borehole C3828 suggests that these probably are present elsewhere in the subsurface at the disposal site. The IDF excavation will be geologically mapped to document the occurrence of any clastic dikes that may exist at the site.

5.3.2 Groundwater Hydrology

The unconfined aquifer under the IDF site occurs in the fluvial gravels of the Ringold Formation and flood deposits of the Hanford formation. The thickness of the aquifer ranges from about 70 meters at the southwest corner of the site to about 30 meters under the northeast corner of the IDF site. The Elephant Mountain Member of the Columbia River Basalt Group forms the base of the unconfined aquifer (Figure 5-4).

The unsaturated zone beneath the land surface at the IDF site is approximately 100 meters thick and consists of the Hanford formation. The water level in boreholes in and around the site indicates that the water table is in the lower gravel sequence of the Hanford formation and at an elevation of approximately 123 meters above sea level. The water table is nearly flat beneath the IDF site. Table 5-1 gives water level information from wells near the site. The locations of the wells are shown on Figure 5-1. The latest water table map shows less than about 0.1 meter of hydraulic head differential across the IDF site (Figure 5-5).

The Ringold Formation lower mud unit occurs within the aquifer at the southwest corner of the IDF site (299-E17-21) but is absent in the central and northern parts of the site (299-E24-7 and 299-E24-21). The lower mud unit is known to be a confining or partly confining layer at places under the Hanford Site (PNNL-12261) and this might be the case under the southwest corner of the IDF site. Groundwater samples were collected and analyzed from above and below the lower mud unit during drilling of well 299-E17-21. Chemical parameters (pH, electrical conductivity, and Eh) were different in the two samples suggesting that the lower mud is at least partly confining in the area. No contamination was found above or below the lower mud. An interpretation of the distribution and thickness of this stratum is shown in Figure 5-4. The surface of the lower mud unit is interpreted to dip gently to the southwest (PNNL-13652).

Hydrographs for selected wells near the IDF site are shown in Figure 5-6. Although the water table is extremely flat in the area of the IDF, hydrographs suggest that groundwater flow has had an easterly component throughout the 1990s and has not significantly changed due to cessation of discharges to the 216 B pond system. Hydrographs for the older wells (299-E23-1, 299-E23-2, and 299-E24-7) show two maxima in the water level. These coincide with the operation of the PUREX Plant, which operated between 1956 and 1972 and between 1983 and 1988. All the hydrographs show a decline in the water table during recent years. The rate of decline is between 0.18 and 0.22 meter per year and will take between 10 and 30 years to stabilize. The reason for the decline is the cessation of effluent discharge to the 216-B Pond System, which is centered northeast of 200 East Area. Based on hindcast water table maps (BNWL-B-360), the water table is expected to decline another 2 to 7 meters before reaching pre-Hanford Site elevations. The cessations of effluent discharge also are responsible for changes in the direction of groundwater flow across much of the 200 East Area.

Groundwater flow beneath the IDF site recently was modeled to be southeasterly (PNNL-13400). This direction differs from the easterly direction predicted by the analysis of WHC-SD-WM-RPT-241 and other earlier reports. The southeasterly flow direction primarily is attributable to inclusion of the highly permeable Hanford formation sediments in the ancestral Columbia River/Missoula flood channel in the analysis. A southeasterly flow direction is reflected in the geographic distribution of the regional nitrate plume and in the distribution of other constituents under the south-central 200 East Area (PNNL-14187). As stated in PNNL-13404, the water table gradient is too low to be used for determining flow direction or flow rate at the PUREX Plant cribs immediately east of the IDF site.

Hydraulic conductivity directly beneath the IDF site was estimated from data collected during four slug tests at well 299-E17-21 and five slug tests of 299-E24-21. The interval tested at 299-E17-21 was the upper 7.8 m of the unconfined aquifer from 101.3 to 109.1 m depth. That portion of the aquifer is Hanford formation gravel from 101.3 to 102.1 m depth and Ringold Formation unit E gravels from 102.1 to 109.1 m depth (PNNL-11957). The interval tested at well 299-E24-21 was entirely in the Hanford formation gravel sequence between 95.2 and 101.3 m depth. The best-fit value to the data from 299-E17-21 indicated a hydraulic conductivity of about 68.6 meters per day (PNNL-11957) and from 299-E24-21 suggested a hydraulic conductivity of 75 meters per day (PNNL-13652).

5.4 CONTAMINANT PLUME DESCRIPTION [D-10d]

Although no groundwater monitoring has been done for the IDF, groundwater monitoring has been done in support of RCRA permitting activities and in support of other activities in the area. The results of that monitoring show that a regional nitrate plume exists beneath the IDF site (PNNL-14187). In the south-central 200 East Area, the plume extends in a northwest - southeast direction along the axis of the Columbia River/Missoula flood channel eroded into the Ringold Formation sediments. The channel is filled with more transmissive Hanford formation sediments.

5.4.1 Groundwater Contamination

Nitrate, associated with past-practice activities in 200 East Area, is a general groundwater chemistry parameter and is not a contaminant of concern for the IDF. However, the distribution of existing nitrate in the groundwater gives an indication of the general groundwater flow direction and the influence that adjacent sites might have on the IDF.

High nitrate concentrations found near liquid waste disposal facilities located outside the IDF site that received effluent from the PUREX Plant are decreasing steadily with time. The highest nitrate concentration found in 2002 was 170,000 μg/L in well 299-E17-9 at the 216-A-36B crib and the crib is thought to be the source of the nitrate. The drinking water standard for nitrate is 45,000 μg/L (nitrate ion).

Nitrate in well 299-E24-18, just inside the east boundary of the IDF site, decreased from a high of 86,300 μg/L in 1990 to a low of 17,000 μg/L in 1993, reflecting the cessation of PUREX Plant operations in 1988. Since 1993, nitrate has increased to 48,300 μg/L in 2003 (Figure 5-7). The reason for the increase is not understood. One possibility is related to changing groundwater flow direction. During PUREX Plant operations, flow direction was probably to the northwest because of effluent discharges to the B Pond System and PUREX Plant cribs, and nitrate contamination might have spread to the northwest during that period. Subsequently, liquid discharges to the B Pond System and PUREX Plant cribs have ceased and the flow direction in the area of the IDF site apparently has returned to the southeast direction. With that change, higher levels of nitrate-contaminated groundwater might be returning to the area from the northwest.

Except for an anomalous value of 82,600 µg/L in 1988, nitrate concentration in well 299-E24-7 was fairly steady and ranged between 12,800 and 35,400 µg/L between 1985 and 1996 when the well was last sampled (Figure 5-7). The last two measured values from 1995 and 1996 were 26,000 µg/L. Farther southwest, nitrate detected in 1998 in well 299-E17-21 in Ringold unit E was 23,600 µg/L.

5.4.2 Vadose Zone Contamination

Very little characterization and monitoring of the soil have been done at the IDF site because no major construction or waste disposal activities have occurred in this part of the Hanford Site. A pre-operational environmental monitoring plan (RPP-6877) for the disposal facility was issued in 2000. Implementation of that plan has begun and characterization activities will occur during the next few years. The pre-operational environmental monitoring plan has a strong emphasis on vadose zone characterization and deferred groundwater monitoring to this groundwater monitoring plan. Vadose zone information resulting from pre-operational monitoring will be included, if applicable, in updates to this groundwater monitoring plan.

The pre-operational monitoring plan identified three areas near the IDF site that might have had an influence on the vadose zone beneath the site. These are the 218-E-1 Burial Ground and an unplanned release associated with the burial ground; the coal ash pile in the northwest part of the site; and a transfer line along the northern part of the west boundary of the IDF site (RPP-6877). Work was outlined in the pre-operational monitoring plan to determine whether these three areas had introduced contamination to the site. Appropriate results from pre-operational monitoring will be incorporated into this groundwater monitoring plan as results become available and as revisions are needed.

In addition to these facilities, the 216-A-38-1, 216-A-45, and 216-A-10 cribs and the 299-E24-111 injection well are located east of the IDF site. The 216-A-38-1 crib never was used (DOE/RL-92-04). The 299-E24-111 injection well never received any waste (DOE/RL-92-04). The 216-A-45 and the 216-A 10 cribs both received large quantities of liquid waste (DOE/RL-92-04). Because these latter two facilities are more than 200 meters from the IDF site, it is unlikely these facilities have affected the soil beneath the IDF site. Data from the vadose zone in IDF wells drilled along the east side of the site support this.

5.5 DETECTION MONITORING PROGRAM [D-10e]

Because the IDF has not been constructed, no contaminants have been released to the ground or to the groundwater.

5.5.1 Indicator Parameters, Waste Constituents, Reaction Products to be Monitored [D-10e(1)]

Regulated Constituents

The regulated constituents for this groundwater monitoring plan are the constituents identified on the Part A Permit application included in Chapter 1 of this document.

Monitoring Parameters

The parameters to be routinely monitored are listed in Table 5.2. These parameters include the indicator parameters and supplemental parameters.

The indicator parameters will be used to monitor for hazardous constituents reaching the groundwater as a result of IDF operations. Only the indicator parameters are subject to the statistical methods described in Section 5.5.4.7. Total organic carbon and total organic halides are indicator parameters selected to monitor impacts of RCRA regulated organic constituents on the groundwater quality. Specific conductance is selected as an indicator parameter to monitor impacts of metals and anions on groundwater quality. pH is a general indicator of groundwater quality. Specific conductance and pH are measured in the field at the time of sampling. Chromium is included as an indicator parameter because hexavalent chromium is one of the more mobile of the regulated metals to be disposed of at the IDF and should be one of the first constituents to enter groundwater if the regulated facility impacts groundwater.

Analyses of alkalinity, anions, and metals are to provide supplemental data on general groundwater chemistry beneath the IDF. This information aids data interpretation and quality control. Supplemental parameters will not be used in statistical evaluations. Turbidity is analyzed at the well just before sampling and provides an indication of the groundwater condition at the time of sampling.

For the first year of monitoring, all parameters listed in Table 5-2 will be monitored twice each quarter to determine background concentrations. After the first year, indicator and supplemental parameters will be monitored semi-annually. In addition, field measurements of temperature and turbidity will be made at each sampling event.

During the first sampling event at each well for the first year of monitoring, samples will be collected for analysis of the indicator parameters, the supplemental parameters, and the Appendix IX constituents (40 CFR 264) included in Chapter 1 of this permit application. After the first sampling event, samples will be collected for analysis of indicator parameters and supplemental parameters only.

After the first year of sampling, if an indicator parameter suggests there is an impact to groundwater, additional samples will be collected to verify the initial results. If a statistically significant increase in any indicator parameter is confirmed, analyses will be made for the regulated parameters in Chapter 1.

5.5.1.1 Dangerous Waste Characterization [D-10e(1)(a)]

This section describes the waste to be disposed in the IDF and gives background information on how the constituents of concern (regulated constituents) and indicator parameters were selected.

Volume of the Waste Package

The IDF will be a single, expandable disposal facility constructed to RCRA Subtitle C standards, half of which is for disposal of mixed waste the other half will be for disposal of low-level waste. Initial capacity for mixed waste disposal is 82,000 cubic meters of waste with an ultimate capacity of up to 450,000 cubic meters of waste. Disposal capacity beyond the initial 82,000 cubic meters will require a modification to the Part B Permit. The mixed waste types to be disposed in the IDF include vitrified LAW from the RPP-WTP and DBVS. Additionally, mixed waste generated by IDF operations will be disposed of in IDF.

The vitrified LAW will be mostly silicate glass monoliths. The RPP-WTP packages nominally measure approximately 1.22 m diameter by 2.3 m high and the DBVS package nominally measure approximately 2.4 m wide by 3.1 m high by 7.3 m long. Vitrified LAW will be remote handled.

If other forms of immobilized LAW are considered in the future, this monitoring plan will be amended.

Mixed waste generated through waste operations at IDF will be packaged based on the size of the waste, with the most common container being galvanized or aluminized 208 liter containers.

Composition of the Waste Packages

HNF-4921 provides detailed estimates for the inventory of hazardous chemicals in the vitrified LAW feed and in the vitrified LAW package. The composition of the vitrified LAW package was estimated in HNF-4921 based on

(1) the Tank Waste Retrieval System Characterization Program tank-by-tank Best Basis Inventories,

(2) the latest U.S. Department of Energy, Office of River Protection (DOE/ORP) guidance,

(3) the requirements for waste retrieval and vitrification,

(4) available information from waste treatment plant contractors, and (5) proposed operating scenarios for retrieval of waste from DSTs and SSTs.

5.5.1.2 Behavior of Constituents [D-10e(1)(b)]

Almost all of the regulated constituents for the IDF show some degree of retardation in the vadose zone and in the saturated zone. Table 5.3 indicates the range of expected behaviors in the subsurface at the IDF for selected regulated constituents. The constituents in Table 5.3 were selected by comparing the expected constituents in the vitrified LAW package (from HNF-4921) and the historical inventories of the Hanford Site low-level burial grounds (from WHC-MR-0008 and WHC-SD-EN-AP-015) to 40 CFR 264, Appendix IX (see Chapter 1). The mobilities and solubilities in Table 5.3 give an estimated range for the properties of the constituents of concern.

5.5.1.3 Detectability [D-10e(1)(c)]

The detection limits in groundwater for each RCRA regulated constituent and the indicator parameters are given in Table 5-4.

5.5.2 Groundwater Monitoring Program [D-10e(2)]

The following sections provide a description of wells, equipment decontamination, representative samples, and monitoring wells that are not upgradient.

5.5.2.1 Description of Wells [D-10e(2)(a)]

The groundwater monitoring well network for the IDF ultimately will have eight wells: three hydraulically upgradient of the facility and five hydraulically downgradient. The downgradient wells will be placed to sample groundwater passing the point of compliance. The point of compliance at the IDF site is a plane connecting the groundwater monitoring wells along the southern and eastern sides of the site in accordance with WAC 173-303-645 (6), which states "The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated unit". The monitoring network will consist of existing and new, downgradient wells to complete the monitoring network. All wells will be WAC 173-160 compliant.

Three upgradient wells will be used for the IDF monitoring network. Two of these wells (299-E18-1 and 299-E24-21) are existing wells. Upgradient well 299-E24-21 was installed in March 2001 for characterization of the IDF site. The well, located at the northeast corner of the site (Figure 5-8), was constructed to RCRA standards as per WAC 173-160. Well 299-E18-1 was installed in 1988 as part of the 2101-M RCRA monitoring network. The well currently has 2 to 3 meters of water above the bottom of the screened interval.

The third upgradient well will be a new well located at the northwest corner of the IDF (Figure 5-8). The well will be constructed to RCRA standard as per WAC 173-160 and screened at the water table.

Three of the downgradient wells are existing wells (299-E17-22, 299-E17-23, and 299-E17-25) that were installed as WAC 173-160 compliant wells in 2002. Their location is shown in Figure 5-8. The remaining two downgradient wells will be installed in a sequence coordinated with the IDF operations.

Three phases of trench construction are assumed for the purposes of this monitoring plan. Excavation for the first phase is scheduled for September 2004 and a new phase is planned for every ten subsequent years. Changes in the planned operations of the IDF will be reflected in changes to this groundwater monitoring plan as needed.

The first new downgradient well will be installed along the eastern side of the facility (Figure 5-8) at least one year before the IDF receives waste. The second new downgradient well will be installed along the southern boundary of the Site at least one year before the third phase of waste disposal becomes operational. Both wells will be installed such that at least one year of background data can be obtained prior to the associated operational phase becoming active. Figure 5-8 shows the sequence for both groundwater well construction and waste disposal. The locations of all existing and new wells in the IDF monitoring network are noted on the figure.

The placement of the wells for the IDF monitoring network was based on professional judgment. The efficiency of the resulting groundwater monitoring network was evaluated using a simple two dimensional, horizontal transport model called the monitoring efficiency model (MEMO) (Wilson et al. 1992). The model estimates the efficiency of a monitoring network at the point of compliance. The model simulates a contaminant plume originating from a series of grid points within the disposal facility using the Domenico-Robbins method (Domenico and Robbins 1985). The model calculates both advective flow and dispersive flow in two dimensions and determines whether the resulting plume will be detected by a monitoring well before the plume travels some selected distance beyond the disposal facility boundary. The selected distance is termed the buffer zone. (A longitudinal dispersivity of 95 meters and horizontal dispersivity of 9.5 meters were used to evaluate the monitoring network in Figure 5-8.) Outputs from the model are the monitoring efficiency and a map of the disposal facility showing areas where leaks would not be detected under the given site-specific parameters provided as input to the model. Monitoring efficiency is defined as the ratio of the area within a disposal facility from which a release likely would be detected to the total area of the disposal facility, expressed as a percentage.

The monitoring efficiency calculated by the MEMO model for the proposed monitoring network is 100% for phase I, 98% for phase II, and 99% for phase III (Figure 5-8).

All wells for the IDF site will be constructed to meet WAC 173-160 requirements. The wells will be protected at the surface with a concrete pad, protective posts, a protective outer casing, and locking cap. The casing and screen will be stainless steel, an appropriate filter pack for the screen slot size will be used, and an annular seal of bentonite and cement will be emplaced. All wells will be screened at the water table with 10.6 meter long screens, which will accommodate the greatest possible future decrease in water level. The wells will be developed and dedicated sampling pumps will be installed.

New wells will be surveyed with a down hole gyroscope at the time of construction to determine any deviation from vertical so that corrections can be made to subsequent water level measurements. Gyroscope surveys will also be conducted on existing wells in the network prior to IDF operations.

5.5.2.2 Equipment Decontamination [D-10e(2)(b)]

Drilling equipment will be decontaminated using high temperature and pressure [82°C (180°F) and greater than 70.3 kg/cm^2 (1,000 psi)] washing with an approved cleaning solution. The equipment will be rinsed with clean water. The procedure is specified in controlled manuals.

Equipment for collecting soil samples during drilling for later chemical analysis and for measuring the water table will be decontaminated according to established methods. The methods call for washing equipment with phosphate-free detergent, rinsing three times with reverse osmosis/de-ionized water, rinsing once with 1M or 10% nitric acid (glass or stainless steel equipment only), rinsing three more times with reverse osmosis/de-ionized water, and a final rinse with chromatograph grade hexane. Equipment will be dried for 50 minutes at 100°C (212°F). After drying, equipment will be wrapped in unused aluminum foil and sealed with tape.

No decontamination of groundwater sampling equipment will be necessary because each well will have a dedicated pump.

5.5.2.3 Representative Samples [D-10e(2)(c)]

No groundwater chemistry data specific to the IDF site are available. Sample representativeness will be addressed after collection of the first year of background data.

5.5.2.4 Locations of Background Groundwater Monitoring Wells that are not Upgradient [D-10e(2)(d)]

All background groundwater monitoring wells at the IDF are located upgradient.

5.5.3 Background Values

Groundwater background (baseline) has not been established for the IDF site. Background data will be determined before construction of the site using the wells described previously (Section 5.5.2.1) for the use of upgradient vs. downgradient comparisons (Section 5.5.4.7).

5.5.3.1 Plan for Establishing Groundwater Quality Data [D-10e(3)(b)]

Well location, sampling frequency, sampling quantity, and background values are discussed in the following sections.

5.5.3.1.1 Well Locations [D-10e(3)(b)(i)]

Groundwater monitoring wells in the IDF monitoring network were described in Section 5.5.2.1 and their locations are shown on Figure 5-8.

5.5.3.1.2 Sampling Frequency [D-10e(3)(B)(ii)]

Eight background samples will be collected during the first year of monitoring from phase I wells. Two samples will be collected quarterly for one year. For the new well needed for phase III operations, two samples will be collected quarterly for one year before phase III is operational. For all wells, two independent samples will be collected each quarter, one per month for 2 consecutive months followed by a month of non-sampling. This sequence will be repeated each quarter during the first year of monitoring. Section 5.5.3.1.3 provides frequency logic.

5.5.3.1.3 Sampling Quantity [D-10-e(3)(b)(iii)]

The performance of the statistical method proposed for the IDF is evaluated by the following two goals:

- To have adequate statistical power to detect real contamination when contamination occurs
- To keep the network-wide Type I error (across all constituents and wells being tested) at an acceptably low level (approximately 5%). [Note that the Type I error in the detection monitoring stage equates to the false positive rate, that is, the probability that the test will indicate contamination has occurred although no contamination has truly occurred.]

The statistical power and the network-side false-positive rate of a test depend on several factors, including the background sample size, the type of proposed test, and the number of comparisons. All other factors being equal, the larger the sample size is (i.e., the number of background samples), the greater the statistical power is. Therefore, as recommended in EPA/530-R-93-003, at least eight independent samples will be collected from each well for background purposes. This is a sufficient number of samples to establish a reliable background (EPA/530-R-93-003) and meets the regulations in WAC-173-303-645(9)(d).

5.5.3.1.4 Background Values

The default method of analysis of variance (ANOVA) will be used to detect any impact on groundwater quality at the IDF where the mean of the measurements from compliance (downgradient) wells is compared to the mean of the distribution of background data from the upgradient wells. The details of the method are described in Section 5.5.4.7.1.

5.5.4 Sampling, Analysis and Statistical Procedures [D-10e(4)]

Sample collection, sample preservation and transfer/shipment, analytical procedures, chain of custody and additional requirements for compliance point monitoring are discussed in the following sections.

5.5.4.1 Sample Collection [D-10e4(a)]

Groundwater sampling procedures, sample collection documentation, sample preservation and transfer/shipment, and chain-of-custody requirements are described in subcontractor operating procedures/manuals and in a quality assurance project plan for the Hanford Groundwater Performance Assessment Project. Quality requirements for sampling activities, including requirements for procedures, containers, transport, storage, chain of custody, and records requirements, are specified in a statement of work (SOW) to subcontractors. To ensure that samples of known quality are obtained, the subcontractor will be required to use contractor-controlled procedures based on standard methods for groundwater sampling whenever possible. The procedures will be reviewed for technical quality and consistency. In addition, periodic assessments of sample collection activities will be performed to further ensure that procedures are followed to maintain sample quality and integrity. The following is a brief description of the sampling requirements.

Samples generally will be collected after three casing volumes of groundwater are withdrawn or after the field parameters pH, temperature, and specific conductance have stabilized. Field parameters are measured in a flow-through chamber. Turbidity should be equal to or below 5 NTU (nephelometric turbidity units) before sample collection if possible. Sample preservatives will be added to the collection bottles in the laboratory before their use in the field. Samples to be analyzed for metals will be filtered in the field to ensure results represent dissolved metals and do not include particulates (40 CFR 136.3). Duplicates, trip blanks, and field equipment blanks will be collected as part of the general quality control program.

Water level measurements will be made each time a well is sampled. Procedures developed in accordance with the techniques described in American Society for Testing and Materials (1988), Garber and Koopman (1968), OSWER 9950.1, and U. S. Geological Survey (1977) will be followed to measure water levels. Water levels will be measured primarily with laminated steel electrical sounding tapes, although graduated steel tapes are used occasionally.

5.5.4.2 Sample Preservation and Shipment [D-10e(4)(b)]

Sample preservation will be done in accordance with existing procedures. A chemical preservative label will be affixed to the sample container listing the specific preservative. The brand name, lot number, concentration, and date opened of the preservatives will be recorded. A calibrated dispenser or pipette will be used to dispense preservatives. Appropriate measures will be taken to eliminate any potential for cross contamination.

Sample packaging and transfer/shipping will be done in accordance with subcontract procedures. Samples will be labeled and sealed with evidence tape, wrapped with bubble wrap, and placed in a

Department of Transportation approved container with coolant (if required). Hazardous samples will have packaging parameters determined by associated hazards. A chain of custody will accompany all samples.

5.5.4.3 Analytical Procedures [D-10e(4)(c)]

The methods for analysis of chemical constituents in groundwater will conform to *Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods, 3rd Ed.* (SW-846); *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020) or other EPA methods; and the *Annual Book of ASTM Standards* (American Society for Testing and Materials, 1986). The methods used to obtain routine data results are presented in Table 5-4.

5.5.4.3.1 Data Storage and Retrieval

All contract analytical laboratory results will be submitted by the laboratory to be loaded into the Hanford Environmental Information System (HEIS) database. Most data are received from the laboratory in electronic form, and will be loaded electronically. Parameters measured in the field will be entered into HEIS either manually or through electronic transfer. Hard copy data reports are received for records storage. Data from the HEIS database will be retrieved for data validation, data reduction, and trend analysis. Copies of supporting analytical data will be sent yearly to Pacific Northwest National Laboratory (PNNL) for storage.

5.5.4.3.2 Data Verification and Validation

Verification of analytical data provided by the subcontracted laboratory will be performed in accordance with established procedure. This procedure includes checks for: (1) completeness of hardcopy deliverable, (2) condition of samples on receipt by the laboratory, (3) problems that arose during the analysis of the samples, and (4) correct reporting of results. The procedure also describes the actions to be taken if data are incomplete or deficient.

Verification and validation of groundwater chemistry data will be performed according to established procedures. Data will be reviewed quarterly to assure the data are complete and representative. The review will include evaluation of quality control data (e.g., field blanks, duplicates, and laboratory blanks) and a technical review by a project scientist familiar with the hydrogeology of the site. The technical review might include comparison of recent data to historical trends and comparison of related constituents. Suspect data will be investigated through the data review process in accordance with established procedures and will be flagged in the database.

5.5.4.3.3 Reporting

Groundwater chemistry and water level data will be reviewed after each sampling event and will be available in the HEIS database. The results of the statistical evaluation and associated information will be submitted to Ecology quarterly in Hanford Site groundwater monitoring reports.

If statistically significant evidence of contamination is determined (after waste has been introduced to the facility and after the confirmation re-sampling evaluation process) for one or more of the indicator parameters at any monitoring well at the compliance point, and if the owner or operator decides not to make a false-positive claim, the following will be performed.

- Notify Ecology in writing within 7 days of the finding indicating which chemical parameters or dangerous waste constituents have shown statistically significant evidence of contamination.

- Determine whether dangerous constituents are present and, if so, in what concentration.

- The owner or operator might re-sample within 1 month and repeat the analysis for those compounds detected in the above (i.e., second bullet). The resample data will be compared with the trigger value.
- Submit an application for a permit modification, if necessary, to establish a compliance-monitoring program to Ecology in 90 days or within the time agreed to in writing by Ecology.

The dangerous constituents detected, either in the initial analysis or in the second confirmation analysis, will form the basis for compliance monitoring.

In case of a false-positive claim [as allowed by WAC 173-303-645 (9)(g)(vi)], the following will apply.

- Notify Ecology in writing within 7 days of the finding (i.e., exceedance) and indicate that a false-positive claim will be made.
- Submit a report to Ecology within 90 days or within the time agreed to in writing by Ecology. This report should demonstrate that a source other than the regulated unit caused the contamination or that the contamination resulted from an error in sampling, analysis, evaluation, or natural variation in groundwater chemistry.
- Submit an application for a permit modification, if necessary, to make any appropriate changes to the detection-monitoring program within 90 days or within the time agreed to in writing by Ecology.
- Continue to monitor in accordance with the detection-monitoring program.
- Submit an application for a permit modification, if the detection monitoring program is determined to no longer satisfy the requirements [of WAC 173-303-645(9)], to make any appropriate changes to the program within 90 days or within the time agreed to in writing by Ecology.

5.5.4.4 Chain of Custody [D-10e(4)(d)]

The procedures used for chain-of-custody control of samples are documented in existing manuals. The procedure requires that each transfer of custody shall be documented by the signatures of the custodian relinquishing the samples and the custodian receiving the samples, as well as the time and date of transfer. The laboratory custodian will sign and date the chain-of-custody form upon receipt of the samples at the laboratory.

5.5.4.5 Additional Requirements for Compliance Point Monitoring [D-10e(4)(e)]

This section describes sampling frequency and determination of groundwater quality for the samples from the groundwater monitoring network. Compliance data will be compared to baseline data collected from the upgradient wells and a determination of impacts to groundwater will be made using the proposed ANOVA method (explained in Section 5.5.4.7.1).

5.5.4.5.1 Sampling Frequency [D-10e(4)(e) (i)]

Under final status regulations, the default sampling procedure states that a sequence of at least four samples from each well (background and compliance wells) must be collected at least semiannually during detection monitoring at an interval that ensures, to the greatest extent technically feasible, that an independent sample is obtained [40 CFR 264.97(g)(1) and (2), WAC 173-303-645 (8)(g)(i) and (ii), and (9)(d)].

The default sampling procedures are adopted for the IDF as follows: four independent samples from each groundwater monitoring well will be sampled for the indicator parameters (Table 5-2) semiannually during the active life of the regulated unit (including the closure period), one per month for 4 consecutive months followed by two months of non-sampling. The mean of the measurements from the downgradient wells will be compared semiannually to the mean of the distribution of the background data using ANOVA.

5.5.4.5.2 Compliance Point Groundwater Quality Values [D-10e(4)(e)(ii)]

The groundwater quality data collected from the groundwater monitoring wells will be compared to the mean of the background data from upgradient wells for each constituent by ANOVA. If the mean is calculated from transformed baseline data (logarithmic transformation or nonparametric approach), then the monitoring data will be transformed accordingly; otherwise, the original monitoring data will be used in the comparisons.

During detection monitoring, data verification will be applied in case of an initial exceedance. For ANOVA test, if the test of hypothesis of equal means for all wells fails, *post hoc* comparisons are needed to determine which compliance well(s) is (are) contaminated. This will be done by comparing concentration differences (called contrasts in the ANOVA and multiple comparison framework) between each compliance well with the background wells (EPA/530-SW-89-026). If the contaminated compliance well(s) is (are) determined by *post hoc* comparisons, verification sampling will be implemented for the constituent(s) in question. Verification sampling is needed to determine if the exceedance is an artifact caused by an error in sampling, analysis, or statistical evaluation or an actual variation in groundwater chemistry. A collection of at least four measurements from the re-sampled compliance well(s) is required to perform ANOVA test on comparison with the mean of the background data (EPA/530-R-93-003). Adequate time should elapse to ensure statistical independence between the original measurements and the re-sample measurements, which is assured by the sampling frequency proposed in Section 5.5.4.5.1.

The existing nitrate plume beneath the IDF site is described in Section 5.4.1. Nitrate is not included in Chapter 1 and, therefore, is not a constituent of concern for the IDF. Existing groundwater conditions will be monitored by the indicator parameters and supplemental constituents as described in Section 5.5.1. Specific conductance will respond to nitrate so that any changes in the nitrate concentration will be reflected by changes in the indicator parameter specific conductance.

Anion analysis is one of the supplemental constituents to be monitored at the IDF site. Anion analysis will determine the nitrate concentration. Therefore, through comparison of regression lines of specific conductance and nitrate (Zar, 1999) and/or contaminant source analysis (Gibbons, 1994), it can be determined whether any change in specific conductance is due to a change in nitrate. If a change in specific conductance is due to a change in nitrate, then that specific conductance change is not attributed to the IDF. If, however, a statistically significant change in specific conductance is not attributable to nitrate, verification sampling will occur as described above.

5.5.4.6 Annual Determination [D-10e(4)(f)]

Groundwater flow rate and flow direction at the IDF site will be determined annually for the uppermost aquifer. Flow rate will be determined by calculation using the groundwater gradient, and the Darcy flow equation, $v_h = K_h i_h / n_e$, where v_h is the horizontal groundwater velocity, K_h is the horizontal hydraulic conductivity, i_h is the horizontal hydraulic gradient, and n_e is the effective porosity. Effective porosities used at Hanford Site RCRA regulated units are on the order of 0.1 to 0.3 (PNNL-14187); effective porosity might be determined specifically for the IDF from hydrologic tests.

Hydraulic gradients will be determined from measurements of water levels.

5.5.4.7 Statistical Determination [D-10e(4)(g)]

This section describes the method of statistical evaluation and the statistical procedures to indicate whether dangerous waste or dangerous waste constituents from the IDF might have entered the groundwater in the uppermost aquifer. These evaluations will be made as soon as practicable after validation of the full data set from each sampling event.

The monitoring program periodically will re-evaluate the statistical tests being used. The methods described will be reviewed during and after background data are collected to ensure the methods are the most appropriate, considering site conditions.

The goal of a RCRA final status detection-monitoring program [WAC 173-303-645(9)] is to monitor for indicator parameters that provide a reliable indication of the presence of dangerous constituents in groundwater in the uppermost aquifer beneath the site. This is accomplished by testing for statistically significant changes in concentrations of indicators in downgradient wells relative to baseline values. The default statistical method ANOVA is proposed for the detection monitoring program of the IDF. The proposed statistical method is consistent with EPA/530-SW-89-026, EPA/530-R-93-003, and WAC-173-303-645.

The number of tested constituents will be limited to the indicators to maintain a sufficiently low false-positive rate (EPA/530-R-93-003, page 62; Gibbons 1994, page 16). Verification sampling is an integral part of the statistical design to lower the overall false-positive rate and determine whether the difference between background and compliance-point data is an artifact caused by an error in sampling, analysis, or statistical evaluation (Section 5.5.4.5.2).

5.5.4.7.1 Statistical Procedure [D-10e(4)(g)(i)]

In accordance with WAC 173-303-645(8)(h), acceptable statistical methodology includes analysis of variance (ANOVA), tolerance intervals, prediction intervals, control charts, test of proportions, or other statistical methods approved by Ecology. The type of monitoring, the nature of the data, the proportions of non-detects, and spatial and temporal variations are some of the important factors to be considered in the selection of appropriate statistical methods. The EPA default method ANOVA will be implemented for the IDF site to compare the differences of means of the measurements from upgradient and downgradient wells. The detailed discussions of the ANOVA test can be found in EPA/530-SW-89-026 and statistical textbooks (Gilbert, 1987; Casella and Berger, 1990; Davis, 2002), and can be executed using commercial statistical software such as SAS or SYSTAT. Under WAC 173-303-645(8)(i)(ii), the proposed statistical method must comply with the performance standard, that is, for a multiple comparisons procedure the Type I error level must be no less than 0.05, and maintained at the level of no less than 0.01 for individual well comparisons. By definition, Type I error is the false rejection rate of the null hypothesis (H_0) of the statistical test. In detection or compliance monitoring, the statistical test is defined as H_0: no release, i.e., the means of the distributions from upgradient and downgradient wells are the same, and the alternative (H_a) evidence of release, e.g., "clean until proven contaminated"(EPA/530-R-93-003). Therefore, the proposed statistical method must comply with the requirement of maintaining Type I error which equates false positive rate in the stage of detection monitoring at approximate 5% level. As described in EPA/530-SW-89-026, ANOVA procedures have the advantages of combining multiple downgradient into a single statistical test, thus enabling the network-wide false positive rate for any single constituent (not multiple constituents) to be kept at 5%, and also maintain reasonable power for detecting contamination.

The details of the ANOVA procedures are described as follows (EPA/530-SW-89-026):

- First, check the proportion of non-detects of the measurements from the upgradient and downgradient wells. When the proportion of non-detects is less than 15%, the non-detects will be reported as one-half the minimum detection limit or practical quantitation limit, and proceed with parametric ANOVA analysis. When the proportion of non-detects is greater than 15%, non-parametric ANOVA analysis will be used for comparing the means of downgradient and upgradient wells.

- Evaluate the distributions of the measurements from the upgradient and downgradient wells. The assumptions with parametric ANOVA test are the residuals are normally distributed with equal variance. The normality of the distribution the residuals can be checked using coefficient of variation, plotting the data on probability plot, and/or Shapiro-Wilk's test (EPA/530-SW-89-026; Gibbons, 1994). The assumption of normality usually can be met by log-transforming the data or by other Box-Cox transformations. When the assumptions of normality and lognormality cannot be justified, the non-parametric ANOVA method will be used for the IDF. Bartlett's test can be used in checking equality, or homogeneity, of variances.

- The parametric ANOVA procedures include:

  - Assume a monitoring network with k wells, and total number of observations N. First, compute well total, well mean, and well residuals (observations subtracted by well mean) for each well, and grand total and mean of all observations (all wells). The well residuals are used to check the assumption of normality.

  - Compute the sum of squares of difference between well means and the grand mean, SS_{wells} which is a measure of the variability between wells with (k-1) degrees of freedom.

  - Compute the total sum of squares of differences between all observations and the grand mean, SS_{total}, which is a measure of the variability in all observations with (N-1) degrees of freedom.

  - Compute the sum of squares of differences of observations within wells from the well means, SS_{error}, which is a measure of the variability within wells with (N-k) degrees of freedom calculated by the following subtraction:

    $$SS_{error} = SS_{total} - SS_{wells}$$

  - Test the hypothesis of equal means for all k wells by computing F value with the means squares of differences:

    $$F = MS_{wells} / MS_{error}$$

    where the means of squares are the sums of squares divided by the associated degrees of freedom, that is, $MS_{wells} = SS_{wells} / (k-1)$, and $MS_{error} = SS_{error} / (N-k)$. Compare the F value to the tabulated F statistics with (k-1) and (N-k) degress of freedom at the 5% significance level (EPA/530-SW-89-026, Appendix B, Table 2). If the calculated F value exceeds the tabulated F statistics, the null hypothesis of equal well means is rejected. Proceed with test of contrasts in the next step. Otherwise, the hypothesis of equal means is accepted that there is no significant difference between the concentrations at k wells (upgradient and downgradient wells), that is, no evidence of contamination.

  - If the hypothesis of equal well means is rejected, contrasts (concentration differences between a compliance well and background wells) will be tested for each compliance well to determine which compliance well(s) is (are) contaminated. Bonferroni t-statistics will be computed to determine if the significant F value is due to difference between background and compliance wells. Assume that of the k wells, k_b are background (upgradient) wells, and k_c are compliance (downgradient) wells (i.e., $k_b + k_c = k$). Each of the k_c compliance wells is compared to the mean of the background wells as the following steps:

    - Compute the mean m_b from the k_b background wells with a total of n_b samples.

    - Compute the difference D_i between the mean from the i^{th} compliance well and the mean from the background wells.

- Compute the standard error of the difference from the i^{th} compliance well with n_i observations as:

  $$SE_i = [MS_{error}\,(1/n_b + 1/n_i)]^{1/2}$$

  where MS_{error} is computed previously as the measure of variability within wells.

- Obtain the t-statistics from Bonferroni's t-table (EPA/530-SW-89-026, Appendix B, Table 3) with a significance level of (α=0.05/k_c) but no less than 0.01 (for individual comparison) and (N-k) degrees of freedom. The critical value for the i^{th} compliance well is defined as: $C_i = SE_i \times t$.

- If the difference D_i exceeds the critical value C_i, conclude that the mean of the i^{th} compliance well is significantly higher than the mean of the background wells. Otherwise conclude that the well is not contaminated.

- The one-way non-parametric ANOVA tests the null hypothesis that the data from each well come from the same continuous distribution and hence have the same median. The procedures, called the Kruskal-Wallis test, include the following steps:

  - Assume the monitoring network as defined previously with a total of N observations from k wells (k_b background wells and k_c compliance wells). Rank all N observations from least (1) to greatest (N). Let the background wells be group 1, and denote the compliance wells as group 2 to (k_c+1). (one group per compliance well).

  - Compute the sum (R_i) and the average (m_i) of the ranks of the n_i observations in the i^{th} group.

  - Compute the Kruskal-Wallis statistics (H) as

    $$H = \left[\frac{12}{N(N+1)}\sum_{i=1}^{kc+1}\frac{R_i^2}{n_i}\right] - 3(N+1)$$

  - Compare the calculated H value to the tabulated chi-squared value with k_c degrees of freedom (EPA/530-SW-89-026, Appendix B, Table 1). The null hypothesis of equal medians is rejected when the calculated H value exceeds the tabulated critical value.

  - When the null hypothesis of equal medians is rejected, compute the critical difference C_i for each compliance well to the background data (group 1 with n_b observations):

    $$C_i = Z_{(0.05/kc)}\left[\frac{N(N+1)}{12}\times\left(\frac{1}{n_b}+\frac{1}{n_i}\right)\right]^{1/2}$$

    where $Z_{(0.05/kc)}$ is the upper (0.05/k_c) percentile from the standard normal distribution (EPA/530-SW-89-026, Appendix B, Table 4). If there are more than five compliance wells ($k_c > 5$), use $Z_{0.01}$, the upper one-percentile from the standard normal distribution ($Z_{0.01}$=2.32) for individual comparison (WAC-173-303-645(8)(i)(ii)).

  - Compute the difference ($D_i = m_i - m_1$) of average rank m_i (i=2 to k_c+1) for each compliance well to the background (m_1). Compare the difference D_i to the critical value C_i for each compliance well. If D_i exceeds C_i, conclude that the median of the i^{th} compliance well is significantly higher than the background median.

- As monitoring continues, the background data will be updated periodically (e.g., every year or two) to incorporate the new data from upgradient wells. This updating process will continue for the life of the monitoring program. Prior to updating older background data with more recent results, a two-sample t-test will be run to compare the older concentration levels with the concentrations of the proposed update samples. If the t-test does not show a significant difference at the 5 percent significant level, proceed to re-estimate the baseline parameters by including the more recent data. If the t-test does show a significant difference, the newer data will not be included as background unless some specific factors can be identified explaining why background levels at the IDF site have naturally changed (EPA/530-R93-003).

Formal testing for outliers will be done when an observation of the background data seems inconsistently high (by orders of magnitude) compared to the rest of the data set in order to avoid the artificial increase of the mean of the background data and a corresponding increase of the false negative rate. Statistical methods such as the Grubbs' method (Grubbs, 1969), the box-and-whisker plot (Ostle and Malone, 1988), EPA guidance (EPA/530-SW-89-026, page 11-14) and/or American Society for Testing and Materials guidance (ASTM, 1996) will be used for testing outliers. The outliers must be checked to determine if the measurements are in error and need to be corrected or excluded from calculating the background mean. If no specific error is found, the measurements must be retained in the data.

A statistically significant exceedance over background (baseline) levels only indicates that the new measurement in a particular monitoring well for a particular constituent is inconsistent with chance expectations based on the available sample of background (baseline) measurements. Any statistical result must be supported by other information to determine if a waste disposal facility has impacted groundwater (ASTM 1996).

5.5.4.7.2 Results [D-10e(4)(g)(ii)]

Sampling and analysis results are reviewed at least semiannually (i.e., after each sampling event) and are available in HEIS. The DOE will submit results of statistical evaluations to Ecology.

5.5.5 Compliance Monitoring Program [D-10f]

A compliance monitoring program that satisfies requirements set forth in WAC 173-303-645(10) will be established for the IDF if detection-level monitoring reveals statistically significant evidence of dangerous waste contamination from sources within the regulated unit. If compliance monitoring is required, DOE will submit a revised monitoring plan to Ecology specifying dangerous constituents to be monitored, sampling and analysis protocols, statistical evaluation methods, etc. In the compliance monitoring program, the dangerous constituents or parameters will be compared to concentration limits specified in the facility permit as discussed in WAC 173-303-645(5) during the compliance period.

The RCRA regulations [WAC 173-303-645(9)(g)] state that if a statistical exceedance occurs in a downgradient well, the entire network immediately must be resampled and analyzed for the constituents in Appendix IX of 40 CFR 264. This sampling would be conducted in parallel with a required permit modification. Appendix IX is an extensive list including a wide variety of volatile and semivolatile organic compounds and trace metals. It is prudent to narrow the analyte list to the specific exceedance event; e.g., if the exceeding contaminant is total organic halides, the project would analyze for the halogenated hydrocarbons most likely to be present in the area. Results of the resampling will form the basis for returning to detection monitoring or designing a compliance monitoring program

5.5.6 Corrective Action Program [D-10g]

If, at a point of compliance (a well), dangerous constituents of concern are measured in the groundwater at concentrations that exceed the applicable groundwater concentration limit, Ecology must be notified in 7 days, and an application to modify the permit to include a corrective action plan must be sent to

Ecology within 90 days or within the time agreed to by Ecology. A description of the groundwater monitoring plan, including all additional corrective actions that are appropriate for a corrective action program will be prepared and submitted to Ecology when the need for corrective action first is identified.

This section has been identified as
"Official Use Only" (OUO)
and is available to view by appointment at
the Nuclear Waste Program
Resource Center
3100 Port of Benton
Richland, Washington.

Please contact Valarie Peery at
(509) 372-7920
for a viewing appointment.

Table 5-1. Water Levels in Groundwater Wells in the Vicinity of the IDF Site.

Well	Measure date	DTW m[a]	WT elev m[b]	Ref elev m[c]
299-E13-10	03/14/02	101.7	122.5	226.31
299-E17-12	03/14/02	100.0	121.1	221.09
299-E17-13	04/12/01	97.7	122.6	220.34
299-E17-17	04/12/99	97.8	122.8	220.54
299-E17-18	10/03/02	98.5	122.3	220.76
299-E17-20	04/09/97	97.1	123.2	220.33
299-E17-21	04/23/98	100.4	122.7	224.26
299-E17-22	05/20/02	98.1	122.5	220.59
299-E17-23	05/20/02	101.6	122.2	223.84
299-E17-25	05/21/02	98.3	126.7	225.03
299-E18-1	03/14/02	98.2	122.4	220.65
299-E18-3	06/27/96	97.8	123.4	221.20
299-E18-4	06/27/96	97.7	123.4	221.05
299-E19-1	03/22/88	100.4	124.9	225.26
299-E23-1	03/14/02	96.0	122.4	218.39
299-E23-2	12/20/94	97.2	123.5	220.77
299-E24-4	08/10/98	90.6	122.9	213.47
299-E24-7	06/11/97	96.2	123.2	219.34
299-E24-16	10/04/02	97.7	122.3	220.02
299-E24-17	04/07/97	97.36	122.9	220.16
299-E24-18	10/02/02	98.0	122.3	220.35
299-E24-21	03/22/01	95.4	122.6	217.85

[a] DTW = depth to water
[b] WT elev = elevation of water table (meters above mean sea level)
[c] Ref elev = reference elevation (meters above mean sea level, North American Vertical Datum 88 reference), generally top of well casing.

Table 5-2. Monitored Constituents for the IDF.

Indicator parameters	Supplemental constituents
Chromium (filtered)	Alkalinity
Specific conductance (field)	Anions
Total organic carbon	ICP metals
Total organic halides	Turbidity (field)
pH (field)	

Table 5-3. Expected Behavior of Selected Regulated Constituents/Materials for the IDF.

Constituent/material	**Expected charged state**	**Expected mobility[1] (K_d)**	**Comments**
Organics			
Acetonitrile	N/A	High (0.16)	Miscible with water (Howard Volume IV, 1993)
Carbon tetrachloride	N/A	High (0.60); 0.29 (DOE/RL-93-99)	Moderately soluble in water (805 mg/L) (Howard, Volume II,1990)
Creosote[2]	N/A	High (0.03 to 0.06)[3]	Relatively low solubility in water. Naphthalene solubility in water (31.7 mg/L [Howard, Volume 1, 1989]). Anthracene solubility in water (0.03 to 0.5 mg/L[Mackay et al, Volume II, 1992])
Dioxane	N/A	High (0.01)	Miscible with water (Howard, Volume II, 1990)
Ethylene glycol	N/A	Unknown[4]	Miscible with water (Howard, Volume II, 1990)
Naphthalene		Moderate (4 to 10); 1.4 (DOE/RL-93-99)	Sparingly soluble in water (31.7 mg/L [Howard, Volume I, 1989]).
Polychlorinated biphenyls	N/A	Low (20 to 100); 440 to 2,300 (DOE/RL-93-99)	Low solubility in water. 0.01 to 1 mg/L as Aloclors (Mackay et al. 1992); 0.27 to 1.45 mg/L (WHC-SD-EN-TI-201)
Tetrachloroethylene	N/A	High (2.1); 0.22 (DOE/RL-93-99)	Moderately soluble in water (1,503 mg/L) (Howard, Volume II, 1990)
Toluene	N/A	High (0.37 to 1.8); 0.18 (DOE/RL-93-99)	Moderately soluble in water (535 mg/L) (Howard, Volume II, 1990)
Trichloroethylene	N/A	High (1.0); 0.1 to 1.0 (WHC-SC-EN-TI-201); 0.11 (DOE/RL-93-99)	Moderately soluble in water (1,100 mg/L) (Howard, Volume II, 1990)
Vinyl chloride	N/A	High (0.004); 0.056 (DOE/RL-93-99)	Moderately soluble in water (2,763 mg/L) (Howard, Volume I, 1989)
Inorganics			
Antimony	Cation (Sb^{+2})	Moderate (0 to 40, best estimate: 20 [DOE/RL-93-99])	Moderately soluble (best estimate): 1,000 mg/L (DOE/RL-93-99)
Arsenic	Anion (AsO_4^{-3})	High , 0 (DOE/RL-93-99)	Moderately soluble (best estimate): 1,000 mg/L (DOE/RL-93-99)
Barium	Cation (Ba^{+2})	Moderate, 20 to 200, best estimate: 50 (DOE/RL-93-99)	Low solubility (best estimate): 1 mg/L (DOE/RL-93-99)
Beryllium	Cation (Be^{+2})	Moderate, 15 to 200, best estimate: 20 (DOE/RL-93-99)	Solubility unknown. Best estimate: 1 mg/L
Cadmium	Cation (Cd^{+2})	Moderate, 15 to 30, best estimate: 23 (DOE/RL-93-99)	Sparingly soluble. Best estimate: 25 mg/L (DOE/RL-93-99)
Chromium	Anion (CrO_4^{-2})	High (0.0 to 1.02 [PNNL-13895); 0.001 (WHC-SC-EN-TI-201)	Low solubility: 0.5 to 10 mg/L (WHC-SC-EN-TI-201)
Lead	Cation (Pb^{+2})	Low (1,330 to 469,000 [PNNL-13895])	Low solubility: 287 µg/L in Hanford Site groundwater (PNL-9791)
Mercury	Cation (Hg^{+2})	Moderate, best estimate: 30 (DOE/RL-93-99)	Solubility unknown. Best estimate: 1 mg/L (DOE/RL-93-99)

Table 5-3. Expected Behavior of Selected Regulated Constituents/Materials for the IDF.

Constituent/material	Expected charged state	Expected mobility[1] (K_d)	Comments
Nickel	Cation (Ni^{+2}) $Ni(OH)_2$ $NiCO_3$	Low (48 to 337 [PNNL-13895)	Low solubility: 1.9 mg/L in Hanford Site groundwater (PNL-9791)
Selenium	Anion (SeO_4^{-6})	High (3 to 10 [PNNL-13895]) (3 to 8 PNNL-11966)	Moderately soluble. Best estimate: 1,000 mg/L (DOE/RL-93-99)
Silver	Cation (Ag^+)	Moderate, 20 to 30, best estimate: 25 (DOE/RL-93-99)	Sparingly soluble (best estimate): 25 mg/L (DOE/RL-93-99).

N/A = Not applicable

[1] Unless cited in the column, K_d (partition coefficient) values were calculated from K_{oc} (normalized sorption coefficient) values obtained from either the Handbook of Environmental Fate and Exposure Data for Organic Chemicals series (Volumes I-IV) (P.H. Howard, ed) or the Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals series [Mackay et al. 1992a, 1992b]. For all organics (except carbon tetrachloride), the calculation assumes an organic carbon content for Hanford Site soil of 1.0%. The value of organic carbon assumed is conservative recognizing that the organic carbon content of most Hanford Site soil falls considerably below this value. However, applying this level of conservatism also recognizes that mineral-driven sorption likely plays a role in organic constituent mobility for Hanford Site soils with organic carbon content at or below 0.1% (PNNL-13560). A calculation of a K_d value using acetonitrile as an example is as follows. The literature estimated value of K_{oc} for acetonitrile is 16 (Howard 1993).

$K_d = f_{oc} \text{ X } K_{oc}$ where f_{oc}= the mass fraction of organic carbon in the soil.

K_d (acetonitrile) = 0.01 X 16 = 0.16.

[2] Creosote is a coal tar distillate containing high quantities of naphthalene and anthracene (Lewis, R.J., Sr. 1993).

[3] Because creosote is predominately a mixture of naphthalene and anthracene (footnote 2), assumed K_{oc} values for naphthalene (Howard 1989) and anthracene (Mackay et al., Volume II) in calculating a K_d range for creosote.

[4] This constituent has a low octanol/water partition coefficient indicating that its adsorption to soil would be low (Howard, Volume II, 1990)

Table 5-4. Analytical Methods and Method Detection Limits for Regulated Constituents and Indicator Parameters.

Class of Compounds	Analytical Methods	Method Detection Limit[2] (ug/L)
Metals		
	SW 846, Method 6010 (ICP metals)	0.18 - 51[1]
	SW 864, Method 7060 (Arsenic)	1
	SW 846, Method 7131 (Cadmium)	0.1
	SW 846, Method 7191 (Chromium)	1
	SW 846, Method 7421 (Lead)	1
	SW 846, Method 7470 (Mercury)	0.2
	SW 846, Method 7740 (Selenium)	2
	SW 846, Method 7841 (Thallium)	1
Semi-Volatile Organics		
	SW 846, Method 8041	Not available
	SW 846, Method 8270	10 - 1000[1]
Pesticides/Polychlorinated Biphenyls		
	SW 846, Method 8081 (Pesticides)	Not available
	SW 846, Method 8082 (PCBs)	0.005 – 0.025[1]
Herbicides		
	SW 846, Method 8151	0.02 – 1.3[1]
Volatile Organic Compounds		
	SW 846, Method 8260 (VOAs)	0.01 - 57[1]
	SW 846, Method 8021 (Halogenated VOAs)	0.003 - 3[1]
Dioxins		
	SW 846, Method 8280	0.01 - 0.05[1]
General Chemistry		
	SW 846, Method 9012 (Cyanide)	Not available
	SW 846, Method 9010 (Cyanide)	20
	SW 846, Method 9030 (Sulfide)	200 - 400[1]
Alkalinity		
	EPA-600/4-79-020, Method 310.1	Not available
Anions		
	EPA-600/R-93-100, Method 300.0	2 – 2-[1]
pH		
	Company specific	Not applicable
Specific conductance	SW 846, Method 9050	Not available

1. Detection limit varies according to specific compound. The range of contract required detection limits for all compounds detected by the specific analytical method is given.
2. Method detection limits are from SW846 and EPA Methods, not the detection limits required by contract with the analytical laboratories.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 6.0 **Procedures to Prevent Hazards**

Figure

Tables

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 7.0 **Contingency Plan**

Appendix

Table

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7.0 CONTINGENCY PLAN [G]

The WAC 173-303 requirements for a contingency plan are satisfied in the following documents: portions of the *Hanford Emergency Management Plan* [Attachment 4 of the HF RCRA Permit (DW Portion)] and portions of the *Building Emergency Plan for the Integrated Disposal Facility* (Appendix 7A).

The unit-specific building emergency plan also serves to satisfy a broad range of other requirements [e.g., Occupational Safety and Health Administration standards (29 CFR 1910), *Toxic Substance Control Act of 1976* (40 CFR 761) and U.S. Department of Energy Orders]. Therefore, revisions made to portions of this contingency plan document that are not governed by the requirements of WAC 173-303 will not be considered as a modification subject to WAC 173-303-830 or HF RCRA Permit (DW Portion) Condition I.C.3.

Table 7-1 identifies which portions of the building emergency plan are written to meet WAC 173-303 contingency plan requirements. In addition to the building emergency plan portions identified in Table 7-1, Section 12.0 of the building emergency plan is written to meet WAC 173-303 requirements identifying where copies of the *Hanford Emergency Management Plan* and the building emergency plan are maintained on the Hanford Facility. Therefore, revisions to Section 12.0 and the portions identified in Table 7-1 are considered a modification subject to WAC 173-303-830 or the HF RCRA Permit (DW Portion), Condition I.C.3.

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Table 7-1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Hanford Emergency Management Plan (DOE/RL-94-02): Attachment 4 of the HF RCRA Permit (DW Portion)	Building Emergency Plan[1] (***ILAW Document Number***)
-350(3)(a) - A description of the actions which facility personnel must take to comply with this section and WAC 173-303-360.	X[2] Section 1.3.4	X[2] Sections 7.1, 7.2 through 7.2.5, and 7.3[3] Sections 4.0, 8.2, 8.3, 8.4, 11.0
-350(3)(b) - A description of the actions which shall be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the owner or operator, but cannot be transported pursuant to the requirements of WAC 173-303-370(5), Manifest system, reasons for not accepting dangerous waste shipments.	X[2] Section 1.3.4	X[2,4] Section 7.2.5.1
-350(3)(c) - A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in WAC 173-303-340(4).	X Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3-1	
-350(3)(d) - A current list of names, addresses, and phone numbers (office and home) of all persons qualified to act as the emergency coordinator required under WAC 173-303-360(1). Where more than one person is listed, one must be named as primary emergency coordinator, and others must be listed in the order in which they will assume responsibility as alternates. For new facilities only, this list may be provided to the department at the time of facility certification (as required by WAC 173-303-810 (14)(a)(I)), rather than as part of the permit application.		X[5] Section 3.1, 13.0
-350(3)(e) - A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.	X Hanford Fire Department: Appendix C	X Section 9.0

Table 7-1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Hanford Emergency Management Plan (DOE/RL-94-02): Attachment 4 of the HF RCRA Permit (DW Portion)	Building Emergency Plan[1] (*ILAW Document Number*)
-350(3)(f) - An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes.	X[6] Figure 7-3 and Table 5-1	X[7] Section 1.5

An 'X' indicates requirement applies.

[1] Portions of the *Hanford Emergency Management Plan* not enforceable through Appendix A of that document are not made enforceable by reference in the building emergency plan.

[2] The *Hanford Emergency Management Plan* contains descriptions of actions relating to the Hanford Site Emergency Preparedness System. No additional description of actions are required at the site level. If other credible scenarios exist or if emergency procedures at the unit are different, the description of actions contained in the building emergency plan will be used during an event by a building emergency director.

[3] Sections 7.1, 7.2 through 7.2.5, and 7.3 of the building emergency plan are those sections subject to the Class 2 "Changes in emergency procedures (i.e., spill or release response procedures)" described in WAC 173-303-830, Appendix I Section B.6.a.

[4] This requirement only applies to TSD units that receive shipments of dangerous or mixed waste defined as offsite shipments in accordance with WAC 173-303.

[5] Emergency Coordinator names and home telephone numbers are maintained separate from any contingency plan document, on file in accordance with HF RCRA Permit (DW Portion) General Condition II.A.4. and are updated, at a minimum, monthly.

[6] The Hanford Facility (sitewide) signals are provided in this document. No unit/building signal information is required unless unique devices are used at the unit/building.

[7] An evacuation route for the TSD unit must be provided. Evacuation routes for occupied buildings surrounding the TSD unit are provided through information boards posted within buildings.

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

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Integrated Disposal Facility

Appendix 7A **Building Emergency Plan**

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 8.0 **Personnel Training**

Appendix

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8.0 PERSONNEL TRAINING [H]

This chapter discusses personnel training requirements based on WAC 173-303 and the HF RCRA Permit (DW Portion). The HF RCRA Permit (DW Portion), Condition II.C (Personnel Training), contains training requirements applicable to Hanford Facility personnel and non-Facility personnel. Compliance with these requirements at the IDF is demonstrated by information contained both in Chapter 8.0 of DOE/RL-91-28, Attachment 33 of the HF RCRA Permit, and this chapter. This chapter supplements Chapter 8.0 of DOE/RL-91-28.

8.1 OUTLINE OF INTRODUCTORY AND CONTINUING TRAINING PROGRAMS [H-2]

The introductory and continuing training programs are designed to prepare personnel to manage and maintain the TSD unit in a safe, effective, and environmentally sound manner. In addition to preparing personnel to manage and maintain TSD units under normal conditions, the training programs ensure that personnel are prepared to respond in a prompt and effective manner should abnormal or emergency conditions occur. Emergency response training is consistent with the description of actions contained in Chapter 7.0, "Contingency Plan".

Introductory training includes general Hanford Facility training and TSD unit-specific training. General Hanford Facility training is described in DOE/RL-91-28, Section 8.1, and is provided in accordance with the HF RCRA Permit (DW Portion), Condition II.C.2. TSD unit-specific training is provided to Hanford Facility personnel allowing personnel to work unescorted. Hanford Facility personnel cannot perform a task for which they are not properly trained, except to gain required experience while under the direct supervision of a supervisor or coworker who is properly trained. Hanford Facility personnel assigned the job title of Emergency Coordinator and alternates to this position performing tasks described in WAC 173-303-360 (e.g., Building Emergency Directors) are thoroughly familiar with applicable contingency plan documentation, operations, activities, location, and properties of all waste handled, location of all records, and the unit/building layout.

Continuing training meets the requirements for WAC 173-303-330(1)(b) and includes general Hanford Facility training and TSD unit-specific training. General Hanford Facility training is the same as described for introductory training. TSD unit-specific training provides an annual review of emergency response training and an annual review of training necessary to ensure TSD unit operations are in compliance with WAC 173-303.

8.2 DESCRIPTION OF TRAINING PLAN

In accordance with HF RCRA Permit (DW Portion), Condition II.C.3, the unit-specific portion of the *Hanford Facility Dangerous Waste Permit Application* must contain a description of the training plan. The plan is written to comply with WAC 173-303-330 and is found in Appendix 8A. Written training plan documentation is maintained outside of the *Hanford Facility Dangerous Waste Permit Application* and the HF RCRA Permit. Therefore, changes made to the written training plan documentation are not subject to the HF RCRA Permit modification process. The training plan will be maintained as part of the operating records of the facility and will be available to regulators upon request.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Appendix 8A **Dangerous Waste Training Plan**

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USQ #03-2039-D

CH2M HILL Hanford Group, Inc.		**Manual**	**Management Plan**
		Document	**IDF-PLN-07, REV A-2**
DANGEROUS WASTE TRAINING PLAN		**Page**	**1 of 10**
		Issue Date	**May 14, 2003**
		Effective Date	**May 26, 2003**

FUNCTIONAL AREA MANAGER: **P.C.Miller**

DOCUMENT OWNER: **S. A. Davis**

1.0 PURPOSE AND SCOPE

This document outlines the dangerous waste training plan (DWTP) developed for the Integrated Disposal Facility(IDF) operated by the River Protection Project (RPP) Tank Farms Contractor.

This plan applies to IDF personnel employed by the CH2M HILL Hanford Group, Inc., the visitors CH2M HILL Hanford Group, Inc. brings onto the Hanford facility, and any subcontractors conducting work on behalf of CH2M HILL Hanford Group, Inc. The Hanford facility constitutes the Hanford site as defined by the Hanford facility Resource Conservation and Recovery Act (RCRA) permit issued by Ecology.

2.0 RESPONSIBILITIES

2.1 Management

The waste management facility manager has overall responsibility for training at the IDF under his control that includes but is not limited to: (5.1.1)

- Determine training requirements and training compliance for Hanford facility personnel, subcontractors, and visitors who obtain access or work within the IDF unit.

- Identify training requirements to contractors working in or around IDF units.

2.2 Training Manager

- Ensure instructors have satisfactory instructional skills and are technically knowledgeable through: current qualification/certification or specialized training, license/certificate or a degree in the technical area, or other appropriate training or experience (see DOE/RL-91-28 Chapter 8.0). (5.1.1)

- Conduct informal job analysis and identify training commensurate with personnel duties and responsibilities.

- Design and develop training programs.

- Develop and instruct training courses.

- Develop and maintain On-The-Job training requirements.

- Maintain the RPP-IDF training records.

2.3 Environmental Organization Responsibilities:

- Consult with training organization and IDF management in the development and evaluation of current training programs.

- Assist IDF manager in determining training requirements and RCRA compliance for personnel.

- Maintain current knowledge of RCRA training requirements pertaining to Hanford facility personnel.

2.4 Contracted Services (e.g., Fluor Federal Services (FFS) and Waste Management)

Contracted personnel who are classified as Hanford facility personnel have the following responsibilities:

- Ensure that employees are trained to meet RPP-IDF training requirements.
- Maintain employee training records and provide them if requested by RPP-IDF.

2.5 CH2M HILL Waste Services Responsibilities

- Provide daily Federal Register review, regulatory interpretation, and application of DOT regulations. As new requirements are identified, this information is distributed to the HAZMAT employees

- Maintain the authorized shippers list by reviewing shippers' qualifications through training records and verifying receipt of "request for authority" forms signs by requestor's management. This list is updated and distributed monthly

- Maintain a database, tracks shipping activities, and changes to the authorized shipper's list

- Conduct DOT compliance verification inspection and verification on HAZMAT, HW, RAM, and RMW shipments

- Provide information to training records regarding course completion.

3.0 PROCESS

3.1 Training Program

The introductory and continuing training programs are designed to prepare employees to operate and maintain the tank farms in a safe, effective, efficient, and environmentally sound manner. In addition to preparing employees to operate and maintain the tank farms under normal conditions, the training program ensures that employees are prepared to respond in a prompt and effective manner should abnormal or emergency conditions occur.

Introductory training includes general Hanford facility training and TSD unit-specific training.

General Hanford facility training is described in DOE/RL-91-28, Section 8.0, and provided in accordance with the Hanford Facility RCRA Permit (DW Portion), Condition II.C.

TSD unit-specific training is provided to Hanford facility personnel, allowing personnel to work unescorted and, in some cases, is required for escorted access. Hanford facility personnel cannot perform a task for which they are not properly trained, except to gain required experience while under the direct supervision of a supervisor or coworker who is properly trained.

The IDF Dangerous Waste training program is implemented. Incumbent personnel will complete new requirements within six months of the requirements being identified. Training of new employees is completed within the first six months of assignment. Training for personnel assigned to new positions is completed within six months of reassignment. Personnel who have not completed training are permitted to work at the IDF only under the supervision of a trained employee. IDF operations management is responsible for ensuring that personnel are trained and required qualifications are maintained. (5.1.3)

Continuing training meets the requirements for WAC 173-303-330(1)(b) and includes general Hanford facility training and TSD unit-specific training. (5.1.2)

3.2 Emergency Response Training

Federal and state regulations require that personnel be able to respond effectively to emergencies. In accordance with WAC 173-303-330(1)(d), personnel are trained on aspects applicable to operations. The following table indicates requirements from WAC 173-303-330(1)(d) applicable to IDF operations. (5.1.1, 5.1.4)

Elements of WAC 173-303-330(1)(d)	**Applicability to TSD Units (1) and < 90-day Accumulation Areas (2)**	
	(1)	**(2)**
Procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment	YES	YES
Key parameters for automatic waste feed cut-off systems	YES	NO
Communications or alarm systems	YES	YES
Response to fires or explosions	YES	YES
Response to groundwater contamination incidents	YES	YES
Shutdown of operations	YES	YES

3.3 Dangerous Waste Worker Categories

Employee duties at the IDF are categorized within four worker categories. In the event personnel duties and responsibilities overlap between categories, the employee will complete the training requirements for each category. These categories are: (5.1.1, 5.1.5)

1. All Employees

2. Waste Worker
3. Advanced Waste Worker
4. Waste Worker Supervisor/Manager

Each employee is assigned a job title (from salaried nonexempt or bargaining unit classifications) or position (from exempt classifications). Job or position descriptions include requisite skills, work experience, education and other qualifications, and a list of duties and/or responsibilities for each job title or position. The work experience, education, and other qualifications required for each position are maintained by IDF Human Resources. As a minimum, "all employees" require a high school diploma or equivalent. Personnel filling exempt, management, or engineering positions normally require a college degree with two or more years of industry experience. (5.1.5)

Only names of Hanford facility personnel who carry out job duties relating to TSD unit waste management operations at IDF are maintained. Names are maintained in electronic data storage within the Integrated Training Electronic Matrix (ITEM). A list of Hanford facility personnel assigned to IDF is available upon request.

In the following sections, brief job titles and position descriptions of employees associated with dangerous waste management at IDF are listed within the appropriate waste worker category. (5.1.5)

3.3.1 All Employees

Hanford facility personnel included in this position are not categorized into one of the other three worker positions. Non-Hanford facility personnel included within this position are those personnel that require access to portions of the Hanford facility not accessible to the public.

Personnel in the "all employees" position are prohibited from performing duties or responsibilities associated with the management of waste in accumulation/storage containers on the Hanford facility. These personnel have the responsibility to report spills and releases that they discover in addition to taking any evacuation or take cover actions in response to specific incidents that may occur.

Most of the Hanford facility personnel categorized as "all employees" will be administrative and technical/professional personnel which include secretaries, clerks, and support organizations who perform walk-downs or provide oversight. Most non-Hanford facility personnel will be categorized as "all employees" since these personnel generally tour, provide oversight, or are brought on the Hanford facility for interviews. Other non-Hanford facility personnel who gain access to the Hanford facility to complete work in controlled areas that will not directly involve the management of dangerous or mixed waste, will be categorized as "all employees."

All employees are required to complete Hanford General Employee Training (HGET) with an annual refresher (HGET core).

3.3.2 Waste Workers

Hanford facility personnel or non-Hanford facility personnel with waste management duties and responsibilities who require unescorted access and are limited to the initial generation of dangerous or mixed waste and placing that waste into a pre-approved container, or who conduct dangerous or mixed waste inspections, are categorized as waste workers.

The pre-approved container can include those in a satellite accumulation area, <90-day accumulation area, or temporary storage and disposal unit.

These personnel could generate dangerous or mixed waste while working on a non-RCRA system (e.g., building maintenance) or working on a temporary storage and disposal unit when conducting maintenance. These personnel could also include operators who conduct daily inspections on tank systems to ensure they are operating properly, and operators who conduct daily inspections on ancillary equipment.

The work may be unsupervised or completed under the supervision of qualified unit/building personnel (e.g., the person in charge or field work supervisor). In addition, a waste worker must fulfill the roles of an "all employee." Hanford facility personnel categorized as waste workers may be assigned duties and responsibilities for:

- Placing waste they generate into pre-approved containers and filling out log sheets, where applicable

- Completing radiological surveys of dangerous or mixed waste

- Loading packaged containers onto trucks or movement of containers

- Responding to a spill or release of known contents where the duties and responsibilities are limited to containing the spill/release, returning the drum to an upright position, and placing the known spilled material or waste into a pre-approved container

- Applying container markings or labels based on direction received from others

- Responding to regulatory agency compliance inspectors' questions about waste management practices

- Performing an inventory of dangerous or mixed waste

- Conducting inspections of dangerous or mixed waste.

Personnel who function as waste workers may include, but are not limited to, the following:

- Maintenance and craft personnel
- Operators
- Health physics technicians
- Transporters
- Contractor crafts
- Technical support staff.

The list of employees currently filling this position is maintained by the ITEM.

3.3.3 Advanced Waste Worker

Hanford facility personnel are categorized as advanced waste workers if their duties and responsibilities concerning dangerous or mixed waste exceed that of waste workers (therefore, an advanced waste worker may fulfill the roles of a waste worker.) Examples of these duties and responsibilities can include determining container markings, sampling of waste, designation of waste material(s), and classification of waste materials prior to shipment.

The list of employees currently filling this position is maintained by the ITEM.

3.3.4 Waste Worker Supervisor/Manager

Various types of managers and non-managers are included in this position. Hanford facility personnel assigned to unit/buildings can be categorized as waste worker supervisor/managers if they direct waste worker or advanced waste worker activities relating to dangerous waste management and compliance activities. Managers and non-managers who direct waste workers and advanced waste workers have many similar duties and responsibilities relating to dangerous or mixed waste management and are required to take the same courses.

The following staff has duties and responsibilities that meet this description:

- Emergency coordinator and/or alternate(s) (e.g., building emergency directors and some building wardens)
- Environmental Compliance Officer and Waste Management manager for IDF
- Immediate managers of waste workers and advanced waste workers (e.g., field work supervisors, Radiological Control first-line managers and operations engineers/managers).

The list of employees currently filling this position is maintained by the ITEM.

3.4 Matrix of Training Requirements for Each Waste Worker Category

The following training requirements are maintained in the ITEM. Based on training assessments, oversight, and acting within federal and state regulations, IDF management may change the training requirements. For this reason, a current course listing is available upon request.

Course descriptions with retrain frequencies are linked to the courses in the ITEM. Continuing training (retraining) courses are linked in the ITEM database to the initial training course. If the continuing training is not kept current, the system will show the initial course as delinquent. (5.1.5)

3.4.1 All Employees

NOTE: Select link for course description (5.1.5)

000001

HANFORD GENERAL EMPLOYEE TRAINING - FULL

3.4.2 Waste Worker

[ ] Option 01 Waste Worker Core, Individual performs duties as a Waste Worker at the River Protection Project Tank Farms Contractor.

000001 HANFORD GENERAL EMPLOYEE TRAINING - FULL
03E060 RPP/TANK FARM FACILITY EMERGENCY HAZARDS CHECKLIST
350560 RPP WASTE HANDLING, SEGREGATION AND PACKAGING
XXXXX Integrated Diposal Facility Orientation

[ ] Option 02 The course covers federal, state and company policy regarding the management of containerized waste, both regulated (dangerous) and non-regulated.

035100 CONTAINER WASTE MANAGEMENT INITIAL

3.4.3 Advanced Waste Worker

[ ] Option 01 Advanced Waste Worker Core, Individual performs duties as an Advanced Waste Worker at the RPP Tank Farms Contractor.

000001 HANFORD GENERAL EMPLOYEE TRAINING - FULL
035100 CONTAINER WASTE MANAGEMENT INITIAL
03E060 RPP/TANK FARM FACILITY EMERGENCY HAZARDS CHECKLIST
350560 RPP WASTE HANDLING, SEGREGATION AND PACKAGING
XXXXXX Integrated Diposal Facility Orientation

[ ] Option 02 Waste Designator, Individual performs Waste Designation duties at the RPP Tank Farms Contractor

035010 WASTE DESIGNATION
035012 WASTE DESIGNATION QUALIFICATION
035020 FACILITY SAMPLING AND ANALYSIS

[ ] Option 03 Hazardous Waste Shipper, Individual performs Hazardous Waste Shipping duties at the RPP Tank Farms Contractor. Note: Need to select Option 04 "Radioactive Materials Shipper" if Individual will be performing duties as a "Mixed Waste Shipper".

020159 ADVANCED COURSE 2 - HAZARDOUS WASTE SHIPPER CERTIFICATION TRAINING

[ ] Option 04 Radioactive Materials Shipper, Individual performs Radioactive Material Shipping duties at

the RPP Tank Farms Contractor. Note: Need to select Option 03 "Hazardous Waste Shipper" if Individual will be performing duties as a "Mixed Waste Shipper".

020069 ADVANCED COURSE 3 - RADIOACTIVE MATERIALS SHIPPER CERTIFICATION TRAINING

3.4.4 Waste Worker Supervisor/Manager

[ ] Option 01 Waste Worker Supervisor/Manager Core, Individuals that direct Waste Worker or Advanced Waste Worker activities relating to dangerous or mixed waste management and compliance activities.

- 000001 HANFORD GENERAL EMPLOYEE TRAINING - FULL
- 035050 ENVIRONMENTAL REGULATIONS AT HANFORD (CLASSROOM)
- 03E060 RPP/TANK FARM FACILITY EMERGENCY HAZARDS CHECKLIST
- 350560 RPP WASTE HANDLING, SEGREGATION AND PACKAGING
- XXXXXX Integrated Diposal Facility Orientation

[ ] Option 02 Waste Shipper/Supervisor, Individual performs Waste Shipping / Supervision duties at the RPP Tank Farms Contractor

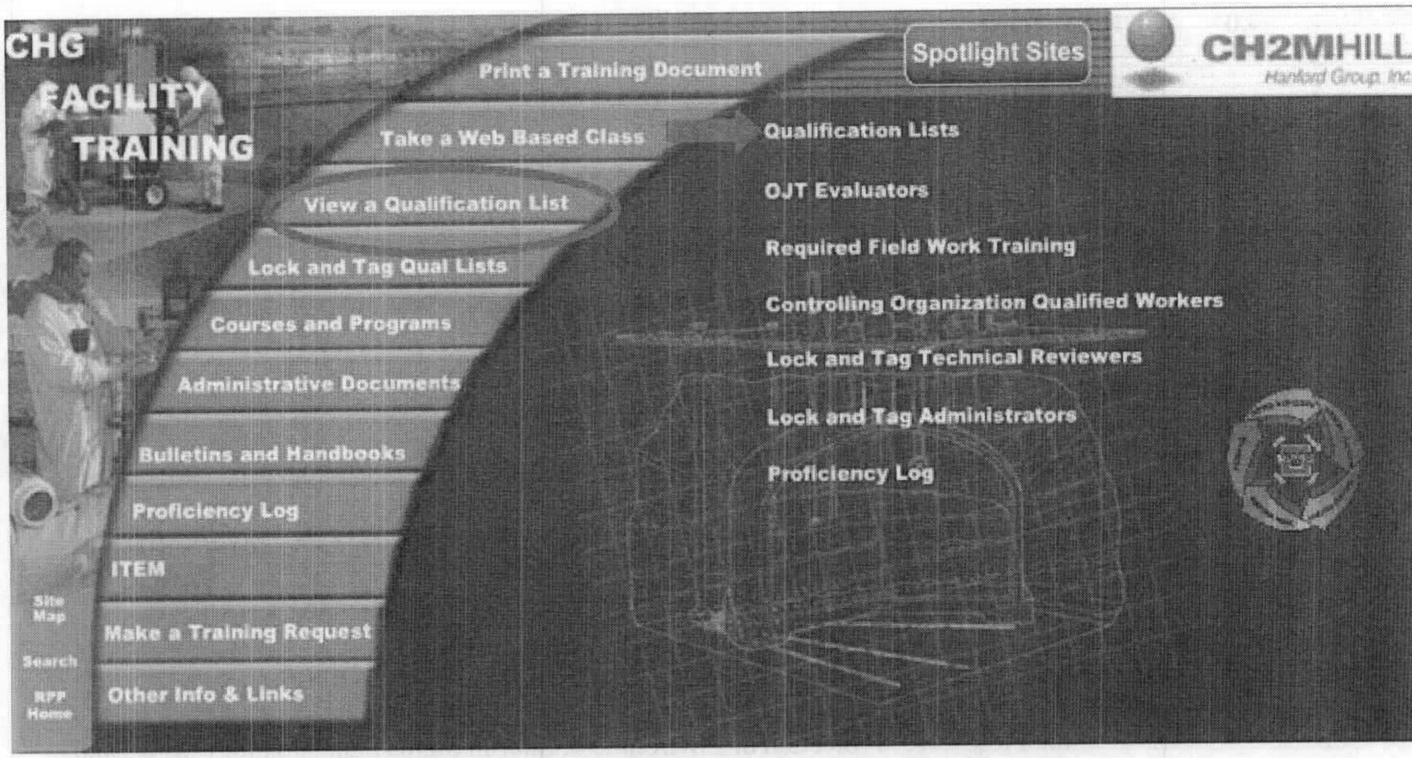
- 020078 ADVANCED COURSE 4 - MIXED WASTE SHIPPER CERTIFICATION TRAINING
- 020159 ADVANCED COURSE 2 - HAZARDOUS WASTE SHIPPER CERTIFICATION TRAINING
- 035100 CONTAINER WASTE MANAGEMENT INITIAL

[ ] Option 03 Waste Designator/Supervisor, Individual performs Waste Designation / Supervision duties at the RPP Tank Farms Contractor

- 035010 WASTE DESIGNATION
- 035012 WASTE DESIGNATION QUALIFICATION
- 035020 FACILITY SAMPLING AND ANALYSIS

3.5 Job-Specific Facility Training

The IDF-specific and job-specific qualifications and/or certifications are maintained according to contractual and regulatory requirements. IDF management uses qualification lists to ensure personnel they assign to work in the tank farms meet current training requirements. The qualification lists, generated using the PeopleSoft® database, are updated on a daily basis and are posted to the IDF Training Web Page.



3.6 Training Records

Training records, as described in WAC 173-303-330, consist of documentation that show training has been completed. Training records associated with personnel identified in the DWTP are maintained in accordance with DOE/RL-91-28 Chapter 8.0. Hanford Facility training records include both electronic data storage and hard copies. Course completion documentation for personnel is maintained in both hard copy and electronic formats. (5.1.5)

The course completion documentation will contain the course number, course title, and date of completion. Copies of the training record files for IDF Dangerous Waste management employees are stored at IDF Training. The originals are sent to Fluor Hanford, Inc. (FH) Training and are initially maintained in Richland, Washington. Original hard copy training records are transferred periodically to the Records Holding Facility in Richland, Washington. After approximately one year, the original hard copy training records are archived at the permanent record storage center in Renton, Washington. Course completion documentation of former employees are maintained in accordance with DOE/RL-91-28 Chapter 8.0 and Hanford Facility RCRA Permit, General Facility Condition II.I.1, Regarding Facility Operations Record.

When a training record is requested during an inspection, an electronic data storage record will initially be provided. If the electronic data storage record does not satisfy the inspection concern, a hard copy training record will be provided. Training records of former employees may not be available through computers at IDF and may require a representative from FH Training to access the PeopleSoft® system for this information.

4.0 DEFINITIONS

No terms or phrases unique to this procedure are used.

5.0 SOURCES

5.1 Requirements

1. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1) and (1)(a), Personnel Training. (S/RID)

2. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1)(b). (S/RID)

3. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1)(c). (S/RID)

4. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1)(d). (S/RID)

5. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(2). (S/RID)

5.2 References

1. 40CFR265.16, "Protection of Environment, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Personnel Training.

2. DOE/RL-91-28 Rev 4, "Dangerous Waste Portion Of The Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste," Chapter 8, Personnel Training.

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 11.0 **Closure and Financial Assurance**

Figure

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11.0 CLOSURE AND FINANCIAL ASSURANCE [I]

This chapter discusses preclosure, closure, and postclosure activities for the IDF. This closure plan complies with WAC 173-303-610 and represents the baseline for closure.

The IDF will be constructed on 25 hectares of vacant land southwest of the PUREX Plant in the 200 East Area (Figure 2-1). The landfill will be segregated into a RCRA permitted side and a non-RCRA permitted side. The scope of this permit application is limited to the western side of the landfill where the RCRA waste will be placed. The waste containers and bulk waste that meet the IDF waste acceptance criteria will be inventoried, and disposed in this lined landfill. Leachate collected from the lined landfill will be transferred to leachate collection tanks located in proximity to the landfill for subsequent treatment.

A more detailed discussion of IDF waste types and the identification of the IDF processes and equipment are provided in Chapters 3.0 and 4.0, and attendant appendices. The IDF only will accept and dispose waste containers and bulk waste that meet the IDF waste acceptance criteria, RCRA and LDR.

The closure process will be the same for partial closure or closure of the entire IDF. The remainder of this chapter describes the performance standards that will be met, and the closure/postclosure activities that will be conducted.

Federal facilities are not required to comply with WAC 173-303-620 as is stated in the regulations and as described in Condition II.H.3. of the *Dangerous Waste Portion of the Hanford Facility RCRA Permit* (Ecology 2001).

11.1 CLOSURE PLAN [I-1]

Waste containers and bulk waste that meet the IDF waste acceptance criteria will be disposed in the lined landfill that complies with WAC 173-303-665 standards (Chapter 4.0). The IDF will be closed according to current applicable WAC 173-303 regulations, DOE requirements, best management practices, and will be integrated with the overall cleanup activities performed under the Tri-Party Agreement (HFFACO 2001).

The disposal landfill cover will be designed and located to comply with WAC 173-303-665(6) and WAC 173-303-610. The specification and/or variation for other cover designs will be provided at the time of closure once a hazard(s) has been defined.

11.2 CLOSURE PERFORMANCE STANDARDS [I-1a]

Closure requirements found in DOE/RL-91-28, Chapter 11.0, combined with requirements found in WAC 173-303-665(6), will make up the closure performance standards for the IDF.

11.3 PRECLOSURE ACTIVITIES

Preclosure activities could include, at a minimum, placing interim or final covers over the filled portions of the landfill as the landfill is expanded to accept more waste. Placement of covers over the filled portions might be deferred until closure of all the IDF. Once a decision is made to construct the final cover over the landfill, a closure cover design will be used that satisfies the dangerous waste disposal requirements defined in WAC 173-303.

The selection of a final cover design has not been identified. Figure 11-1 shows an example of a typical Hanford Site landfill cover design. Design(s) will include features to satisfy the minimum requirements found in WAC 173-303-665(6).

11.4 MAXIMUM EXTENT OF OPERATION [I-1b(1)]

The maximum process design capacity of the IDF conservatively is calculated to be 100 hectare-meters, which is 1,000,000 cubic meters (Chapter 1.0, Part A, Form 3, Section III). The IDF landfill will be segregated into a RCRA permitted side of 50 hectare-meters and a non-RCRA permitted side of 50 hectare-meters.

11.5 DECONTAMINATING EQUIPMENT AND STRUCTURES

All ancillary equipment and its secondary containment, and instrumentation (e.g., level-indicating devices, leak detection devices, pumps, piping) meet the definition of "debris" as defined in WAC 173-303-040. Items in direct contact with mixed waste are assumed to meet the definition of "hazardous debris" as defined in WAC 173-303-040.

Currently, three options are available for treating hazardous debris. The first option is to treat the debris using one of the three debris treatment technologies-extraction, destruction, or immobilization-as described in 40 CFR 268.45. If the hazardous debris is treated using approved extraction or destruction technologies, the debris is no longer required to be managed as a dangerous waste as long as the debris does not exhibit a characteristic of a dangerous waste. If hazardous debris contaminated with a listed waste is treated using an immobilization technology, it remains a listed waste, even after the LDR treatment standards are met unless Ecology makes a case-by-case determination that the debris "no longer contains" a mixed waste. In effect, by making this "contained-in" determination on a case-by-case basis, Ecology will be setting clean closure standards in accordance with the closure performance standards of WAC 173-303-610(2)(a)(ii).

The second option is to treat the hazardous debris to meet the constituent-specific LDR treatment standard for the waste or waste-specific constituents contaminating the debris; however, such debris, even after treatment, may be considered a dangerous waste under the dangerous waste regulations and may require management at a facility permitted to manage dangerous waste.

The third option involves obtaining a "contained-in determination" for the hazardous debris, thereby rendering the waste "non-hazardous" for those waste-specific listed constituents that fall below MTCA method B risk-based health limits. Moreover, it must be proven that the debris does not designate as a characteristic waste under WAC-173-303.

11.5.1 CONTAMINATED SOIL

Contaminated soil could be generated as a result of spill cleanup. Since the majority of IDF operations will be preformed within secondary containment (see Chapters 4.0 and 6.0) the potential for spilling dangerous waste into the surrounding soil is low. Contaminated soil generated as a result of a dangerous waste spill will be managed pursuant to WAC-173-303-200.

Once the soil is designated, appropriate treatment and disposal or storage options will be determined and implemented.

A contained-in determination could also be sought for contaminated soil generated as a result of a spill. For contaminated media the contained-in policy requires that a statistically based sampling plan be used for obtaining the data to support a contained-in demonstration. The contained-in policy does not require that the waste be analytically nondetectable for it to be considered non-dangerous. However, the analytical results must prove that the listed constituents in the soil are below health-based limits as provided in WAC 173-303-610(2)(b)(i) and that the soil does not exhibit any dangerous waste characteristics (i.e., soil does not designate for D codes). If approved by Ecology, this could allow waste that falls below specific health-based levels to be disposed of without requiring treatment

11.6 CLOSURE OF LANDFILL UNITS [I-1e and I-1e(2)]

Closure of the IDF will be consistent with the closure requirements specified in WAC-173-303-665(6) and WAC 173-303-610. The cover design(s) will satisfy the requirements of WAC 173-303-665(6).

11.6.1 Cover Design [I-1e(2), I-1e(4), I-1e(5), I-1e(7), and I-1e(8)]

The cover could consist of several layers constructed on top of a native soil base. A generalized cross-section of an example cover is shown on Figure 11-1. It is assumed that before construction of the final cover, the waste form would be stabilized appropriately.

11.6.1.1 Grade Layer

The surface of the landfill would be graded and/or shaped, if necessary, to match the slope of the desired low-permeability layer. Additional soil would be placed over the landfill to achieve the required cover grade. This grade layer could taper from zero thickness near the edge of the cover boundary to perhaps several meters at the center of the cover; the thickness would depend on the lateral dimensions of the particular cover and the grade of the cover.

11.6.1.2 Low-Permeability Layer

The selection of an appropriate material for this layer would be based on the hazard that is to be isolated. The low-permeability layer will be the primary barrier in preventing soil and/or water from migrating into the waste zone and meet WAC 173-303-655 (6) (v) "Have a permeability less than or equal to the permeability of any bottom liner system or natural sub soils present".

11.6.1.3 Drainage Layer

The drainage layer would conduct any water that percolates through the overlying layers laterally to the drainage ditch. Thus, the drainage layer would prevent hydraulic pressure from building up directly on the low-permeability liner, and thereby eliminate one set of forces that would drive moisture through the primary moisture control barrier.

11.6.1.4 Plant, Animal, and Human Intrusion Layer (optional)

The performance objectives for the permanent isolation surface barrier are summarized as follows:

- Function in a semiarid to sub-humid environment
- Limit the recharge of water through the waste to near zero amounts [0.05 centimeter per year ($1.6x10^{-9}$ centimeters per second)]
- Be maintenance free
- Minimize the likelihood of plant, animal, and human intrusion
- Limit the exhalation of noxious gases
- Minimize erosion-related problems
- Meet or exceed WAC 173-303-665(6) cover performance requirements

- Isolate waste for 1,000 years.

To satisfy the intrusion performance objective, an optional layer would be included in the design of barriers that require the additional human and/or biointrusion protection to reduce either the environmental or human health risk.

11.6.1.5 Graded Filter Layer

A graded filter consisting of crushed rock overlaid by sand would be placed on either the plant, animal, and human intrusion layer if incorporated into the design, or directly over the drainage layer. The graded filter would serve to separate the surface soil layer from the drainage layer. A geotextile would be placed on the top of the graded filter to decrease the potential for fine material to enter the filter and drainage zone. The geotextile would be permeable, allowing drainage, and would not support a standing head of water.

11.6.1.6 Surface Soil Layer

The two most important factors in engineering the surface soil thickness would be the assignment of the water retention characteristics for soil and climate information. Surface soil would be placed over the geotextile to intercept, store, and recycle water, and prevent damage to the underlying structure from natural and synthetic processes.

11.6.1.7 Vegetative Cover

The vegetative cover would perform three functions. First, the plants would return water stored in the surface soil back to the atmosphere, significantly decreasing net infiltration and reducing the amount of moisture available to penetrate the cover. Second, the vegetation would stabilize the surface soil component of the cover against wind and water erosion. Finally, the vegetative cover would restore the appearance of the land to a more natural condition and appearance.

A mixture of seeds would be used to establish vegetation. The seed types would be selected based on resistance to drought, rooting density, and ability to extract water.

11.6.2 Wind Erosion

The principal hazard associated with wind erosion is the thinning of the cover surface soil layer. This in turn potentially could lead to breaching of the moisture barriers, gradually allowing larger quantities of water to reach the waste. The engineering approaches to mitigating wind erosion of the cover would be (1) designing the surface soil layer with an appropriate total thickness to compensate for future soil loss that might result from wind erosion, (2) establishing a vegetative cover on the surface to reduce wind erosion, and (3) including an appropriate coarse material (admix) in the upper layer of the surface soil to form an armor layer.

11.6.3 Water Erosion

The potential hazard associated with water erosion is the same as that for wind erosion, namely the loss of soil from the top or surface layer.

Several of the following engineering approaches could be adopted to minimize the potential for water erosion:

- Limiting the surface slopes
- Providing *run*-on control with the sideslope drainage ditches
- Compacting the surface soil in a way that promotes significant infiltration rather than excessive run-off
- Properly designing the sideslopes to prevent gullying
- Establishing a vegetative cover to slow surface run-off
- Incorporating coarse material (pea gravel admix) in the upper portion of the surface soil layer to help form an erosion-resistant armor
- Limiting flow path lengths through the use of vegetation and admix.

The cover design would be evaluated for potential erosion damage from overall soil erodibility, sheet flow, and gullying.

11.6.4 Deep-Rooted Plants

The following design features could minimize the potential for problems with deep-rooted plants.

- The surface soil (top two layers) would retain most of the precipitation, because the underlying drainage layer would have significantly higher permeability and much less water retention capacity. Therefore, it is expected that vegetation preferentially would occupy the surface soil layer and not have an affinity for growing into the drier underlying layers.

- The thickness of the surface soils would be sized to promote the development of semiarid deep-rooted perennial grasses and to discourage the development of deep-rooting intrusive species.

11.7 SCHEDULE FOR CLOSURE [I-1f]

As stated previously, closure of the IDF will be a complex process. At the time of closure, this closure plan will be updated to reflect the current closure plan schedule per WAC 173-303-830, Appendix I. In addition, when a closure date is established, a revised closure plan and closure schedule will be submitted to Ecology that contains detailed information regarding specific activities and implementation timeframes.

11.8 EXTENSION FOR CLOSURE [I-1(g)]

An extension for closure request is anticipated to complete the closure/postclosure process of the IDF.

11.9 POSTCLOSURE PLAN [I-3]

Because of the long active life of the IDF, a comprehensive postclosure plan will be developed when closure becomes imminent or when 200 Areas cleanup activities prescribed by the Tri-Party Agreement require integration.

Figure 11.1. Typical Hanford Site Landfill Cover Design

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 13.0 Other Federal and State Laws

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13.0 OTHER FEDERAL AND STATE LAWS [J]

Generally, the laws applicable to the IDF include, but might not be limited to, the following:

- *Atomic Energy Act of 1954*
- *Federal Facility Compliance Act of 1992*
- *Clean Air Act of 1977*
- *Safe Drinking Water Act of 1974*
- *Emergency Planning and Community Right-to-Know Act of 1986*
- *Toxic Substances Control Act of 1976*
- *National Historic Preservation Act of 1966*
- *Endangered Species Act of 1973*
- *Fish and Wildlife Coordination Act of 1934*
- *Federal Insecticide, Fungicide, and Rodenticide Act of 1975*
- *Hazardous Materials Transportation Act of 1975*
- *National Environmental Policy Act of 1969*
- *Washington Clean Air Act of 1967*
- *Washington Water Pollution Control Act of 1945*
- *Washington Pesticide Control Act of 1971*
- *State Environmental Policy Act of 1971.*
- *Letter ,C.J .Paperiello NRC to J.E Kinzer DOE/RL "Classification of Hanford Low-Activity Tank Waste Fraction" dated June 9th 1997*

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PART I									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
I.A.	EFFECT OF PERMIT								
I.A.1.		*	*	*	*	*	*	*	
I.A.2.		*	*	*	*	*	*	*	
I.A.3.		*	*		*	*	*	*	
I.A.4.	Coordination with the FFACO		*		*	*	*	*	
I.B.	PERSONAL AND PROPERTY RIGHTS		*		*	*	*	*	
I.C.	PERMIT ACTIONS								
I.C.1.	Modification, Revocation, Reissuance, or Termination		*		*	*	*	*	
I.C.2.	Filing of a Request		*		*	*	*	*	
I.C.3.	Modifications		*		*	*	*	*	
I.D.	SEVERABILITY								
I.D.1.	Effect of Invalidation		*		*	*	*	*	
I.D.2.	Final Resolution		*		*	*	*	*	
I.E.	DUTIES AND REQUIREMENTS								
I.E.1.	Duty to Comply		*		*	*	*	*	
I.E.2.	Compliance Not Constituting Defense		*		*	*	*	*	
I.E.3.	Duty to Reapply		*		*	*	*	*	
I.E.4.	Permit Expiration & Continuation		*		*	*	*	*	
I.E.5.	Need to Halt or Reduce Activity Not a Defense		*		*	*	*	*	
I.E.6.	Duty to Mitigate		*		*	*	*	*	
I.E.7.	Proper Operation & Maintenance		*		*	*	*	*	
I.E.8.	Duty to Provide Information		*		*	*	*	*	
I.E.9.	Inspection & Entry		*		*	*	*	*	
I.E.9.a.			*		*	*	*	*	
I.E.9.b.			*		*	*	*	*	
I.E.9.c.			*		*	*	*	*	
I.E.9.d.			*		*	*	*	*	
I.E.10.	Monitoring & Records								
I.E.10.a.			*		*	*	*	*	
I.E.10.b.			*		*	*	*	*	
I.E.10.c.			*		*	*	*	*	
I.E.10.d.			*		*	*	*	*	
I.E.10.e.			*		*	*	*	*	

CATEGORIES ARE DEFINED AS FOLLOWS:

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B. North Slope and ALE
C. Interim Status TSD Units
Areas Between TSDs (excluding A and B)
D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

1 – For Category B, Part I Conditions only apply if future TSD activities are begun on the North Slope or ALE.
2 – For Category C, all Part I Conditions apply to activities subject to Conditions II.U. and II.V.
3 – For Category D, Part I Conditions only apply to activities subject to Conditions II.A., II.C., II.D.4., II.G., II.I., II.L.3., II.O., II.Q., II.S., II.T., II.X., and II.Y.

PART I									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
I.E.11.	Reporting Planned Changes		*			*	*	*	
I.E.12.	Certification of Construction or Modification		*				*		
I.E.13.	Anticipated Noncompliance		*		*	*	*	*	
I.E.14.	Transfer of Permits		*			*	*	*	
I.E.15.	Immediate Reporting								
I.E.15.a.			*		*	*	*	*	
I.E.15.b.			*		*	*	*	*	
I.E.15.c.			*		*	*	*	*	
I.E.15.d.			*		*	*	*	*	
I.E.15.e.			*		*	*	*	*	
I.E.16.	Written Reporting		*		*	*	*	*	
I.E.17.	Manifest Discrepancy Report								
I.E.17.a.			*			*	*	*	
I.E.17.b.			*		*	*	*	*	
I.E.18.	Unmanifested Waste Report		*			*	*	*	
I.E.19.	Other Noncompliance		*		*	*	*	*	
I.E.20.	Other Information		*		*	*	*	*	
I.E.21.	Reports, Notifications, & Submissions		*		*	*	*	*	
I.E.22.	Annual Report		*		*	*	*	*	
I.F.	SIGNATORY REQUIREMENT		*		*	*	*	*	
I.G.	CONFIDENTIAL INFORMATION		*		*	*	*	*	
I.H.	DOCUMENTS TO BE MAINTAINED AT FACILITY SITE		*		*	*	*	*	

CATEGORIES ARE DEFINED AS FOLLOWS:

A. Leased Land
B. North Slope and ALE
C. Interim Status TSD Units
Areas Between TSDs (excluding A and B)
D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

1 – For Category B, Part I Conditions only apply if future TSD activities are begun on the North Slope or ALE.
2 – For Category C, all Part I Conditions apply to activities subject to Conditions II.U. and II.V.
3 – For Category D, Part I Conditions only apply to activities subject to Conditions II.A., II.C., II.D.4., II.G., II.I., II.L.3., II.O., II.Q., II.S., II.T., II.X., and II.Y.

PART II									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
II.A.	FACILITY CONTINGENCY PLAN								
II.A.1.					*	*	*	*	For Category D, II.A Conditions only apply to releases of hazardous substances that threaten human health or the environment.
II.A.2.					*	*	*	*	
II.A.3.					*	*	*	*	
II.A.4.					*	*	*	*	
II.B.	PREPAREDNESS AND PREVENTION								
II.B.1.						*	*		
II.B.2.						*	*		
II.B.3.						*	*		
II.B.4.						*	*		
II.C.	PERSONNEL TRAINING								
II.C.1.						*	*	*	
II.C.2.					*	*	*	*	
II.C.2.a.					*	*	*	*	
II.C.2.b.					*	*	*	*	
II.C.2.c.					*	*	*	*	
II.C.2.d.					*	*	*	*	
II.C.2.e.					*	*	*	*	
II.C.3.						*	*	*	
II.C.4.					*	*	*	*	For Category D, Condition II.C.4 will not apply to unrestricted (publicly accessible) areas.
II.D.	WASTE ANALYSIS								
II.D.1.						*	*	*	
II.D.2.						*	*	*	
II.D.3.						*	*	*	
II.D.4.					*				
II.E.	QUALITY ASSURANCE/ QUALITY CONTROL								
II.E.1.						*	*	*	
II.E.2.						*	*	*	

CATEGORIES ARE DEFINED AS FOLLOWS:

A. Leased Land
B. North Slope and ALE
C. Interim Status TSD Units
D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)
Areas Between TSDs (excluding A and B)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

PART II									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
II.E.2.a.						*	*	*	
II.E.2.b.						*	*	*	
II.E.2.c.						*	*	*	
II.E.2.d.						*	*	*	
II.E.3.						*	*	*	
II.E.3.a.						*	*	*	
II.E.3.b.						*	*	*	
II.E.4.						*	*	*	
II.E.5.						*	*	*	
II.F.	GROUND WATER AND VADOSE ZONE MONITORING					*	*	*	
II.F.1.	Purgewater Management					*	*	*	
II.F.2.	Well Remediation and Abandonment					*	*	*	
II.F.2.a.						*	*	*	
II.F.2.b.						*	*	*	
II.F.2.c.						*	*	*	
II.F.2.d.						*	*	*	
II.F.3.	Well Construction					*	*	*	
II.G.	SITING CRITERIA				*		*		For Category D, Condition II.G only applies if a new TSD unit is to be sited.
II.H.	RECORDKEEPING AND REPORTING								
II.H.1.	Cost Estimate for Facility Closure					*	*	*	
II.H.2.	Cost Estimate for Post-Closure Monitoring and Maintenance					*	*	*	
II.H.3.						*	*	*	

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C. Interim Status TSD Units
Areas Between TSDs (excluding A and B)
D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

PART II									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
II.I.	FACILITY OPERATING RECORD								For Category D, II.I Conditions only apply to activities subject to this Permit as defined by this matrix. For Category E, Condition applicability to be specified in Part V. Condition II.I only applies to existing records and records prepared after the date of Permit issuance.
II.I.1.		*	*		*	*	*	*	
II.I.1.a.		*	*		*	*	*	*	
II.I.1.b.							*	*	
II.I.1.c.					*	*	*	*	
II.I.1.d.						*	*	*	
II.I.1.e.			*		*				
II.I.1.f.					*	*	*	*	
II.I.1.g.						*	*	*	
II.I.1.h.	Condition Reserved								
II.I.1.i.						*	*	*	
II.I.1.j.						*	*	*	
II.I.1.k.					*	*	*	*	
II.I.1.l.	Condition Reserved								
II.I.1.m.						*	*	*	
II.I.1.n.					*	*	*	*	
II.I.1.o.	Condition Reserved								
II.I.1.p.			*		*	*	*	*	
II.I.1.q.			*		*	*	*	*	
II.I.1.r.					*	*	*	*	
II.I.1.s.					*	*	*	*	
II.I.1.t.					*	*	*	*	
II.I.2.		*	*		*	*	*	*	
II.J.	FACILITY CLOSURE								
II.J.1.						*	*	*	

CATEGORIES ARE DEFINED AS FOLLOWS:

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Areas Between TSDs (excluding A and B)
D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

PART II									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
II.J.2.						*	*	*	
II.J.3.						*	*	*	
II.J.4.						*	*	*	
II.J.4.a.						*	*	*	
II.J.4.b.						*	*	*	
II.J.4.c.						*	*	*	
II.J.4.d.						*	*	*	
II.K.	SOIL/GROUND WATER CLOSURE PERFORMANCE STANDARDS								
II.K.1.						*	*	*	
II.K.2.						*	*	*	
II.K.3.						*	*	*	
II.K.3.a.						*	*	*	
II.K.3.b.						*	*	*	
II.K.3.c.						*	*	*	
II.K.4.						*	*	*	
II.K.5.						*	*	*	
II.K.6.						*	*	*	
II.K.7.						*	*	*	
II.L.	DESIGN AND OPERATION OF FACILITY								
II.L.1.	Proper Design and Construction					*	*	*	
II.L.2.	Design Changes, Nonconformance and as-built Drawings					*	*	*	Condition II.L.2, applies to Categories E & G only if it is a landfill closure.
II.L.2.a.						*	*	*	
II.L.2.b.						*	*	*	
II.L.2.c.						*	*	*	
II.L.2.d.						*	*	*	
II.L.2.e	Facility Compliance				*	*	*	*	
II.M.	SECURITY					*	*	*	
II.N.	RECEIPT OF DANGEROUS WASTES GENERATED OFF-SITE								
II.N.1.	Receipt of Off-Site Waste						*		
II.N.2.	Waste From Sources Outside the U.S.						*		
II.N.3.	Notice to Generator						*		

CATEGORIES ARE DEFINED AS FOLLOWS:

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Areas Between TSDs (excluding A and B)

D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

PART II									
CONDITION		CATEGORY							QUALIFIERS
PART	TITLE	A	B	C	D	E	F	G	
II.O.	GENERAL INSPECTION REQUIREMENTS								
II.O.1.					*	*	*	*	
II.O.1.a.					*				
II.O.1.b.					*				
II.O.1.c.					*				
II.O.1.d.					*				
II.O.2.					*	*	*	*	
II.O.3.					*	*	*	*	
II.P.	MANIFEST SYSTEM								
II.P.1.						*	*	*	
II.P.2.						*	*	*	
II.Q.	ON-SITE TRANSPORTATION								
II.Q.1.					*	*	*	*	
II.Q.1.a.					*	*	*	*	
II.Q.1.b.					*	*	*	*	
II.Q.1.c.					*	*	*	*	
II.Q.1.d.					*	*	*	*	
II.Q.1.e.					*	*	*	*	
II.Q.1.f.					*	*	*	*	
II.Q.1.g.					*	*	*	*	
II.Q.1.h.					*	*	*	*	
II.Q.2.					*	*	*	*	
II.R.	EQUIVALENT MATERIALS								
II.R.1.						*	*	*	
II.R.2.						*	*	*	
II.R.3.						*	*	*	
II.S.	LAND DISPOSAL RESTRICTIONS				*	*	*	*	
II.T.	ACCESS AND INFORMATION				*	*	*	*	
II.U.	MAPPING OF UNDERGROUND PIPING								
II.U.1.				*		*	*	*	
II.U.2.				*		*	*	*	
II.U.3.				*		*	*	*	
II.U.4.				*		*	*	*	
II.V.	MARKING OF UNDERGROUND PIPING			*		*	*	*	

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E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)
Areas Between TSDs (excluding A and B)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

PART II									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
II.W.	OTHER PERMITS AND/OR APPROVALS								
II.W.1.						*	*	*	
II.W.2.						*	*	*	
II.W.3.						*	*	*	
II.X.	SCHEDULE EXTENSIONS								
II.X.1.				*	*	*	*	*	Condition II.X, only applies to Category C if activities are subject to Conditions II.U, and II.V.
II.X.2.				*	*	*	*	*	Condition II.X, only applies to Category D if activities are subject to this Permit as defined by this matrix.
II.Y.	CORRECTIVE ACTION	*	*	*	*	*	*	*	
II.Y.1.	Compliance with Chapter 173-340 WAC	*	*	*	*	*	*	*	
II.Y.1.a.		*	*	*	*	*	*	*	
II.Y.1.b.		*	*	*	*	*	*	*	
II.Y.1.c.		*	*	*	*	*	*	*	
II.Y.1.d.		*	*	*	*	*	*	*	
II.Y.1.e.		*	*	*	*	*	*	*	
II.Y.1.f.		*	*	*	*	*	*	*	
II.Y.1.g.		*	*	*	*	*	*	*	
II.Y.2.	Acceptance of Work Under Other Authorities or Programs and Integration with the FFACO	*	*	*	*	*	*	*	
II.Y.2.a.		*	*	*	*	*	*	*	
II.Y.2.b.		*	*	*	*	*	*	*	
II.Y.2.c.		*	*	*	*	*	*	*	
II.Y.2.d.		*	*	*	*	*	*	*	
II.Y.3.	Releases of Dangerous Waste or Dangerous Constituents Not Covered by the FFACO	*	*	*	*	*	*	*	
II.Y.3.a.	U.S. Ecology	*	*	*	*	*	*	*	
II.Y.3.b.	Newly Identified Solid Waste Management Units and Newly Identified Releases of Dangerous Waste or Dangerous Waste Constituents	*	*	*	*	*	*	*	

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D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

PART III									
CONDITION		CATEGORY							QUALIFIERS
PART	TITLE	A	B	C	D	E	F	G	
III.	UNIT SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS								
III.2.A.	**305-B Storage Facility** Compliance with Approved Permit						*		
III.2.B.	Amendments to the Approved Permit						*		
III.3.A.	**PUREX Storage Tunnels** Compliance with Approved Permit						*		
III.3.B.	Amendments to the Approved Permit						*		
III.4.A.	**Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility** Compliance with Approved Permit						*		
III.4.B.	Amendments to the Approved Permit						*		
III.5.A.	**242-A Evaporator** Compliance with Approved Permit						*		
III.5.B.	Amendments to the Approved Permit						*		
III.6.A.	**325 Hazardous Waste Treatment Units** Compliance with Approved Permit						*		
III.6.B.	Amendments to the Approved Permit						*		
III.10.A	**Waste Treatment and Immobilization Plant** Compliance with Approved Permit						*		
	Amendments to the Approved Permit						*		
III.11.A.	**Integrated Disposal Facility** Compliance with Approved Permit						*		
	Amendments to the Approved Permit						*		

CATEGORIES ARE DEFINED AS FOLLOWS:

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B. North Slope and ALE
C. Interim Status TSD Units
Areas Between TSDs (excluding A and B)
D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.

PART IV									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
IV.	UNIT SPECIFIC CONDITIONS FOR CORRECTIVE ACTION								
IV.1.A.	**100-NR-1 Operable Unit** Compliance with Approved Corrective Measures Study				*	*			
IV.2.A	**100-NR-2 Operable Unit** Compliance with Approved Corrective Measures Study				*	*			

PART V									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
V.	UNIT SPECIFIC CONDITIONS FOR UNITS UNDERGOING CLOSURE								
V.16.A.	**1325-N Liquid Waste Disposal Facility** Compliance with Approved Modified Closure Plan					*			
V.16.B.	Amendments to the Approved Closure Plan					*			
V.17.A.	**1301-N Liquid Waste Disposal Facility** Compliance with Approved Modified Closure Plan					*			
V.17.B	Amendments to the Approved Closure Plan					*			
V.18.A.	**1324-N Surface Impoundment** Compliance with Approved Modified Closure Plan					*			
V.18.B	Amendments to the Approved Closure Plan					*			
V.19.A.	**1324-NA Surface Impoundment** Compliance with Approved Modified Closure Plan					*			
V.19.B	Amendments to the Approved Closure Plan					*			

PART VI									
CONDITION		**CATEGORY**							**QUALIFIERS**
PART	**TITLE**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	
VI.	UNIT SPECIFIC CONDITIONS FOR UNITS IN POST-CLOSURE								
	300 Area Process Trenches Compliance with Approved Modified Closure Plan							*	
	Amendments to the Approved Modified Closure Plan							*	
	183-H Solar Evaporation Basins Compliance with Approved Modified Closure Plan							*	
	Amendments to the Approved Post- Closure Plan							*	

CATEGORIES ARE DEFINED AS FOLLOWS:

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B. North Slope and ALE
C. Interim Status TSD Units
D. TSD Unit Closures (in Part V)
E. TSD Operating Units (in Part III)
F. TSD Units in Post-Closure/Modified Closure (in Part VI)
Areas Between TSDs (excluding A and B)

* Condition applies to this category, as modified by applicable footnotes and qualifiers.