Section 33 00 00 – Utilities (Maintenance; Common Work Results; Schedules; Instrumentation & Control)

1. See also Division 02 for Site Improvement Standards.
2. See also Division 22 for Plumbing Standards.
3. See also Division 23 for HVAC (steam, chilled water, condensate, etc.) Standards.
4. See also Division 26 for Electrical.
5. See also Division 27 for Communications.
6. See also Division 31 for Earthwork Standards.
7. See also Division 32 for Exterior Improvements Standards.
8. See also appendices for various space type requirements.
9. FS Cartographer locates shall be initiated through 'one-call' to City of Eugene.
10. Exterior placement of any and all equipment requires CPRE and FS approval to ensure compliance with the UO Campus Plan. If approved, all University policies shall be followed.
11. Per the 'Design Review Requirements' at the beginning of this document, a drawing layer of 'Maintenance Access' is to be incorporated into ALL drawings and system designs. This layer MUST be maintained through all phases of design and construction.
12. ALL/ANY item that requires special tools and/or test equipment must be brought to the attention of the pertinent Owner's FS personnel prior to specification and/or installation.
13. Inaccessible Equipment:
    a. If after meetings, reviews, comments, etc., there are documented and/or discussed changes not incorporated into the construction documents and installed equipment is not accessible for operation and maintenance, equipment shall be removed and reinstalled at no additional cost to the UO or the project. Discussions of payment will occur with the design team.
    b. 'Accessible' is defined as being capable of being reached without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and ductwork. Access must not exceed 14ft in height, a typical ladder working height.
14. FS maintains a survey database for storm sewer and sanitary sewer utilities on campus. These surveys shall be utilized in all design efforts. Coordination with FS for upgrades and/or replacements of nearby or impacted lines is also required.
15. Tunnel coordination with CPS is required for the following:
    a. Required tunnel ventilation locations and methods.
    b. Tunnel changes such as connection locations, connection methods, maintenance access locations, etc.
    c. Required tunnel access with each new building; locations and methods.
    d. New/replacement manhole locations for usability and maintenance; old manholes are then to be removed.
    e. Every straight tunnel length shall have at least one chase access.
    f. New building coordination with existing access locations.
    g. If tunnel ceiling damage occurs this must be adequately repaired at the contractor's expense.
16. For any and all penetrations through utility tunnel walls, ceilings, etc. use 'Link-Seal' to seal the penetration.
17. Manhole requirements:
    a. Manhole covers must be labeled storm, sanitary, etc.
    b. Manholes must be labeled with UO manhole number/ID on the lid and inside the rim / collar. ID number is to be determined during design by coordination with FS Cartographer and noted on final drawings.

Section 33 00 00 – Utilities continued

c. New/replacement manhole locations must be coordinated with CPS for locations that makes sense for usability and maintenance.
d. Old/Abandoned manholes are to be removed.

Section 33 10 00 – Water Utilities (Distribution Piping; Distribution Equipment)

1. In lieu of city water supply to a building a flow meter is required on water supplied reporting to the DDC system.
2. Gallon meter required for make-up water to heat exchangers with pulsed output ONLY to the DDC system.
3. Fire Hydrants:
   a. Reference the latest revision of the American Water Works Association (AWWA) standard C502.
   b. Manufacturers known to be acceptable; Mueller Centurion; Kennedy K-81D; M&H #129.
   c. Hydrants shall be painted safety yellow.
   d. Dry barrel compression type that opens against pressure is required. The valve shall be in the up position when closed.
   e. Provisions shall be provided for lubrication of the operating stem; either an oil reservoir or pressure lubrication fitting.
   f. The main valve's drain valve shall be of non-corrosive metal with rubber drain valve facings.
   g. All packaging glands and seals shall be O-ring type.
   h. Hydrants shall be the dry bonnet type with the internal operating nut enclosure located above the plane of the nozzles.
   i. The main valve shall be 5-1/4 inch.
   j. The inlet flanges shall be 6" with MJ style connection on the shoe; EWEB requirement.
   k. The nozzle section shall be a 3-way design with two 2-1/2 inch NST hose nozzles and one 5-1/2 inch NST pumper nozzle. There shall NOT be any type of cap retainer chains or devices.
   l. The operating nut shall be a one piece design with a weather cap or seals. It shall have a 1-1/2 inch pentagon, opening left.
   m. The hydrant shall be a high profile design with 30 inch minimum dimension from the top of the hydrant to the bury line at approximately 3 inches below the break flange.

SECTION 33 40 00 Storm Drainage Utilities

Document revision history: 11/2026 – Original Publication

Date	Section	Description of Change

Section 33 40 00 – Storm Drainage Utilities (Piping; Drains; Pumps; Subdrainage; Structures)

1. All serviceable storm drainage components shall be designed and located to permit inspection, cleaning, repair, and replacement using standard Facilities maintenance equipment without removal of permanent building components.
2. NO site drainage into sump pumps is allowed without coordination with Owner's Representative to get FS approval.
3. No downspouts or site drainage piping internal to a building.
4. Grates:
    a. Grates shall not be located immediately adjacent to major sources of debris, such as beneath trees, unless specifically designed for the anticipated maintenance burden.
    b. 3/8" x 1" minimum grate openings.
    c. 60 square-inch minimum grate area serving a maximum of 300 square-feet of paved watershed.
    d. 144 square-inch grate to serve a maximum of 1000 square-feet of paved watershed.
    e. 4 square-feet grate to serve all areas larger than 1000 square feet. Grates shall be **removable without demolition** of adjacent paving and readily accessible for maintenance.
    f. Decorative grates need to be coordinated with Owner's Representative to get FS Exterior Supervisor approval and will not be used in traffic areas.
    g. Grates selection requires nonslip surfaces and ADA compliance in pedestrian areas.
5. Drains:
    a. Storm drains are to be cast in or labeled 'Storm Drain – Do NOT Dump' with a thermally applied decal.
    b. Corner drains are preferred vs. flat drains, and are to be installed against planters and/or retaining walls when possible.
    c. Stormwater shall drain away from building perimeters and entries.
    d.
    e. Drain locations shall account for future maintenance access, including vacuum trucks where applicable.
    f. Underground drain lines should have accessible clean-outs and/or structures arranged so lines can be jetted, or camera-inspected.
    g. Where drain piping passes beneath critical paving or structures, consider requiring sleeves or other maintainable/replacement-friendly arrangements.
    h. .
6. Catch basins are not to be placed within parking spaces.

7. Provide free-draining rock foundation drainage at below-grade foundation walls and beneath slabs where required to prevent accumulation of groundwater
8. Outdoor drains under roofed areas should not go to stormwater.

SECTION 33 61 00 Chilled Water Energy Distribution

Document revision history: 08/2026 Original Publication

Date	Section	Description of Change

PART 1 – GENERAL

Summary

a. Section includes pipe, fittings, joining methods, specialties, and pumping units for chilled water systems.
    - Piping
    - Insulation
    - Valves
    - Specialties
        - Instrumentation
        - Strainers
        - Filter vessels
    - Control Valves
- Connections

General Design Guidelines

a. The Utility is defined by:
    - All piping connected to the chilled water plant throughout the tunnels up to the first isolation valve inside the building.
b. Chilled water requirements
    - The Chilled Water System operates at pressures up to 150 psi
    - No makeup water shall be connected to the central chilled water system.
    - Make-up water for closed loop hydronic systems shall not be supplied by chilled water.
    - Supply valve at the building entrance should be modulating and controlled remotely through the building automation system.
    - Provide temperature and differential pressure transmitters on the tunnel supply and return mains at each building connection. Connect these transmitters to the building automation system and to the utility metering software PME.
    - Pete's plugs are required within 1ft of the temperature and pressure sensors on supply and return piping.
    - Provide strainers on supply piping at each building connection.

c. Tunnel requirements
    - Utility piping shall be routed through the tunnel system. Any exception must be submitted to Campus Planning and Facilities Management for review and approval.
        - If direct buried piping design is approved, all the piping must be individually sleeved / cased with a direct-buried piping system: condensate, steam, chilled water, etc. All sleeves must continue into the building a minimum of 12 inches.

Submittals

a. Provide pipe flushing plan
b. Chemical treatment plan and safety data sheet documentation.
c. Provide pressure testing plan
d. Products

Qualifications

a. Tunnel training

PART 2 – PRODUCTS

2.1 Chilled Water Piping

a. NPS 2" and smaller
   - Black steel pipe, class 150, malleable iron fittings, cast iron flanges and flange fittings, and welded or threaded joints

b. NPS 2-1/2" and larger
   - Black steel pipe, class 150, malleable iron fittings, cast iron flanges and flange fittings, and welded and flanged joints

c. Strainers
   - Acceptable manufacturers
   - Mesh size – 40
   - Removable basket
   - Valve on blowdown
   - Bypass around critical operation buildings required.

2.2 Piping Insulation

a. Tunnels
   - Phenolic foam insulation
   - Serviceable components should have removable insulation pads
   - All piping components and accessories require insulation with vapor barrier.
   - Valve stem extension handles required on all insulated piping.

b. Jacketing
   - Insulation shall be provided with a Mylar vapor barrier, covered by a PVC jacketing.
   - Aluminum jacketing required at high traffic points or in areas where piping crosses the walking pathway.

2.3 Valves

a. Provide ball valves as indicated in chart below, provide gate valves for all connections above 2.5" meeting requirements in chart below. Use of butterfly valves requires review and approval by Owner.

Type	Service(s)	Size	Req.	Connection	Basis of design
Ball valve	Chilled water	2 inch and smaller	Full port, 2 piece bronze. 150 psig SWP	Threaded	Apollo 77-140
Butterfly valve	Chilled water	2.5 inch –12 inch	Suitable for bidirectional dead end service 150 psig SWP, ductile iron with SS stem	Lug style	Apollo LD145/WD145
		12 inch –24 inch	Double offset, Class 150 WCB carbon steel or CF8M, RTFM/PTFE seat, stainless steel disk and stem	Lug style	Apollo 215L
Gate valve	Chilled water	2.5 inch and larger	Full port, non rising stem, cast iron, 125 psig at 338F.	Flanged	Apollo 610F-LFA

b. Isolation Valves / Shutoff valves
   - 2" and smaller – Ball Valves
     - Basis of design: Apollo
       - SWP: 150 psig
       - CWP: 600 psig
       - Body: Two piece bronze
       - Ends: Threaded
       - Seats: Reinforced Teflon (PTFE)
       - Stem: Stainless Steel
       - Ball: Stainless steel
       - Port: Full
       - Packing: Adjustable
   - 2.5" and larger – Gate Valves
       - Class: 150
       - SWP: 150 psig
       - CWP: 200 psig
       - Body: Gray iron
       - Ends: Flanged
       - Stem: Non-rising, bronze
       - Trim: Bronze
       - Bonnet: Bolted
       - Disc: Solid wedge
       - Packing gland: Brass, re-packable under pressure (not required for steam applications)
       - Hand wheel: Cast iron

2.4 Gate Valves

a. Basis of design: Apollo
b. 2" and smaller
   - Class: 150
   - CWP: 300 psig
   - Body: Bronze
   - Ends: Threaded
   - Stem: Non-rising, bronze
   - Bonnet: Bronze
   - Disc: Solid wedge, bronze
   - Packing gland: Brass, re-packable under pressure (not required for steam applications)
   - Hand wheel: Malleable iron or bronze
c. 2.5" and larger
   - Class: 150
   - SWP: 150 psig
   - CWP: 200 psig
   - Body: Gray iron
   - Ends: Flanged
   - Stem: Non-rising, bronze
   - Trim: Bronze
   - Bonnet: Bolted
   - Disc: Solid wedge
   - Packing gland: Brass, re-packable under pressure (not required for steam applications)
   - Hand wheel: Cast iron

d. 3- 12" and larger – Butterfly
   - Butterfly Valves
   - Basis of design: Apollo
   - SWP: 150 psig
   - CWP: 200 psig
   - Body: Ductile iron
   - Seats and liners: EPDM
   - Stem: Stainless steel
   - Disc: Bronze
   - Packing: Adjustable
   - Body and stem seals
   - Operators: Lever lock
   - Lug style only, suitable for bidirectional dead end service at rated pressure without use of downstream flange

e. 12" to 32" – Butterfly Valves
   - SWP: 150 psig
   - CWP: 200 psig
   - Body: Carbon Steel or CF8M
   - Seats and liners: EPDM or RTFM
   - Stem: Stainless steel
   - Disc: Bronze or Stainless

f. Packing: Adjustable
   - Body and stem seals
   - Operators: Gear operated
   - Lug style only, suitable for bidirectional dead end service at rated pressure without use of downstream flange

g. Drain valves
   - Basis of design: Apollo ball valve series 72
   - Threaded end cap.
   - Provide drain valves at all low points and / or every 150 feet of piping system for complete drainage of systems.

2.5 Specialties

a. Wye Strainers
   - Acceptable manufacturers: Armstrong, Spirax Sarco, Mueller Steam Specialty
     - General: Threaded 2" and smaller and flanged connections 2.5" and larger. Threaded blow down outlet connection with valve. Removable screen element.
     - Body: Cast iron

b. Pressure Gauges:
   - Acceptable manufacturers: Ashcroft, Trerice
   - Liquid filled
   - Minimum 4.5" dial size
   - Range of 0-160 psi

c. Temperature Gauges
   - Acceptable manufacturers: Ashcroft, Trerice
   - Liquid filled
   - Thermowell with threaded outlet connection to piping

- Minimum 4.5" dial size
- Range of 32-100 degF

2.6 Connections

a. See standard connection detail appended to this section.

PART 3 – EXECUTION

3.1 Installation

a. Provide isolation valves upstream and downstream of wye strainers.

3.2 Interface with other products

a. Not applicable.

3.3 Testing

a. Water pressure testing to be provided at minimum 150 psig.
b. Pipe flushing and chemical treatment plan must be submitted to CPFM and approved prior to testing.
c. All testing to be witnessed by Owner.
d. Submit chemical treatment results in a report format to CPFM.

3.4 Training

a. Furnish training plan for review by Owner at least two weeks prior to training.
b. Draft O&M's submitted prior to first training session.
c. Contractor as built documents submitted prior to first training session.
d. Labeling of equipment, piping, and accessories is complete prior to first training session.
e. Training by qualified technicians knowledgeable in plumbing systems and components. Sales representatives are not acceptable to teach training courses unless approved by Owner prior to training.

3.5 Flushing Utility Piping

a. Prior to utility piping connection to building piping systems flush water through strainer blowdown or piping drain valves until water is visibly clean of dirt and debris. Remove and clean strainer after flushing and schedule with Owner to inspect for cleanliness.

ABBREVIATIONS

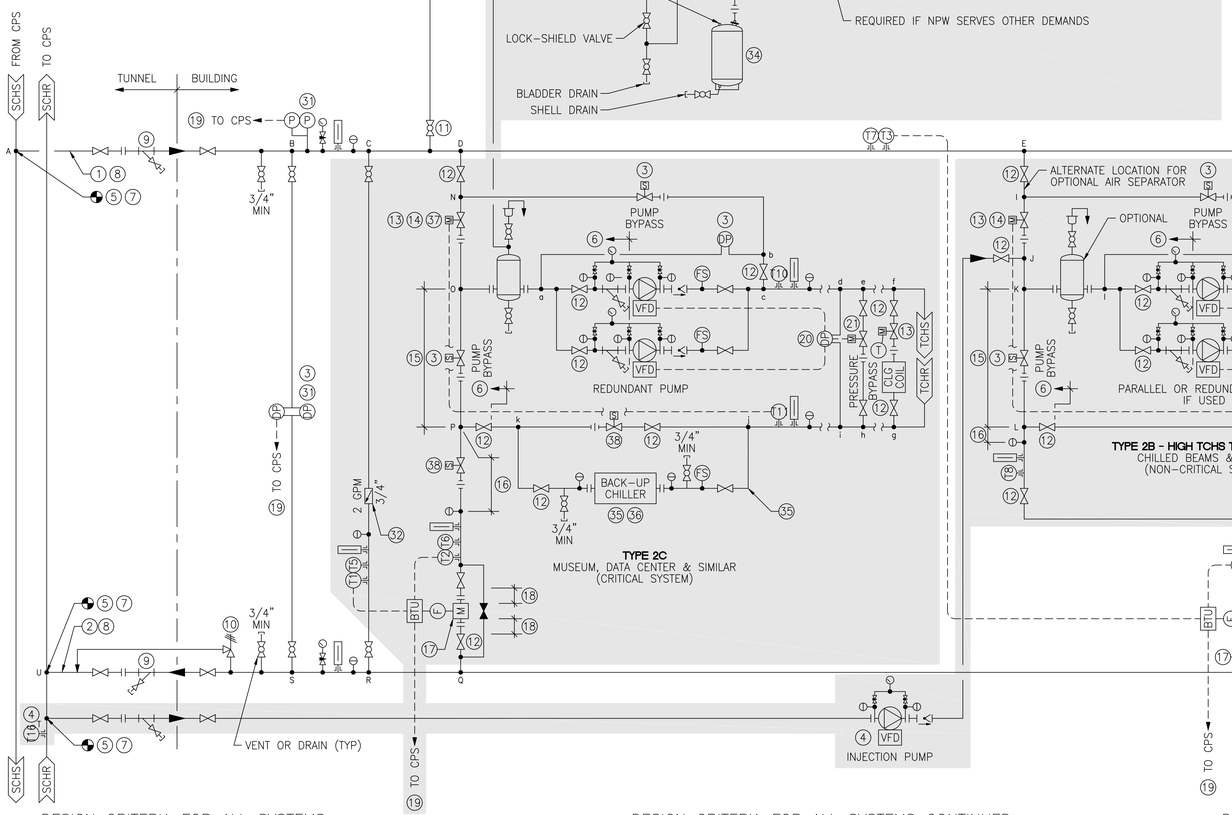
BTU	BRITISH THERMAL UNIT
CD	CONSTRUCTION DOCUMENT
CLG	COOLING
CPS	CENTRAL POWER STATION
DX	DIRECT–EXPANSION
F	FAHRENHEIT
GPM	GALLONS PER MINUTE
MAX	MAXIMUM
MIN	MINIMUM
NPW	NON–POTABLE WATER

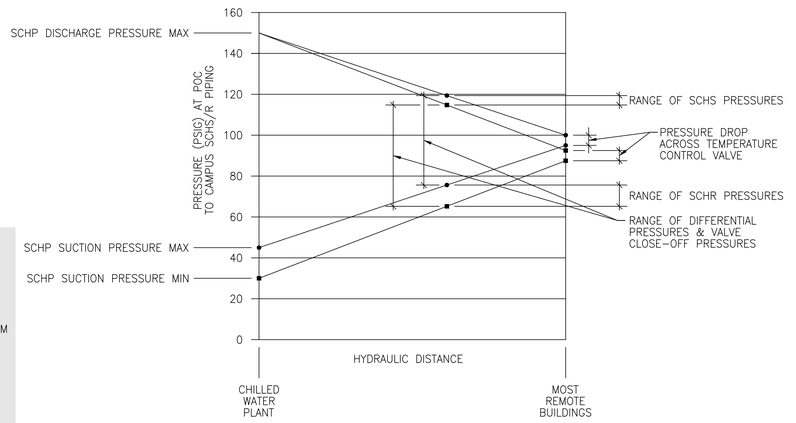
ABBREVIATIONS CONTINUED

PDCV	PRESSURE–DEPENDENT CONTROL VALVE
PICV	PRESSURE–INDEPENDENT CONTROL VALVE
POC	POINT OF CONNECTION
PRV	PRESSURE REGULATING VALVE
PSID	POUNDS PER SQUARE INCH DIFFERENTIAL
PSIG	POUNDS PER SQUARE INCH GAUGE
RPBP	REDUCED PRESSURE BACKFLOW PREVENTER
SCHP	SECONDARY CHILLED WATER PUMP
SCHR	SECONDARY CHILLED WATER RETURN
SCHS	SECONDARY CHILLED WATER SUPPLY

ABBREVIATIONS CONTINUED

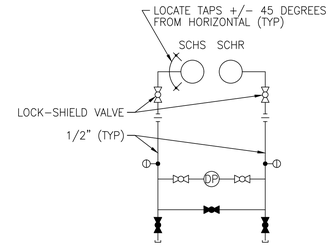
TCHP	TERTIARY CHILLED WATER PUMP
TCHR	TERTIARY CHILLED WATER RETURN
TCHS	TERTIARY CHILLED WATER SUPPLY
TYP	TYPICAL
WG	WATER GAUGE
w/	WITH





SCHS/R PRESSURE GRADIENTS

AT DESIGN CONDITION FOR CHILLED WATER PLANT, AND AT CONSTANT ELEVATION OF 463.40' REFERENCED TO CITY OF EUGENE VERTICAL DATUM AS ESTABLISHED PER BENCHMARK 1020 (14' ABOVE LEVEL TWO OF CHILLED WATER PLANT). OWNER WILL PROVIDE APPROXIMATE MAX SCHS PRESSURE AND SCHS/R DIFFERENTIAL PRESSURE AT PROPOSED POCs TO CAMPUS SCHS/R MAINS.



DIFFERENTIAL PRESSURE STATION

IF SHEET IS LESS THAN 24"x36" IT IS A REDUCED PRINT SCALE REDUCED ACCORDINGLY

SYMBOLS

- POC
- PUMP
- AIR SEPARATOR (SPIROTHERM PREFERRED)
- EXPANSION TANK, DIAPHRAGM OR BLADDER
- VALVE, GATE OR GENERIC ISOLATION
- VALVE, NORMALLY–CLOSED (SHOWN BY FILL)
- VALVE, NEEDLE
- VALVE, BALL
- VALVE, AUTOMATIC FLOW CONTROL
- VALVE, PRESSURE REGULATING
- VALVE, PRESSURE RELIEF
- VALVE, MOTOR–OPERATED, 2–WAY, 2–POSITION
- VALVE, MOTOR–OPERATED, 2–WAY, MODULATING
- VALVE, CHECK, SWING
- VALVE, CHECK, SPRING
- AIR VENT, MANUAL
- AIR VENT, AUTOMATIC
- UNION
- FLANGE
- CAP w/ HOSE THREAD
- STRAINER, WYE w/ BLOW–DOWN VALVE & HOSE THREAD CAP
- THERMOWELL
- PRESSURE/TEMPERATURE INSERTABLE TAP
- INDICATOR, PRESSURE w/ VALVE
- INDICATOR, TEMPERATURE
- SWITCH, FLOW, THERMAL DISPERSION
- SENSOR/TRANSMITTER, TEMPERATURE
- SENSOR/TRANSMITTER, PRESSURE
- SENSOR/TRANSMITTER, DIFFERENTIAL PRESSURE
- SENSOR/TRANSMITTER, FLOW
- ELEMENT, FLOW, MAGNETIC
- ELEMENT, FLOW, POSITIVE DISPLACEMENT
- METER/TRANSMITTER, BTU
- VARIABLE FREQUENCY DRIVE
- PIPE NODE
- NOT APPLICABLE TO SPECIFIC PROJECT

DESIGN CRITERIA FOR ALL SYSTEMS

(1) USE 44F MINIMUM SCHS TEMPERATURE AT DESIGN CONDITION. EXPECT 48F MAXIMUM SUSTAINED SCHS TEMPERATURE DURING FREE–COOLING MODE OF OPERATION AT CHILLED WATER PLANT, WHICH WILL OCCUR AT AMBIENT WET–BULB TEMPERATURES OF 42F OR LOWER. EXPECT 50F MAXIMUM SHORT–TERM SCHS TEMPERATURE DURING TRANSITION AT PLANT FROM FREE TO MECHANICAL COOLING.

(2) DESIGN SYSTEM TO MAXIMIZE SCHR TEMPERATURE AT ALL TIMES. IN ADDITION TO EMPLOYING STRATEGIES DESCRIBED IN NOTES 3, 4, 13 AND 14, OTHER RECOMMENDED STRATEGIES TO MAXIMIZE SCHR AND TCHR TEMPERATURES INCLUDE THE FOLLOWING:

SEGREGATE LOADS WITH COMMON YEAR–ROUND TCHS/R OPERATING TEMPERATURES ONTO DEDICATED SECONDARY/TERTIARY HYDRAULIC ISOLATION BRIDGES AS SHOWN BY TYPE 2A AND 2B BUILDING CONNECTIONS IN PIPING DIAGRAM.

FOR IT ROOMS AND CLOSETS EMPLOY: 1) FAN COIL UNITS w/ AIRSIDE ECONOMIZER; 2) PACKAGED WATER–COOLED EQUIPMENT THAT USES CHILLED WATER AS CONDENSER WATER; OR SPLIT DX EQUIPMENT.

FOR SYSTEMS WITH A SMALL NUMBER OF LARGE COOILING COILS, EMPLOY A COIL PUMP AND HYDRAULIC ISOLATION BRIDGE AT EACH COIL, WHICH ASSURES MAXIMUM TCHR TEMPERATURE AT ALL TIMES.

SELECT COOLING COILS WITH A MINIMUM TUBE VELOCITY OF 3 FEET PER SECOND AT DESIGN CONDITION TO MINIMIZE POTENTIAL FOR LAMINAR FLOW AT LOW PARTIAL LOADS. ADJUST FACE AREA, TUBE DIAMETER, AND NUMBER OF FEEDS AND/OR PASSES AS NECESSARY, OR USE TURBULATORS. COIL PRESSURE DROP UP TO 20'WG IS ACCEPTABLE. FOR COMMODITY EQUIPMENT LIKE FAN COIL UNITS, NOTE THAT CUSTOM COILS MAY BE REQUIRED. SUBMIT ALL COIL SELECTIONS TO OWNER NO LATER THAN 50% CD PHASE OF DESIGN.

USE MECHANICAL TYPE PICVs AT ALL HYDRAULIC ISOLATION BRIDGES AND ALL COOLING LOADS THAT COULD BE EXPOSED TO CAMPUS DIFFERENTIAL PRESSURE (VIA BYPASS AROUND TCHP, FOR EXAMPLE), EXCEPT THAT PDCVs MAY BE USED IN CONJUNCTION w/ ZONE DIFFERENTIAL PRESSURE CONTROLLERS AT HYDRAULIC ISOLATION BRIDGES, AND ELECTRONIC TYPE PICVs MAY BE USED WHERE NO GREATER THAN 20% OF VALVE STROKE IS USED TO DISSIPATE EXCESS DIFFERENTIAL PRESSURE. FOR FORMER CASE USE VICTAULIC (IMI HYDRONIC ENGINEERING) \ TA SERIES 7PR. FOR LATTER CASE SUBMIT DOCUMENTATION TO OWNER NO LATER THAN 50% CD PHASE OF DESIGN.

DO NOT EMPLOY ANY DEVICE OR CONTROL STRATEGY THAT ALLOWS BYPASS FROM SUPPLY TO RETURN, SUCH AS THREE–WAY VALVES AT COOLING COILS TO MAINTAIN MINIMUM LOOP FLOW.

(3) EMPLOY AUTOMATIC BYPASS AROUND TCHP AND TEMPERATURE CONTROL VALVE WHERE DIRECTED BY OWNER. SWITCH TO BYPASS MODE WHEN AVAILABLE CAMPUS DIFFERENTIAL PRESSURE EXCEEDS THAT CURRENTLY PROVIDED BY TCHP. SWITCH BACK TO LOCAL MODE (DEFAULT) WHEN LOOP DIFFERENTIAL PRESSURE FALLS BELOW SET POINT. USE SET POINT SPAN AND TIMER TO MINIMIZE NUISANCE SWITCHING.

DESIGN CRITERIA FOR ALL SYSTEMS CONTINUED

(4) EMPLOY INJECTION PUMP FOR HIGH TCHS TEMPERATURE LOOPS WHERE DIRECTED BY OWNER. SWITCH TO INJECTION MODE WHEN TCHS TEMPERATURE EXCEEDS CAMPUS SCHR TEMPERATURE. SWITCH BACK TO SUPPLY MODE (DEFAULT) WHEN THREE MOST DEMANDING COOLING LOAD TEMPERATURE CONTROL VALVES IN LOOP OPEN TO CHANGEOVER SET POINT (95%).

(5) SPECIFY ALL WETTED COMPONENTS ON BUILDING SIDE OF POCs TO BE RATED FOR 150 PSIG WORKING PRESSURE.

(6) PIPING MATERIAL ON CPS SIDE OF LOCATIONS INDICATED SHALL BE STEEL. PIPING MATERIAL ON OPPOSITE SIDE SHALL BE AS ALLOWED BY CAMPUS STANDARDS.

(7) SPECIFY INITIAL WATER TREATMENT TO MATCH EXISTING. SUBSEQUENT TREATMENT WILL BE PERFORMED AT CPS. CONFIRM REQUIREMENTS WITH OWNER.

(8) SIZE SCHS/R PIPING WITH A MAXIMUM FRICTION LOSS RATE OF 4 FEET WG PER 100 FEET, AND WITH A MAXIMUM VELOCITY OF 10 FEET PER SECOND.

(9) PROVIDE STRAINER w/ 20 MESH SCREEN AND MAGNETIC INSERTS. SIZE FOR MAXIMUM PRESSURE DROP OF 1 PSID CLEAN. OVERSIZING MAY BE NECESSARY. OWNER MAY RELAX REQUIREMENT TO 60 MESH AT HYDRAULICALLY–CRITICAL LOCATIONS.

(10) PROVIDE MINIMUM 3/4" x 1" PRESSURE RELIEF VALVE w/ AUTOMATIC RESET. SET AT 150 PSIG.

(11) PROVIDE LOCK–SHIELD VALVE AND LOCK CLOSED UPON COMPLETION OF INITIAL FILL, FLUSH AND RE–FILL.

(12) DRAWING DEPICTS MINIMUM NUMBER OF ISOLATION VALVES REQUIRED TO REPLACE AN ACTUATED CONTROL VALVE OR BTU/ENERGY METER. PROVIDE ADDITIONAL ISOLATION VALVES WHERE NECESSARY TO LIMIT THE VOLUME OF DRAINED WATER TO 50 GALLONS PER INCIDENT.

(13) WHERE A MECHANICAL TYPE PICV IS REQUIRED PER NOTE 2, USE FLOW CONTROL INDUSTRIES \ DELTA P VALVE, BELIMO \ PICCV OR VICTAULIC (IMI HYDRONIC ENGINEERING) \ TA SERIES 7CP OR 7FP AS APPROPRIATE TO MEET PROJECT REQUIREMENTS. LOWER LIMIT OF CONTROL RANGE SHALL BE BETWEEN 2 AND 7 PSID. UPPER LIMIT AND CLOSE–OFF PRESSURE SHALL MEET OR EXCEED MAXIMUM DIFFERENTIAL PRESSURE SPECIFIED BY OWNER. INCLUDE CONTROL ALGORITHM TO PURGE AIR TRAPPED IN REGULATOR PORTION OF VALVE BY PERIODICALLY STROKING VALVE AS RECOMMENDED BY MANUFACTURER.

(14) MODULATE PICV TO SATISFY A TCHR TEMPERATURE SET POINT (58F DEFAULT), WHICH SHALL BE RESET PERIODICALLY (15 MINUTES) BASED UPON THE POSITION OF ALL TEMPERATURE CONTROL VALVES IN THE TERTIARY LOOP. RESET UPWARD WHEN THREE OR MORE VALVES CLOSE TO A MINIMUM OPEN SET POINT (50%), OR RESET DOWNWARD WHEN THREE OR MORE VALVES OPEN TO A MAXIMUM OPEN SET POINT (95%). DOWNWARD RESET SHALL HAVE PRIORITY.

DESIGN CRITERIA FOR ALL SYSTEMS CONTINUED

ALTERNATE CONTROL STRATEGIES MAY BE CONSIDERED. THIS APPROACH REQUIRES SUBMISSION OF DOCUMENTATION TO DEMONSTRATE THAT MAXIMUM TCHR TEMPERATURES CAN BE MAINTAINED AT ALL TIMES, AND SUBSEQUENT APPROVAL BY OWNER.

(15) SIZE AND CONFIGURE HYDRAULIC ISOLATION BRIDGE FOR A MAXIMUM PRESSURE DROP OF 2 FEET WG. DO NOT INCLUDE ANY FITTINGS, VALVES OR OTHER OBSTRUCTIONS EXCEPT AUTOMATIC BYPASS VALVE IF REQUIRED.

(16) LOCATE ALL TEMPERATURE SENSING DEVICES A MINIMUM OF 10 PIPE DIAMETERS DOWNSTREAM FROM NEAREST MIXING POINT.

(17) PROVIDE CADILLAC HEATX BTU/ENERGY METER SYSTEM, OR EQUIVALENT APPROVED BY OWNER, INCLUDING CMAG METER, TWO TEMPERATURE SENSORS/TRANSMITTERS, NETWORK INTERFACE AND WALL–MOUNTED COMPUTER/DISPLAY.

(18) INSTALL METER IN SCHS/R PIPING AND LOCATE TO SATISFY MANUFACTURER'S REQUIREMENTS FOR MINIMUM CLEARANCES FROM UPSTREAM AND DOWNSTREAM OBSTRUCTIONS.

(19) COORDINATE NETWORK INTERFACE REQUIREMENTS w/ OWNER. TRANSMIT SIMULTANEOUS SNAPSHOT VALUES FOR THE FOLLOWING DATA POINTS TO CPS AND CREATE TWO TREND LOGS w/ INTERVALS AS FOLLOWS:

DATA POINT	TRANSMISSION & STORAGE INTERVAL	TREND LOG INTERVAL
SCHS/R FLOW (GPM)	1 MINUTE	5 MINUTES
SCHS TEMPERATURE (F)	1 MINUTE	5 MINUTES
SCHR TEMPERATURE (F)	1 MINUTE	5 MINUTES
ENERGY (TON–HOURS)	1 HOUR	1 DAY
SCHS PRESSURE (PSIG)	1 MINUTE	5 MINUTES
SCHS/R DIFFERENTIAL PRESSURE (PSIG)	1 MINUTE	5 MINUTES

(20) PROVIDE REMOTE DIFFERENTIAL PRESSURE SENSOR IMMEDIATELY UPSTREAM OF TWO OR THREE MOST HYDRAULICALLY REMOTE COOLING LOADS. WHERE CRITICAL LOCATION MAY CHANGE w/ TIME, PROVIDE SENSOR FOR EACH LOCATION AND CONTROL TO MOST DEMANDING REQUIREMENT.

(21) PROVIDE PDCV w/ LINEAR CHARACTERISTIC NEAR EACH REMOTE DIFFERENTIAL PRESSURE SENSOR. WHERE MORE THAN ONE VALVE IS INSTALLED, CONTROL ALL VALVES IN UNISON TO REQUIREMENT OF MOST DEMANDING SENSOR. SIZE VALVES SUCH THAT THEIR COMBINED FLOW RATE EQUALS THE LARGEST LOOP MINIMUM FLOW RATE (FOR CHILLER, PUMP, ETC.) AT THE LARGEST SET POINT AMONG DIFFERENTIAL PRESSURE SENSORS. WHEN PUMP SPEED IS GREATER THAN MINIMUM SPEED SET POINT, MODULATE PUMP SPEED w/ VALVES CLOSED (PUMP MODE). WHEN PUMP SPEED FALLS TO MINIMUM SPEED SET POINT, HOLD SPEED CONSTANT AND MODULATE VALVES (BYPASS MODE). WHEN VALVES MODULATE TO FULLY–OPEN, SWITCH BACK TO PUMP MODE (DEFAULT)

DESIGN CRITERIA FOR ALL SYSTEMS CONTINUED

22 DO NOT USE AUTOMATIC FLOW CONTROL VALVES OR TRIPLE DUTY VALVES FOR BALANCING PURPOSES.

ADDITIONAL DESIGN CRITERIA FOR CRITICAL SYSTEMS

(31) PROVIDE PRESSURE AND DIFFERENTIAL PRESSURE SENSORS/TRANSMITTERS FOR USE IN CONTROL AND ALARM ALGORITHMS.

(32) PROVIDE SCHS/R BYPASS AND USE AS SOURCE FOR CURRENT SCHS TEMPERATURE. INCLUDE AUTOMATIC FLOW CONTROL VALVE WITH INTEGRAL STRAINER TO MAINTAIN CONSTANT FLOW FROM 8 TO 128 PSID (GRISWOLD \ K VALVE).

(33) SET NO GREATER THAN ELEVATION DIFFERENCE BETWEEN PRV AND HIGH POINT OF ASSOCIATED TCHS/R PIPING LOOP, PLUS 4 PSIG. INTENT IS FOR PRV TO REMAIN CLOSED UNLESS ASSOCIATED TCHS/R LOOP IS ISOLATED FROM SCHS/R LOOP AND LEAK OCCURS.

(34) SET PRE–CHARGE PRESSURE TO EQUAL APPROXIMATE MAXIMUM OPERATING PRESSURE AT THIS LOCATION. INTENT IS FOR TANK TO REMAIN EMPTY WHEN EXPOSED TO THIS PRESSURE.

(35) PROVIDE ELECTRIC HEAT TAPE OR EQUIVALENT APPROVED BY OWNER TO PROVIDE FREEZE PROTECTION FOR ALL EQUIPMENT AND PIPING EXPOSED TO AMBIENT CONDITIONS.

(36) IN ADDITION TO ANY OTHER ALARM ALGORITHMS THAT MAY BE INCLUDED FOR TERTIARY LOOP, ACTIVATE BACK–UP CHILLER UPON HIGH SCHS TEMPERATURE, LOW SCHS PRESSURE, LOW SCHS/R DIFFERENTIAL PRESSURE, AND AS REQUIRED TO PERIODICALLY EXERCISE MACHINE AND ASSURE PROPER WORKING CONDITION (4 HOURS CONTINUOUS, ONCE PER WEEK, SCHEDULE WITH OWNER).

(37) CLOSE VALVE WHEN BACK–UP CHILLER IS ENERGIZED. OTHERWISE, MODULATE VALVE AS SPECIFIED FOR TERTIARY LOOP TEMPERATURE CONTROL.

(38) CLOSE VALVE WHEN BACK–UP CHILLER IS ENERGIZED. OTHERWISE, VALVE SHALL BE OPEN.

REVISION	BY
REV 1 12/14/09	BJH
REV 2 04/11/12	BJH
REV 3 05/11/16	BJH
REV 4 02/27/20	BJH

Wood Harbinger
Bellevue, WA

UNIVERSITY OF OREGON

UNIVERSITY OF OREGON
CENTRAL POWER STATION UPGRADES
1276 UNIVERSITY OF OREGON
EUGENE, OR 97403–1276

CAMPUS CHILLED WATER SYSTEM BUILDING CONNECTION TYPE 2

DATE	11/25/08
SCALE	NONE
ENGR	BJH
DRWN	BJH
CHKD	JBJ
APPR	
JOB	08100.07

MX.XX

SECTION 33 61 33 Chilled Water Energy Metering

Document revision history: 11/2021 Original Publication

Date	Section	Description of Change
7/29/26	1.2.b	Clarified connection detail revision number and date of issuance, flow meter installation requirement location, and added gate valves as an option for isolation.
7/29/26	1.2.c	Added requirements for design details
7/29/26	1.2.d	Added and clarified electrical installation requirements
7/29/26	1.2.e	Added IP requirements
7/29/26	1.4.a	Updated technician experience requirements
7/29/26	2.2.a	Updated basis of design and added enclosure requirements
7/29/26	2.3.a	Clarified location requirements of return temperature sensor
7/29/26	3.1.a	Updated approval language
7/29/26	3.1.d	Added requirements for lockable disconnects

PART 1 – GENERAL

1.1 Summary

a. Section includes metering requirements and equipment including:
- Flow Meter
- Energy / BTU meter
- Chilled Water Supply and Return Temperature sensors / transmitters
- Utility plant monitoring software system

1.2 General Design Guidelines

a. Chilled water utility metering is required for all building connections to central chilled water distribution.
- Flow meters shall be installed to capture all use within the building. Multiple meters may be required based on design.
- Usage / flow to be measured in tons, gpm, temperature differential, displayed at the remote readout, and then sent to Utility Plant Monitoring system via Ethernet.

b. Campus chilled water system building connection detail is available as part of these design standards for reference
- A utility flow meter shall be installed in the supply piping in the utility tunnel or within 10 feet of the utility tunnel doorway in the building.
- A utility flow meter cannot be specified or installed as part of a pumping skid, cooling unit, or equivalent building equipment.
- The flow meter shall be installed on site following requirements in the execution section of this document.
- Provide high performance butterfly or gate isolation valves on meter inlet and outlet.
- Provide bypass piping with 0% leak by isolation valve around meter, this can be sized for 50% of the design chilled water flow for the building.
- Provide differential pressure sensor across building connection and wire to the energy / btu meter additional I/O port.

c. Design documents are required to show
- Utility metering plan including
  i. All installation requirements from the meter manufacturer.
  ii. Requirements for meter inlet and outlet straight lengths of pipe, location of pressure and temperature sensors, etc.
  iii. Locations of flow meters and energy/btu meters
  iv. Meter schedule including manufacturer, model, size, flow rate, power requirements, etc.

v. P&ID diagram detailing all control instrumentation, communication protocols, point source, point type, and point destination.
vi. Section and plan views of all piping connections and metering locations in the tunnel.

d. Electrical Power
- Flow meter and energy / btu meter shall be on a dedicated circuit from a building electrical power connected to standby power if available.
- Provide local lockable disconnect upstream of each flow meter and energy / btu meter.
  1. Label each disconnect with panel / circuit
- Flow meter power and communication wiring must route directly to energy / btu meter and shall not share conduit or enclosures with other equipment wiring.
- Conduit inside tunnels and tunnel spurs shall be Rigid Metal Conduit (RMC).
- Conduit outside of tunnels can be Electrical Metallic Tubing (EMT).
- No ½' EMT allowed
- Conduit must maintain ¼" space from tunnel walls.
- Transitions from EMT to RMC shall be made within 4' before entering tunnel.
- A Junction box (J-box) or conduit body shall be used when transitioning from conduit to flex.
- Flexible Metal Conduit (FMC) inside tunnel must be Liquidtight Flexible Metal Conduit (LFMC).
- LFMC and/or FMC not to exceed 4' in length.
- LFMC and/or FMC diameter to meter must be a minimum of ½".
- Conduit entering conduit bodies shall be supported within 3' of termination point.
- J-boxes must be a minimum of 4" square.
- All J-box knock-outs shall remain accessible for future use.
- There shall be a J-box located at least every 100' the utility tunnel~~.~~.
- All J-boxes must be accessible within 20" arms reach and not obstructed by piping or piping insulation.
- Conduit bodies shall not be used as junction boxes.

e. Networking and Communication
- Gateways and panels must be within 300ft of an Ethernet switch for remote monitoring.
- Energy / BTU meter requires an ethernet data connection. Two ethernet cables should be pulled from the network switch to the energy / btu meter which provides for a spare.
- IP address to be requested through UO Owner's Representative.

1.3 Submittals

a. Flow Meter
- Product data
- Meter selection and sizing

b. Energy / BTU Meter
- Product data
- Wiring diagrams

c. Utility Monitoring Software
- Template graphics
- Integration plan
  i. Include new building node layout
  ii. Proposed technician for startup and integration

d. Operation and Maintenance Manuals
- Product data
- Operation and maintenance data
- Meter Asset Management Data prior to substantial

1.4 Qualifications

a. Technician should have completed startup, meter integration, and graphic buildout in the Power Monitoring Expert software for a minimum of three years.

PART 2 – PRODUCTS

2.1 Flow Meters

a. Chilled water flow meter
   - Basis of design: Cadillac CMAG magnetic flow meter. No exceptions allowed.
   - Communication protocol: Modbus, highway addressable remote transducer (HART).
   - Integral LCD Display
     i. Usage / flow to be measured in tons, displayed at the remote readout

2.2 Energy / BTU Meter

a. Chilled Water Energy / BTU Meter
   - Basis of design: Cadillac Heatx based on project requirements, no exceptions
   - Communication protocol: Modbus
   - Integral LCD Display
     i. Usage rate / flow to be measured in tons, displayed at the remote readout
   - Ethernet gateway
     i. Provide Modbus-ethernet gateway(s) for integration with remote utility monitoring system located at the central power station.
     ii. Provide separate enclosure for gateway, minimum 10”x10”x6”. Include power supply within enclosure.

2.3 Temperature Sensor / Transmitter

a. Chilled Water
   - Basis of design: Cadillac precision matched RTD transmitter, no exceptions
   - Temperature sensors required on supply and return water piping.
     i. Return water temperature sensor should be located to prevent impact from ¾" constant flow piping
   - Threaded outlets and thermowells installed in piping to allow removal of sensors for service and repairs.

2.4 Utility Plant Monitoring System

a. Basis of design: Power Monitoring Expert from Schneider Electric – existing system
   - New meters are required to integrate into existing software monitoring system with custom graphics. Graphic requirements are as follows:
     i. Network diagram graphic updated with new or modified metering.
     ii. New custom graphics that display instantaneous and historical energy data, 15 minute / hourly./.daily / and monthly cumulative trend logs, and monthly peak demand.
     iii. Graphics should match existing layout and include the same data content, see graphics in part 3 execution section for more detail.

PART 3 – EXECUTION

3.1 Installation

a. Any deviations from Standards shall require written approval from the University of Oregon Campus Planning and Facilities Management.
b. Utilities will not be turned on or energized until the following has been completed and verified by the central power station:
   - Utility metering is permanently installed and powered.

- Utilities and Energy has inspected installation and accepted.
- Utility meters have been successfully commissioned and startup documentation provided to Utilities and Energy for acceptance.

c. Meters
- General location – requires approval through Owner's Representative before installation.
  i. Meter displays must be mounted such that they are visible for manual reading from the ground.
  ii. Flow meters must be installed such that they can be accessed with 6 feet ladder and meter display can be read from the ground.
  iii. Energy / BTU meters must be installed such that they can be accessed from the ground
  iv. Energy / BTU meters in the same mechanical room should be installed in close proximity, ideally on same wall or column

d. Electrical Power
- All installations must meet or exceed NEC requirements.
- Cabling must be run in conduit, strapping to outside of conduit is prohibited.
- Tie wraps are not acceptable means of support for conduit.
- Provide lockable disconnects for meter and flow computer.
  i. All line voltage disconnects shall be lockable.

3.2 Interface with other products

a. Utility monitoring software – Power Monitoring Expert (PME) from Schneider Electric
- Chilled Water Energy / BTU meter required to integrate with the campus utility monitoring software (PME). Energy / BTU meter required to have Modbus-ethernet gateway to provide communication between meter and monitoring software.
- Monitoring software (PME) includes custom graphics that display energy data from meters. All new meter installations will require new custom graphics to be created within monitoring software and meter data imported for display on graphics.

3.3 Testing

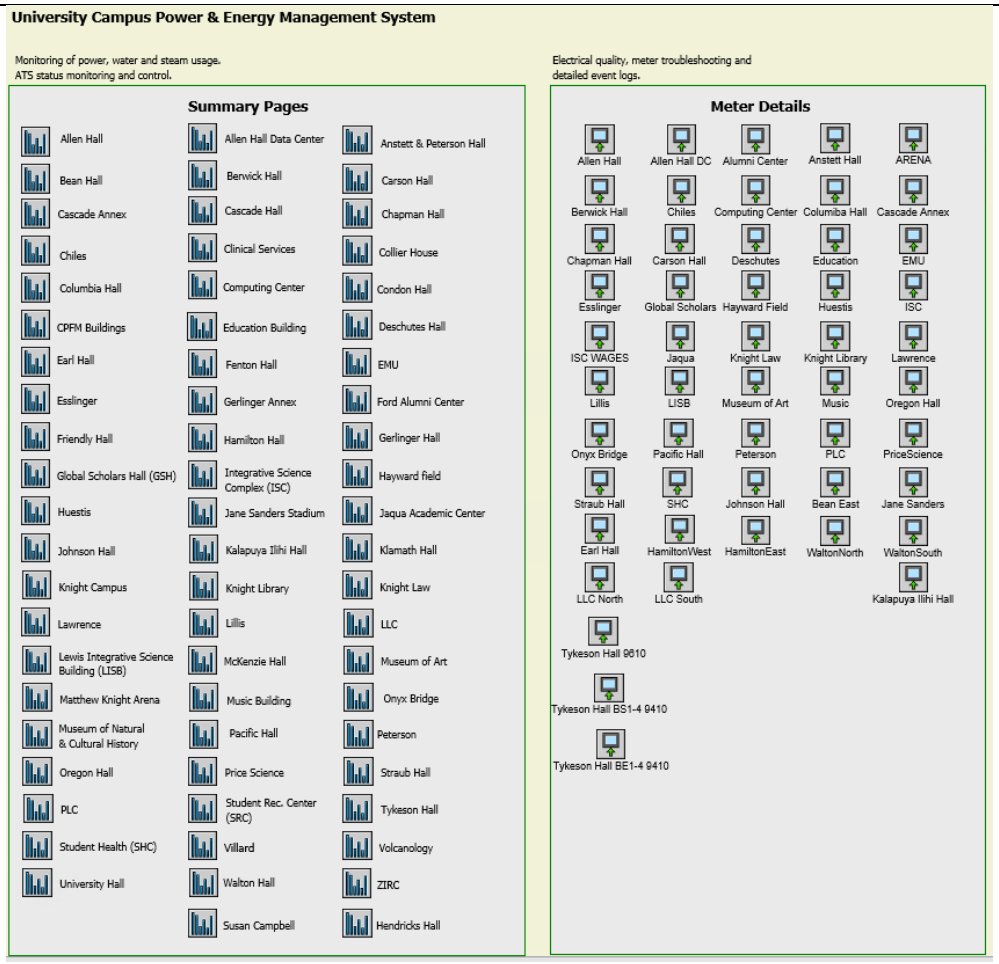
a. Startup and commissioning procedures from the meter manufacturer are required to be completed and all documentation provided to Utilities and Energy for review and acceptance prior to energizing utilities.
b. All startup, testing and commissioning must be witnessed by Owner.
c. Energy / BTU meters must be integrated into the existing utility monitoring software prior to substantial completion. This includes creation of custom graphics displaying energy use data points and trending.
- Owner must be provided a minimum of 2 weeks-notice prior to scheduling meter integration.

3.4 Training

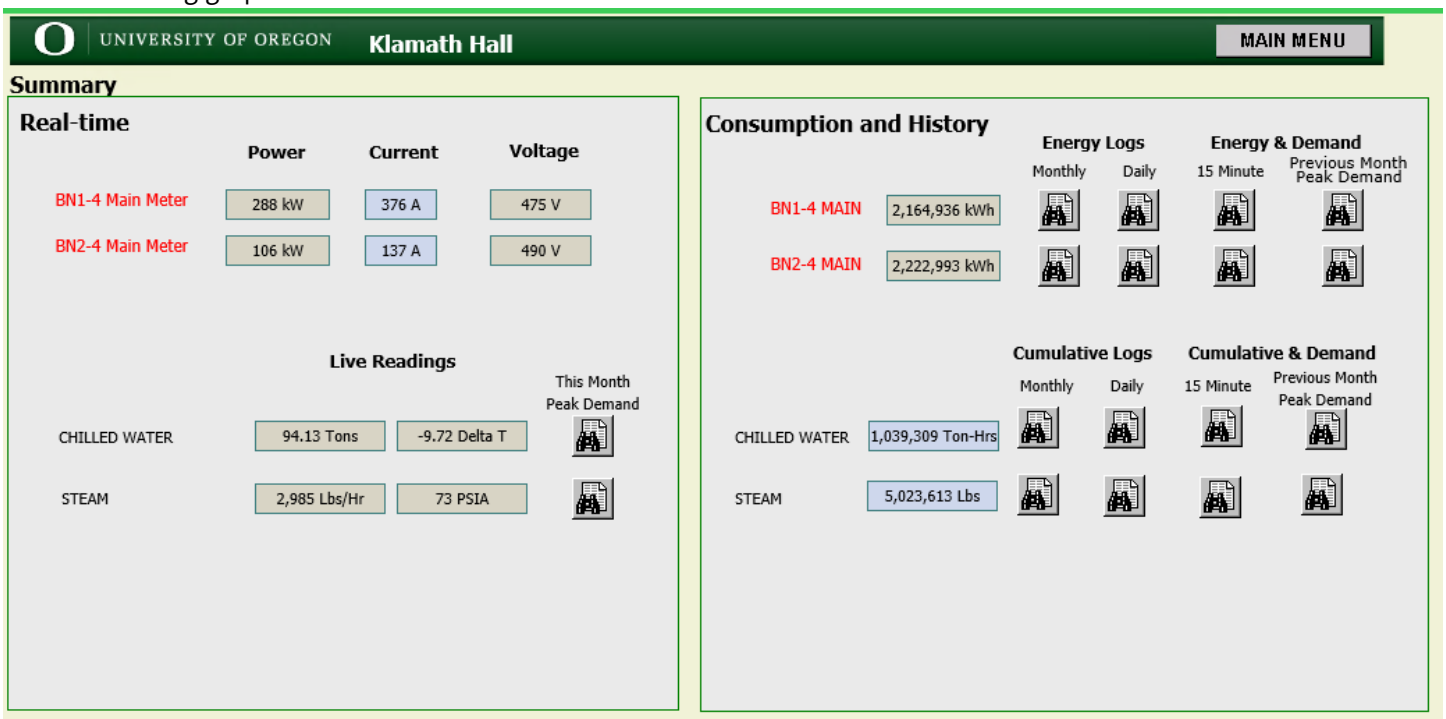
a. Furnish training plan for review by Owner at least two weeks prior to training.
b. Draft operation and maintenance manuals submitted prior to first training session.
c. Labeling of equipment, piping, and accessories is complete prior to first training session.
d. Training by qualified technicians knowledgeable in metering systems and components. Sales representatives are not acceptable to teach training courses unless approved by Owner prior to training.
e. Provide 1 hour of training in the following areas:
- Review maintenance access and general installation
- Review troubleshooting procedures
- Review meter factory and field configuration settings

3.5 Graphics

a. Network diagram



b. Building graphic



SECTION 33 63 00 Steam Energy Distribution

Document revision history: 08/2026 Original Publication

Date	Section	Description of Change

PART 1 – GENERAL

1.1 Summary

a. Section includes pipe, fittings, joining methods, specialties, and pumping units for steam and condensate systems.
   - Piping
   - Insulation
   - Valves
   - Specialties
     i. Safety valves
     ii. Traps
     iii. Strainers
     iv. Vacuum breakers
     v. Pressure reducing valves
     vi. Instrumentation
   - Control Valves
   - Condensate pumps

1.2 General Design Guidelines

a. The Utility is defined by:
   - In buildings without steam pressure reducing valves, Utilities and Energy shall be responsible for all piping and accessories up to the building isolation valve in the tunnel if one is installed or the first valve in the mechanical room.
   - In buildings with pressure reducing valves, Utilities and Energy shall be responsible for the pressure reducing valves, inlet and outlet piping, bypass piping around pressure reducing valves, and any relief valves associated with the pressure reducing valve assembly.
   - Condensate system: Utilities and Energy is responsible for the condensate receiving tank including the pumps, receiving tank, and outlet piping to the utility tunnel.

b. Steam requirements:
   - Design pressure for steam to water heat exchanges shall be 15 psi or less to avoid pressure vessel permits and inspections.
   - Design documents must provide steam load profile in lbs/hr including anticipated maximum and minimum flow rates for winter and summer season.
   - PRV station required when incoming pressure above 20 psi
     i. Provide 1/3 2/3 PRV arrangement with bypass piping and globe valve sized for 50% of the building load.
     ii. Provide building isolation valve where building steam piping connects to utility tunnel main piping.

c. Condensate requirements:
   - All condensate must be piped directly to a main condensate receiving tank for pumping back into the condensate main in the tunnel. Any exception must be submitted for review by Owner.

- Provide check valve and gate valve between the building condensate receiver tank outlet piping and the tunnel condensate main.
- Overflows on condensate sets shall not be higher that the lowest point of a heat exchanger tube bundle and must dump to a floor drain in a safe location; safe locations are outside of circulation or egress areas.
- Do not locate condensate pipes in conduit casings with steam pipes.

d. Tunnel requirements:
   - Utility piping shall be routed through the tunnel system. Any exception must be submitted to Owner for review.
     i. If direct buried piping design is approved, all the piping must be individually sleeved / cased with a direct-buried piping system: condensate, steam, chilled water, etc. All sleeves must continue into the building a minimum of 12 inches.
   - The following must be reviewed and approved by Utilities and Energy during design:
     i. Impacts to existing tunnel access, piping chases, maintenance clearance zones, manholes, etc. Access must be maintained during and after construction projects.
        A. Every straight tunnel length shall have at least one chase access.
     ii. Ventilation locations and methods.
     iii. Coordinate removal of existing piping components and accessories for salvage including pressure reducing valves, isolation valves, flow meters, gauges, etc.

1.3 Submittals

a. Provide pipe flushing plan
b. Chemical treatment plan and safety data sheet documentation.
c. Provide pressure testing plan

1.3 Qualifications

a. Tunnel training

PART 2 – PRODUCTS

2.1 Steam and Condensate Piping

a. Low pressure (0-15 PSIG)
   - 2" and smaller
     1. Schedule 40 black steel pipe, class 150, cast iron flanges and flange fittings, threaded joints
     2. Install spiral wound style gaskets in all steam joint applications.
   - 2.5" and larger
     1. Schedule 40 black steel pipe, class 150, cast iron flanges and flange fittings, and welded and flanged joints
     2. Install spiral wound style gaskets in all steam joint applications.

b. Medium pressure (15 – 100 PSIG)
   - 2" and smaller
     1. Schedule 40 black steel pipe, class 150, cast iron flanges and flange fittings, threaded joints
     2. Install spiral wound style gaskets in all steam joint applications.
   - 2.5" and larger
     1. Schedule 40 black steel pipe, class 150, cast iron flanges and flange fittings, and welded and flanged joints
     2. Install spiral wound style gaskets in all steam joint applications.

c. High pressure (100 – 600 PSIG)
   - 2" and smaller
     1. Schedule 80 black steel pipe, class 150, cast iron flanges and flange fittings, and welded and threaded joints

2. Install spiral wound style gaskets in all steam joint applications.

- 2.5" and larger
  1. Schedule 80 black steel pipe, class 150, cast iron flanges and flange fittings, and welded and flanged joints
  2. Install spiral wound style gaskets in all steam joint applications.

2.2 Insulation

a. Steam piping insulation
   - Basis of design:
     i. RockWool ProRox PS 960 or Johns Manville MINWOOL-1200 High Temperature and Acoustical Pipe Insulation.
        ◊ Minimum of 0.34 Btu*in/(hr*ft²*Degree F.) @ 300 degrees F.
        ◊ Steam pipe less than 8-inch diameter to have minimum of 3-inch-thick insulation.
        ◊ Steam pipe greater than or equal to 8-inch diameter to have minimum of 2-inch-thick insulation.
        ◊ All Mineral Wool to have 0.020 thick stucco embossed aluminum metal jacketing as a cover. Jacketing secured with #8 x 1/2" sheet metal screws.

b. Condensate piping insulation
   - Basis of design:
     i. RockWool ProRox or Johns Manville Micro-Lok HP Acoustical Pipe Insulation.
   - At least 1.5 inch thick if there is space around the pipe. Same metal jacketing as steam and silicanized removable pads for valves and equipment that require maintenance

c. Valves, fittings, flanges, and unions:
   - Removable blankets shall be installed on all valve, strainers, expansion joints and other serviceable steam equipment. Blankets on 60 psi steam fittings to have 2 layers with stainless steel mesh on inner layer and silicone treated fiberglass on outer layer.
   - 2 inch and smaller: Owens Corning Type TIW wool type wrap, Johns Manville HTB 26 insulation blanket, or resilient glass fiber strips to same thickness of adjacent pipe insulation.
   - 2.5 inch and larger: Flexible removable fiberglass blanket fabrication of a sandwich section of fiberglass batt (1 lb per cuft density), same thickness as adjacent pipe insulation, enclosed in glass cloth cover machine sewed at ends, provide stainless steel two hole lacing hooks and sew hooks to blanket; provide stainless steel wire lacing the blanket. Suitable for 450 degF.

d. Aluminum Jackets
   - Required on all utility piping in tunnel system.
   - Jacket shall be 0.016 inch thick stucco embossed aluminum with integral vapor barrier. The interior of the jacket shall be protected by a factory heat sealed co-extruded polysurlyn film consisting of three layers for a total thickness of 3 mils. Metal jackets shall be factory premolded wherever possible.

2.3 Valves

a. Isolation Valves / Shutoff valves
   - Gate valves preferred if installation can provide maintenance access. High performance butterfly valves also acceptable 0% leakage.
   - Gate valves should have a rising stem
   - ANSI flanged end connection 2.5" piping and larger. Threaded end connection 2" and smaller.

b. Steam control valves
   - Steam control valves are to have stainless steel seats and disks
   - Main steam valves are to be normally closed and should fail closed.
   - Steam control valves to hydronic heat exchanger are to be normally closed.

c. Pressure reducing valves
   - Acceptable manufacturers: Spirax-Sarco pilot operator 25P (1-6" piping)

- Operation: pilot operated type.
- Body: Cast steel

d. Safety Valves
- Basis of design: Kunkle model 912.

e. Drain valves
- Basis of design: Apollo ball valve series 72
- Threaded end cap.

2.4 Specialties

a. Sight Flow Indicator: Acceptable manufacturers: Valsteam "Sight Checker SCK", no exceptions
- Provide for all steam traps to visually check the conditions and leakage of steam traps

b. Steam Traps
- Inverted Bucket type
  i. Acceptable manufacturers: Armstrong 800 series, Sprirax Sarco
    ◊ Body: Cast iron
    ◊ Internals: Stainless steel
    ◊ Strainer: Internal strainer not-acceptable, provide separate in line strainer.
- Float and thermostatic (15 psig and below)
  i. Acceptable manufacturers: Armstrong, Spirax Sarco
    ◊ Body: Cast iron
    ◊ Internals: Stainless steel
    ◊ Float: Stainless steel

c. Wye Strainers
- Acceptable manufacturers: Armstrong, Spirax Sarco, Mueller Steam Specialty
  i. General: Threaded or flanged connections. Threaded blow off outlet connection. Removable screen element.
  ii. Body: Cast iron

d. Expansion Joints
- Acceptable manufacturers: Hyspan Model 3501-3506
- Externally Pressurized Bellows type

e. Pressure Gauges:
- Acceptable manufacturers: Ashcroft, Trerice
- Liquid filled

f. Temperature Gauges
- Acceptable manufacturers: Ashcroft, Trerice
- Liquid filled
- Thermowell with threaded outlet connection to piping

2.5 Condensate Pumps

a. Acceptable manufacturers: Bell and Gossett, Mepco, Hoffman

b. Condensate sets should be a duplex pumping set.
- The steam condensate receiver's minimum size is 30 gallons.
- Furnished with two externally adjustable, NEMA 4, two pole float switches for pump control.
- Each pump to have two separate isolation valves. One on inlet and one on outlet.

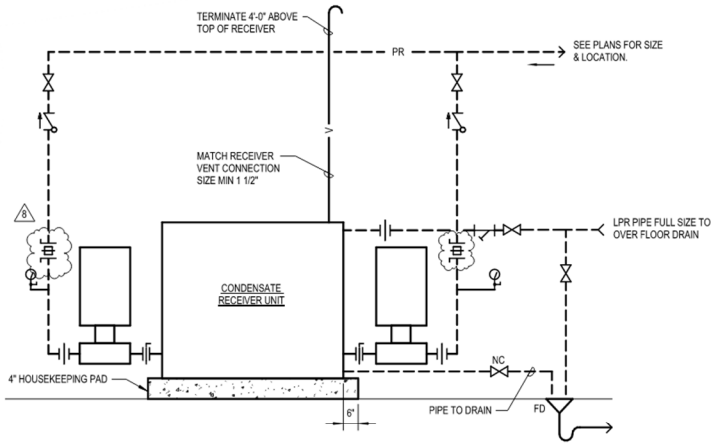
c. Water Pumps:
- Bronze fitted, close coupled to 3500 RPM drip proof motor, permanently aligned.
- Bronze impeller, stainless steel shaft.

d. Condensate Tanks

- Tanks shall be located to allow routine maintenance tasks of tank components including removal and replacement of switches, floats, pumps, motors, level indicators, etc.
- Isolation valves required on pump inlet and outlet.
- Check valves and balance valves required on discharge of each pump.
- Tank should have sampling port location piped to drain with valve.
- Sight glass level Indicator
- Vent to the outside not in mechanical room or tunnel.
- Alarms and monitoring – Integration with building automation system
  i. High Condensate Level Alarm
  ii. Loss of power

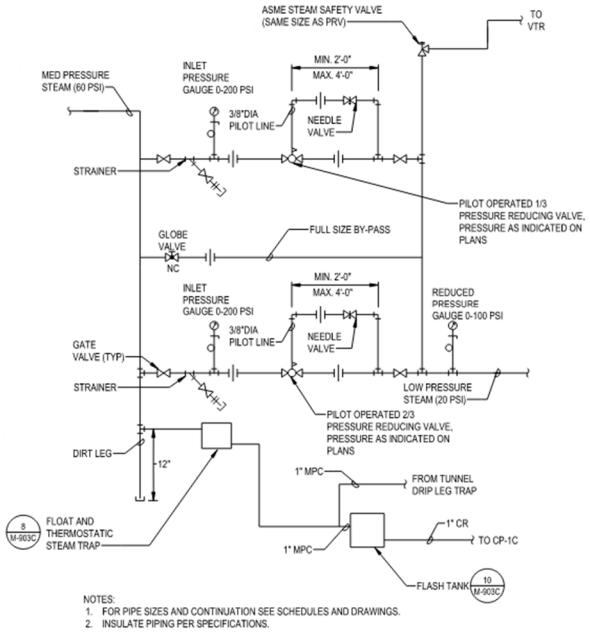
2.6 Connections

a. Connection details for PRV assembly and , condensate receiver assembly shown below.



DUPLEX CONDENSATE RETURN

NOT TO SCALE



STEAM PRESSURE REDUCING STATION

N.T.S.

PART 3 – EXECUTION

3.1 Installation

a. Provide strainers upstream of the steam traps.
b. Provide steam rated ball valves on all strainer blow downs with discharge piping routed away from all equipment or utilities. Provide a cap or plug on the end of the blow down piping.
c. Sight check valves shall be installed downstream of steam traps.
d. Provide isolation valves upstream of wye strainers.
e. Steam traps to be installed with unions upstream and downstream
f. Provide drip pan elbow at safety valve outlet with adequate maintenance access to safety valve.

3.2 Interface with other products

a. Not applicable.

3.3 Testing

a. Water pressure testing to be provided at minimum 150 psig.
b. Pipe flushing and chemical treatment plan must be submitted to U&E and approved prior to testing.
c. All testing to be witnessed by Owner.
d. Submit chemical treatment results in a report format to U&E.

3.4 Training

a. Furnish training plan for review by Owner at least two weeks prior to training.
b. Draft O&M's submitted prior to first training session.
c. Contractor as built documents submitted prior to first training session.
d. Labeling of equipment, piping, and accessories is complete prior to first training session.
e. Training by qualified technicians knowledgeable in steam and condensate systems and components. Sales. representatives are not acceptable to teach training courses unless approved by Owner prior to training.

3.5 Flushing Utility Piping

a. Steam Piping: Prior to utility piping connection to building piping systems blow steam through strainer blowdown or piping drain valves for 15 minutes and until dirt or debris are no longer visible. Remove and clean strainer after flushing and schedule with Owner to inspect for cleanliness.
b. Condensate Piping: Prior to utility piping connection to building piping systems flush water through strainer blowdown or piping drain valves until water is visibly clean of dirt and debris. Remove and clean strainer after flushing and schedule with Owner to inspect for cleanliness.

SECTION 33 63 33 Steam Energy Metering

Document revision history: 11/2021 Original Publication

Date	Section	Description of Change
7/29/26	1.2.d	Added requirements for design details
7/29/26	1.2.f	Added IP requirements
7/29/26	1.4.a	Updated technician experience requirements
7/29/26	2.1.a	Updated basis of design and added enclosure requirements
7/29/26	2.1.b	Added condensate meter requirements
7/29/26	2.2.a	Added enclosure requirements
7/29/26	2.2.b	Added condensate meter requirements
7/29/26	2.3.b	Added condensate meter requirements
7/29/26	3.1.b	Added temporary metering requirements
7/29/26	3.1.c	Added condensate meter requirements
7/29/26	3.1.d	Added disconnect requirements
7/29/26	3.4.e	Updated training hour requirements

PART 1 – GENERAL

1.1 Summary

a. Section includes metering requirements and equipment including:
- Flow Meter
- Energy / BTU meter
- Temperature sensor / transmitter
- Pressure sensor / transmitter
- Utility plant monitoring software system

1.2 General Design Guidelines

a. Steam utility metering is required for all buildings connected to central steam distribution.
- Steam flow meter(s) shall be selected to capture at least 95% of total hourly steam usage within the building. Multiple steam meters may be required based on design and building steam usage.
- Energy / BTU meter must include a temperature compensation transmitter.
- Usage / flow required to be measured in k-lbs / lbs per hour, displayed at the remote readout, and have data transmitted to the existing Utility Plant Monitoring system via Ethernet communication. Hourly and monthly peak steam flow measurement required to be logged and available through the monitoring system.

b. Provide gate type isolation valves on flow meter inlet and outlet.

c. Provide bypass piping with 0% leak by isolation gate valve around meter. Bypass piping to be sized to provide 50% capacity of design building load.

d. Design documents are required to show:
- Utility metering plan including
  i. All installation requirements from the meter manufacturer.
  ii. Requirements for meter inlet and outlet straight lengths of pipe, location of pressure and temperature sensors, etc.
  iii. Locations of flow meters and energy/btu meters
  iv. Meter schedule including manufacturer, model, size, flow rate, power requirements, etc.
  v. P&ID diagram detailing all control instrumentation, communication protocols, point source, point type, and point destination.
  vi. Section and plan views of all piping connections and metering locations in the tunnel.

e. Electrical Power

- Flow meter and energy / btu meter are required to be on a dedicated circuit connected to standby power where available
- Provide local lockable disconnect upstream of each 120-volt flow meter and energy / btu meter.
    1. Label each disconnect with panel / circuit
- Flow meter power and communication wiring must route directly to energy / btu meter and should not share conduit or enclosures with other equipment wiring.
- Conduit inside tunnels and tunnel spurs shall be Rigid Metal Conduit (RMC).
- Conduit outside of tunnels can be Electrical Metallic Tubing (EMT).
- No ½' EMT allowed

- Conduit must maintain ¼" space from tunnel walls.
- Transitions from EMT to RMC shall be made within 4' before entering tunnel.
- A Junction box (J-box) or conduit body shall be used when transitioning from conduit to flex.
- Flexible Metal Conduit (FMC) inside tunnel must be Liquid tight Flexible Metal Conduit (LFMC).
- LFMC and/or FMC not to exceed 4' in length.
- LFMC and/or FMC diameter to meter must be a minimum of ½".
- Conduit entering conduit bodies shall be supported within 3' of termination point.
- J-boxes must be a minimum of 4" square.
- All J-box knock-outs shall remain accessible for future use.
- There shall be a J-box located at least every 100' in the utility tunnel
- All J-boxes must be accessible within 20" arms reach and not obstructed by piping or piping insulation.
- Conduit bodies shall not be used as junction boxes.

f. Networking and Communication
- Gateways and panels must be within 300ft of a network switch for remote monitoring.
- Energy / BTU meter requires an ethernet data connection. Two ethernet cables should be pulled from the network switch to the meter which provides for a spare.
- IP address to be requested through UO Owner's Representative. Refer to Division 28 for the template of information collected.

1.3 Submittals

a. Flow Meter
- Product data
- Meter selection and sizing

b. Energy / BTU Meter
- Product data
- Wiring diagrams

c. Utility Monitoring Software
- Template graphics
- Integration plan
    i. Include new building node layout
    ii. Proposed technician for startup and integration

d. Operation and Maintenance Manuals
- Product data
- Operation and maintenance data
- Meter Asset Management Data prior to substantial

1.4 Qualifications

a. Technician should have completed startup, meter integration, and graphic buildout in the Power Monitoring Expert software for a minimum of three years.

PART 2 – PRODUCTS

2.1 Flow Meters

a. Steam flow meter
   - Basis of design: Cadillac Vortex CV-P, Spirax Gilfo
   - Communication protocol: Highway addressable remote transducer (HART).
   - Output: Simultaneous 4-20mA analog-pulse output
   - Integral LCD Display
     i. Usage / flow in k-lbs / lbs per hr, steam temperature, and steam pressure are to be displayed and monitored via the readout at the meter.

b. Condensate flow meter
   - Basis of design: Cadillac CMAG magnetic flow meter. No exceptions allowed.
   - Communication protocol: Modbus, highway addressable remote transducer (HART).
   - Integral LCD Display
     i. Usage / flow to be measured in k-lbs / lbs per hr, displayed at the remote readout

2.2 Energy / BTU Meter

a. Steam Energy / BTU Meter
   - Basis of design: Cadillac CMASS no exceptions
   - Communication protocol: Modbus
   - Integral LCD Display
   - Ethernet gateway
     i. Provide Modbus-ethernet gateway(s) for integration with remote monitoring dashboard located at the central power station.
     ii. Provide separate enclosure for gateway, minimum 10”x10”x6”. Include power supply within enclosure.

b. Condensate Water Energy / BTU Meter
   - Ethernet gateway and enclosure
     i. Provide Modbus-ethernet gateway(s) for integration with remote utility monitoring system located at the central power station.
     ii. Provide separate enclosure for gateway, minimum 10”x10”x6”. Include power supply within enclosure.

2.3 Temperature Sensor / Transmitter

a. Steam
   - Temperature sensor / transmitter shall have an accuracy of +/- 0.1% of temperature span, be 24 VDC loop powered, provide a scalable 4-20 mADC output, and field adjustable through a local interface or via digital communications highway addressable remote transducer (HART).
   - Threaded outlets and Thermowells shall be installed in steam piping without prohibiting full access to remove sensors for service and repair.

b. Condensate
   - Basis of design: Cadillac precision matched RTD transmitter, no exceptions
   - Temperature sensor required on inlet piping to receiving tank
   - Threaded outlets and thermowells installed in piping to allow removal of sensors for service and repairs.

2.4Utility Plant Monitoring System

a. Basis of design: Power Monitoring Expert from Schneider Electric – existing system

- New meters are required to integrate into existing software monitoring system with new custom graphics that display instantaneous and historical energy data, 15 minute / daily / and monthly cumulative trend logs, and monthly peak demand. Graphics should match existing layout and include the same data content, see appended template for reference.

PART 3 – EXECUTION

3.1 Installation

a. Any deviations from Standards shall require written approval from University of Oregon Campus Planning and Facilities Management.
b. Utilities will not be turned on or energized until the following has been completed and verified by the central power station:
    - Utility metering is permanently installed and powered.
    - Utilities and Energy has inspected installation and accepted.
    - Utility meters have been successfully commissioned and startup documentation provided to Utilities and Energy for acceptance.
    - Temporary utilities need to be metered.
c. Meters
    - General location – requires approval through Owner's Representative before installation
        i. Meter displays must be mounted such that they are visible for manual reading from the ground.
        ii. Flow meters must be installed such that they can be accessed with 6 feet ladder and meter display can be read from the ground.
        iii. Energy / BTU meters must be installed such that they can be accessed from the ground.
        iv. Energy / BTU meters in the same mechanical room should be installed in close proximity to one another, ideally on same wall or column.
            - Condensate meter must installed in a wet leg upstream of the condensate receiver.
d. Electrical Power
    - All installations must meet or exceed NEC requirements.
    - Cabling must be run in conduit, strapping to outside of conduit is prohibited.
    - Tie wraps are not acceptable means of support for conduit or cabling.
    - Provide lockable disconnects for meter and flow computer.
        - All line voltage disconnects shall be lockable.

3.2 Interface with other products

a. Utility monitoring software – Power Monitoring Expert (PME) from Schneider Electric
    - Steam Energy / BTU meter required to integrate with the campus utility plant monitoring software (PME). Energy / BTU meter required to have Modbus-ethernet gateway to provide communication between meter and monitoring software.
    - Monitoring software (PME) includes custom graphics that display energy data from meters. All new meter installations will require new custom graphics to be created within monitoring software and meter data imported for display on graphics.

3.3 Testing

a. Startup and commissioning procedures from the meter manufacturer are required to be completed and all documentation provided to Utilities and Energy for review and acceptance prior to energizing utilities.
b. All startup, testing and commissioning must be witnessed by Owner.

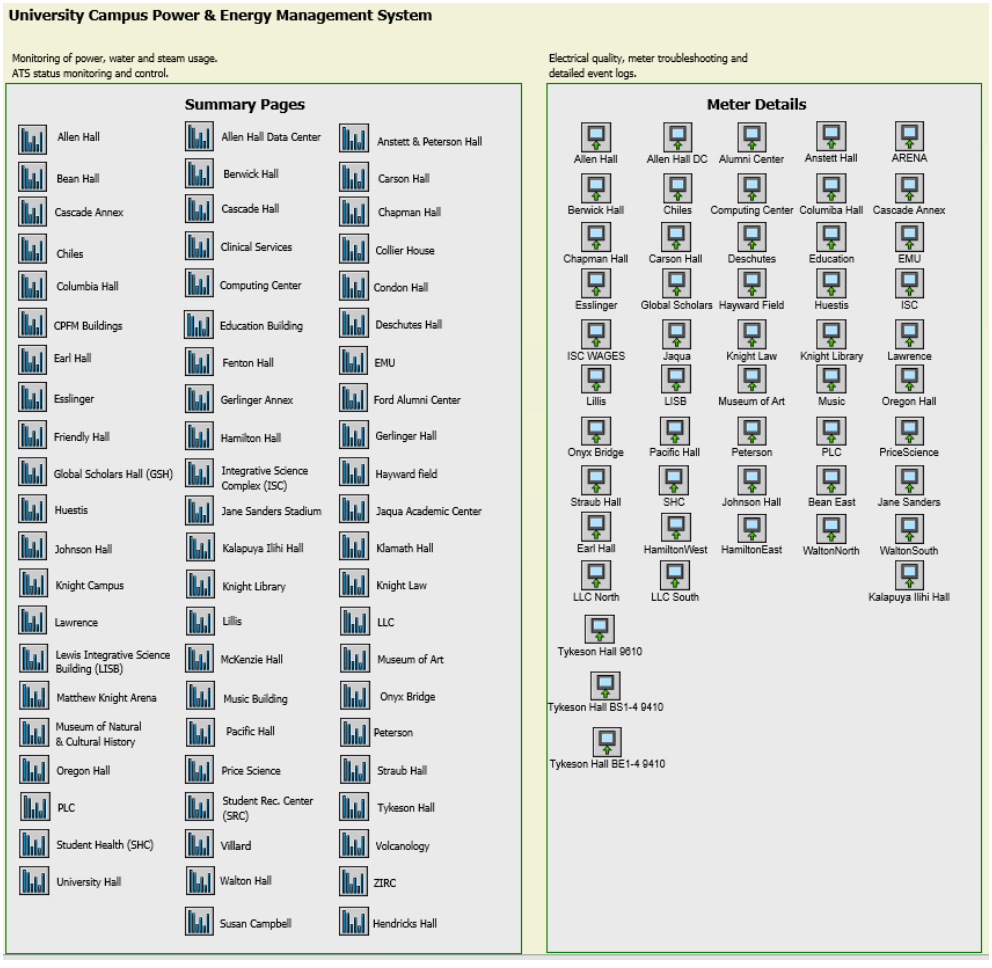
c. Energy / BTU meters must be integrated into the existing utility monitoring software prior to substantial completion. This includes creation of custom graphics displaying energy use data points and trending.
   - Owner must be provided a minimum of 2 weeks' notice prior to scheduling meter integration.

3.4 Training

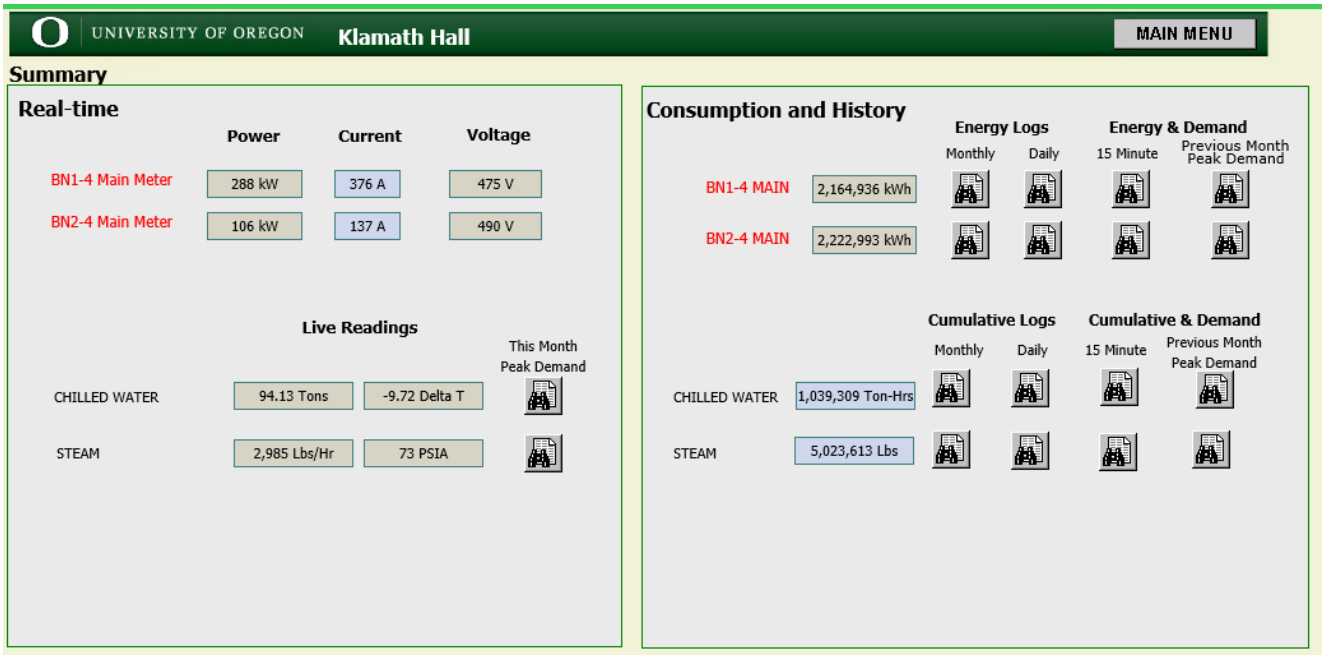
a. Furnish training plan for review by Owner at least two weeks prior to training.
b. Draft operation and maintenance manuals submitted prior to first training session.
c. Labeling of equipment, piping, and accessories is complete prior to first training session.
d. Training by qualified technicians knowledgeable in metering systems and components. Sales representatives are not acceptable to teach training courses unless approved by Owner prior to training.
e. Provide 1 hour of training in the following areas:
   - Review maintenance access and general installation
   - Review troubleshooting procedures
   - Review meter factory and field configuration settings

3.5 Graphics

a. Network diagram graphic



b. Building graphic



Section 33 70 00 – Electrical Utilities (Transmission & Distribution; Substations; Transformers; High-Voltage Switchgear & Protection Devices; Medium-Voltage Switchgear & Protection Devices; Site Grounding)

1. Primary power is to be encased in 2-inch cover minimum and in red-dyed cement.
2. Metering, reporting of meters, and commissioning of main meters must be complete and documented at the time the system is energized.
3. Campus Power Metering & Power Management; Required:

   a. General Requirements:

   - There shall be provided a UL listing for all equipment.
   - Manufacturer will provide services including all materials and labor to maintain operation of equipment for two years.

   b. Basic Power Meter:

   - Only manufacturer known to be acceptable: Square D
   - Features:

     i. Split Core CT's
     ii. Remote Display
     iii. Minimum Functions:

     ◊ Phase Current
     ◊ Volts, L-L
     ◊ Volts, L-N
     ◊ Real Power (KW)
     ◊ Reactive Power (kVAR)
     ◊ Apparent Power (kVA)
     ◊ Power Factor
     ◊ Real Energy (kWh)
     ◊ Power Demand with configurable demand interval
     ◊ Min-Max readings (kW)

     iv. Modbus communication capability to Ethernet Gateway.
     v. Capable of being configured to have specified data alarmed, displayed and logged using Square DSMS-3000 software via Ethernet Gateway or network interface card.

   c. Advanced Power Meter:

   - Only manufacturer known to be acceptable: Square D, PM 870
   - Features:

     i. Integral display with option for remote display.
     ii. Minimum Functions:

     ◊ Current, per phase RMS +/- 0.075%
     ◊ Current, 3-phase average RMS +/- 0.075%
     ◊ Current, apparent RMS +/- 0.075%
     ◊ Voltage, phase-to-phase & phase-to-neutral +/- 0.075%
     ◊ Power factor, per phase +/- 0.15%
     ◊ Power factor, 3-phase total +/- 0.15%
     ◊ Real power, 3-phase total +/- 0.15%
     ◊ Reactive power, 3-phase total +/- 0.15%
     ◊ Apparent power, 3-phase total +/- 0.15%
     ◊ Frequency +/- 0.01%
     ◊ Average demand current, per phase

Section 33 70 00 – Utilities continued

- ◊ Peak demand current, per phase, coincident with kW Peak, kVAR Peak, kVA Peak
- ◊ Average demand, real power
- ◊ Predicted demand, real power
- ◊ Peak demand, real power, coincident with kVA Peak, kVAR Peak
- ◊ Accumulated real energy In, accumulated real energy Out
- ◊ Accumulated reactive energy In, accumulated reactive energy Out
- ◊ Accumulated apparent energy
- ◊ Onboard Alarms (analog, digital, and Boolean)
  - ■ Undervoltage
  - ■ Overvoltage
  - ■ Unbalanced Current
  - ■ Unbalanced Voltage
  - ■ Phase Loss Current
  - ■ Phase Loss Voltage
  - ■ Reverse Power
  - ■ Phase Reversal
- ◊ Onboard logging of alarms, electrical data, trending, and forecasting, maintenance logs andwaveform capture using non-volatile memory of at least 800kb with zero blind sampling capability at 128 samples per cycle.
- ◊ Modbus communication capability to Ethernet Gateway.
- ◊ Capable of being configured to have specified data alarmed, displayed, and logged usingSquare D SMS-3000 software via Ethernet Gateway or network interface card.

d. Distribution Power Meter:

- Only manufacturer known to be acceptable: Square D, CM-4000T or CM3000
- Features

i. Remote Display
ii. Minimum Functions:

- ◊ Phase Current 0.04% of reading
- ◊ Volts, L-L 0.04% of reading
- ◊ Volts, L-N 0.04% of reading
- ◊ Real Power (KW) 0.075% of reading
- ◊ Reactive Power (kVAR) 0.075% of reading
- ◊ Apparent Power (kVA) 0.075% of reading
- ◊ Power Factor +/- 0.002 of reading
- ◊ Frequency +/- 0.01 of reading
- ◊ Real Energy (kWh) 0.075% of reading
- ◊ Reactive Energy (kVARh) 0.075% of reading
- ◊ Apparent Energy (kVAh) 0.075% of reading
- ◊ Energy Accumulation Modes
- ◊ KYZ Output
- ◊ Front Display
- ◊ THD, Voltage and Current with discrete harmonics to the 255th
- ◊ Current Demand
- ◊ Power Demand
- ◊ Date / Time Stamping

Section 33 70 00 – Utilities continued

- ◊ Predicted Power Demand
- ◊ Advanced Demand Options
- ◊ Onboard Alarms (standard, high speed, disturbance, digital, Boolean)
  - ■ Under voltage
  - ■ Over voltage
  - ■ Unbalance current
  - ■ Unbalance voltage
  - ■ Phase loss current
  - ■ Phase loss voltage
  - ■ Reverse power
  - ■ Phase reversal
- ◊ Min / Max Readings
- ◊ Data and Event Logging
- ◊ Downloadable Firmware
- ◊ Adaptive Waveform Capture configurable up to 64 seconds and up to 512 samples per cycle
- ◊ Sag / Swell Detection
- ◊ Programmable
- ◊ Oscillatory and Impulsive Transient Detection using 5mHz sampling on three channels simultaneously
- ◊ Sequence of Event Recording

iii. Modbus communication capability to Ethernet Gateway or integrally mounted Ethernet network interface card.

iv. Capable of being configured and having its data alarmed, displayed, and logged, including waveform capture and transient detection information using Square D SMS3000 software either directly or via an Ethernet Gateway.

e. Ethernet Gateway:

- Only manufacturer known to be acceptable: Square D EGX400
- Ethernet Gateway Requirements

i. Provide an Advanced Ethernet Gateway meeting the requirements.
ii. One 10/100 Mbps UTP port and one 100 Mbps fiber optic port.
iii. 16 MB of internal memory.
iv. Provide storage for standard and custom web pages to display real-time power equipment data and status, instruction manuals, and equipment drawings.
v. Capable of accepting HTML files, PDF files, Active X, CRG, GIF, JPG graphics, MS Office files (doc, xls, ppt, etc.).
vi. Configurable remotely using a standard internet browser.
vii. The Ethernet Gateway shall feature one RS-485 serial port and a second port configurable for RS-232 or RS-485 (support for 2-wire or 4-wire).
viii. A singe Ethernet Gateway, assigned a single IP address, shall provide high speed Ethernet support for up to 192 devices.
ix. Protocols supported: Ethernet – MODBUS / TCP HTTP, FTP. Serial – MODBUS, JBUS, and SY/MAX.
x. Input voltage: 24 Vdc; maximum burden 8 Watts.
xi. The Ethernet Gateway shall operate in ambient temperature of -30 to 80° C, an ambient storage temperature of -40 to 85° C and will operate in relative humidity of 5 to 95%.
xii. The Gateway shall be fitted with a web server to allow users to configure its Ethernet and Serial communication parameters, troubleshoot both Ethernet and serial communication, and add stand-

Section 33 70 00 – Utilities continued

xiii. alone product that offers various mounting configuration and includes at a minimum the following mounting options: DIN rail mounting; wall / panel mounting; flat surface or desk top.
xiv. UL, CUL, CE, NOM and FCC class A compliant.
xv. Compatible with Ethernet TCP / IP networks and allow users to access power monitoring information from any location on a local area network (LAN) or a wide area network (WAN).
xvi. Utilize Modbus / TCP protocol as its high-speed backbone network protocol.
xvii. Allow direct Ethernet connection to monitoring and protective RS-485 field devices. Powermonitoring software running on a PC with a Modbus / TCP driver shall be able to access monitoring, metering, and protective data via the LAN. The PC shall be connected to the Ethernet LAN via Network Interface Card (NIC).
xviii. The Gateway shall provide a twisted pair connection to connect to the Ethernet backbone. The Ethernet twisted pair port shall have the following:

- ◊ An RJ45 connector.
- ◊ Support for 10/100 BaseT connection (10 or 100 Mbit auto-negotiate)
- ◊ Support for both unshielded twisted pair (UTP) as well as shielded twisted pair (STP) wiring.
- ◊ LED's to indicate Ethernet activity. At a minimum, there shall be the following LED's; one for Physical Ethernet Link (LK), one for Transmit (TX), one for Receive (RX).

xix. Provide two serial RS-485 ports to connect serial field devices to the LAN. Each RS-485 serial port shall:

- ◊ Support up to 32 serial devices without a repeater.
- ◊ Support Modbus, Jbus, or mixed mode daisy chain devices.
- ◊ Support 2-wire or 4-wire daisy chain devices.
- ◊ Support baud rates of 1200 to 38400.
- ◊ Support parity values of even and none.
- ◊ Include screw type connectors with 5-positions.
- ◊ Include LED's to indicate serial communication activity. At a minimum, there shall be the following LED's; one for Transmit (Tx), and one for Receive (Rx) per port.

xx. A minimum of one port shall be configurable for either RS-485 or RS-232.
xxi. Each serial port shall have configurable biasing and termination to support 2-wire and 4-wire communicating devices.
xxii. The Ethernet Gateway shall allow a Modbus master on one of its serial ports to request data from devices on the second serial port.
xxiii. Compliant to industrial temperature. It shall withstand an operating temperature range of -30° to
xxiv. +80° C.
xxv. Configurable by either local RS-232 connection and a Hyper Terminal ® interface or local or remote Ethernet connection and a standard web browser.
xxvi. Setup of the Ethernet communication card shall be accomplished via the on-board Ethernet port and a web browser. It shall also be possible via the Ethernet port to upgrade the firmware of the Ethernet Gateway in the field to accommodate new system features.

f. Remote I / O Monitoring Module:

- Only manufacturer known to be acceptable: Square D EGX400
- Components

i. Programmable Logic Controller:

- ◊ Provide a fully functional Programmable Logic Controller (PLC), suitable for simultaneously monitoring up to 16 single ended analog points and 16 digital points (1 digital input module and 1 analog input module).
- ◊ PLC shall have an RJ-45 Ethernet output suitable for connection to the University of Oregon fiber backbone.

Section 33 70 00 – Utilities continued

- ◊ PLC shall be programmable to fully interface with the University of Oregon SMS-3000 power monitoring software via an Ethernet Gateway.
- ◊ PLC shall be capable of communicating over Ethernet using Modbus TCP.
- ◊ All components shall be housed in a steel enclosure.

ii. Uninterruptible Power Supply:
- ◊ Provide an Uninterruptible Power Supply (UPS), rack or wall mountable, suitable for operating the fully configured PLC for 30 minutes.
- ◊ The UPS shall be 120 volt AC input.

iii. Equipment Rack or Enclosure:
- ◊ Provide a standard equipment rack, designed for floor standing applications, suitable sized to support the PLC, the UPS, and any other accessories required in a fully configured system
- ◊ A wall-mounted NEMA 1 enclosure suitable to house all components is acceptable provided that this is the manufacturer's standard configuration.

iv. Digital Input Module: The digital input module shall accommodate up to 8 24-volt DC inputs.

v. Analog Input Module:
- ◊ The analog input module shall accommodate up to 16 single-ended analog inputs.
- ◊ Each of the analog inputs shall be user-configurable as either 4-20ma.

vi. Digital Output Module: The digital output module shall accommodate up to 8 24-volt DC contact outputs.

SECTION 33 71 49: Medium Voltage Transmission Wiring

Document revision history: 09/2026 – Original Publication

Date	Section	Description of Change

PART 1 – GENERAL

1.1 Summary

a. Work Included: Provision of materials, installation and testing of:
   - Medium Voltage Cable
   - Cable Terminations
   - Faulted Circuit Indicators

b. Onsite witness of cable installation by manufacture technician/engineer.
c. U&E Superintendent to approve pulling plan
d. Cable to be provided by the contractor.

1.2 Submittals

a. Product Data: Provide for cable, terminations and accessories.
b. Test Reports: from the factory and prior to energizing Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.
c. Manufacturer's Instructions:
   - Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
   - Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
d. Project Record Documents: Accurately record actual sizes and locations of cables.
e. Operation and Maintenance Data: Include instructions for testing and cleaning cable and accessories.

1.3 Qualifications

a. Manufacturer: Company specializing in manufacturing products specified in this section with minimum thirty (30) years documented experience.
b. Installer: Company specializing in installing products specified in this section with minimum three (3) years documented experience.

1.4 1.4 Delivery, Storage and Handling

a. Accept cable and accessories on site in manufacturer's packaging. Inspect for damage.
b. Store and protect in accordance with manufacturer's instructions.
c. Protect from weather and provide adequate ventilation to prevent condensation.

1.5 1.5 Project Conditions

a. Verify that product measurements match drawings.
b. Verify routing and termination locations of cables prior to rough-in.
   Drawings may show cable routing in approximate dimensions. Route as required to complete wiring system and markup drawings to reflect changes.

1.6 Field Samples

a. After approval and prior to installation, furnish UO CPS Supervisor with a 2-foot length of each type and size of wire and cable along with the tag from the coils or reels from which samples were taken. The sample shall show the manufacturer's marking.

1.7 Industry Standards

a. Cable shall meet or exceed the latest editions of the following industry standards.
   - ICEA S-68-516
   - ASTM B-8, B231
   - AEIC CS-6
   - REA Bulletin 50-70 (U-1)

PART 2 – PRODUCTS

2.1 Medium Voltage Cables, 15 KV:

a. Basis of design manufacturer: The Okonite Company.
b. Multi-Conductor Cable
   - Type MV 105
     i. UL listed for cable tray use.
     ii. 3/C, CLX, 15 KV, conductor shall be compact stranded, Class B annealed copper, covered with an extruded semi-conducting EPR strand screen, 220 mil ethylene-propylene insulation (133%), extruded EPT semi-conducting insulation screen, with a peel strength between 8 and 16 pounds per ½" width strip. 5 mil bare copper shielding tape with 12.5% minimum overlap. Armor Material: Aluminum. Armor Design: Impervious corrugated tube. 80 mil PVC jacket. Suitable for operation continuous at 105°C conductor temperature, 140°C emergency conditions and 250°C for short circuit conditions
c. Single Conductor
   - 1/C 15 KV, conductor shall be compact stranded, Class B annealed copper, covered with an extruded semi-conducting EPR strand screen, 220 mil ethylene-propylene insulation (133%), extruded EPT semi-conducting insulation screen, with a peel strength between 8 and 16 pounds per ½" width strip. 5 mil bare copper shielding tape with 12.5% minimum overlap. 80 mil PVC jacket. UL listed and labeled type MV 105, MC/HL. Suitable for operation continuous at 105°C conductor temperature, 140°C emergency conditions and 250°C for short circuit conditions.
d. Tests
   - Apparent Discharge Test: The completed cable must be tested for corona discharge and shall comply with AEIC requirements. A copy of the original X-Y plot showing discharge leveles for the cable shipped shall be submitted at time of delivery. Maximum discharge shall not exceed 5 pico-coulombs for all voltage levels. No D-C test shall be performed.
e. Warranty
   - The cable shall have a 40-year design life.
f. Quality Assurance:
   - Cable shall be manufactured under a quality assurance program as defined by ISO 9000 and 10 CFR 50 of the Federal Register.

2.2 Load break Elbow Terminations

a. Manufacturers: Elastimold #166LR, with test point; Cooper, 3M.

f. Load break Junctions:
- 4-way load break junction: Elastimold #163J4; Cooper, 3M.
- 3-way load break junction: Elastimold #163J3; Cooper, 3M. With approval from UE super, this is not typical.
- Provide (2) parking bushings for each junction.
- Provide ground wire lug at each junction. Pr
- Provide an insulated cap with ground (Elastimold #160DRG) for each load break bushing insert that will not have a load break elbow connected to it.
- Load break elbow connectors must be compatible with those existing in the University's electrical distribution system.
- In transformer vault, one full wrap of spare conductor around vault.
- Schweizer Test ports (VIN600 for deadbreak, VIN200 for loadbreaks) to have indicator light.

2.2 Faulted Circuit Indicators

a. Acceptable Manufacturers: Edison Control.
b. Description: Three phase, standard indicator, hinged small core with 25-feet of cable, relay output and pull over bail, 200 amp timed inrush restraint trip, 1 amp standard reset and two point mounting (for three phase remote units).

2.3 Preassembled Cable Termination Kits or Splices

a. Acceptable Manufacturers: Elastimold Series K150; Cooper; Raychem; 3M.
b. Description: IEEE 48; Class 1, molded rubber cable termination in kit form with stress cone, ground clamp, non-tracking rubber skirts, load break connector, rubber cap, for universal bushing.

2.4 Fireproofing Tape

a. Manufacturer
   - 3M type 77 or 77W, 3M type 69 glass cloth tape overlap.
b. Product Description: Flexible conformable unsupported intumescent elastomer.
   - Thickness: Not less than 0.030 inches.
   - Elongation: Over 100 percent.
   - Noncorrosive to the cable sheath.
   - Shall not support combustion.
   - Shall not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.
   - Width: 1.5"
c. The completed installation shall be capable of withstanding a high current (60 Hz) fault arc temperature of 13,000 degrees K for 70 cycles.

PART 3 – EXECUTION

3.1 Installation

a. On Site Manufacture Representation
   - Manufactures' technician/engineer shall provide a field advisor for a full day of installation support that includes cable pulling calculation support, termination training, installation training, d-c testing recommendation.
b. Delivery, Storage and Handling
   - Accept cable and accessories on site in manufacturer's packaging. Inspect for damage.
   - Store and protect in accordance with manufacturer's instructions.
   - Protect from weather and provide adequate ventilation to prevent condensation.
c. Project Conditions
   - Verify that field measurements are as shown on drawings.

- Verify routing and termination locations of cable prior to rough-in.
- Cable routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

d. Installation
- Install cable and accessories in accordance with manufacturer's instructions.
- Do not exceed cable pulling tensions and bending radius as specified by the manufacturer. Cable pull calculations to be submitted to owner prior to pull. Inspector shall be on site for the duration of the pull.
- When installed in cable tray, tie wrap the conductors every 10' to the tray. Tie wraps to crisscross the cable.
- Use suitable lubricating compounds on the cables and wires to prevent damage to them during pulling-in. Provide compounds that are not injurious to the cable and wire jackets and do not harden or become adhesive.
- Avoid abrasion and other damage to cables during installation.
- Do not exceed cable pulling tensions and bending radius as specified by the cable manufacturer.
- In cable trays, secure manholes to avoid interference with duct entrances.
- Provide a minimum of 3-feet extra armored cable per 100-feet of run when installed in cable trays to provide sufficient slack at terminal points and cable try expansion points so that movements of cable after installation will not cause damaging strain on cables or terminals.
- In manholes, underground raceways, vaults and other outdoor locations:
  i. Seal the cable ends prior to pulling them in to prevent the entry of moisture.
  ii. Allow sufficient slack in medium voltage cables, grounds and shield wires to allow elbow connectors to be moved to other existing and future load break junctions inside the vault.
  iii. Splice the cables and wires only in manholes and accessible junction boxes. Ground shields and neutral conductor.
  iv. In manholes, trenches and vaults install the cables on suitable porcelain insulators with steel cables racks. Ground cable racks.
  v. Install faulted circuit indicators so they are easily viewed from outside the vault
  vi. Arrange cable in manholes to avoid interference with duct entrances.
- Ensure proper grounding per manufacturer's instructions.
- No double landing is allowed. One lug per bolt.
- Protect installed cables from entrance of moisture.
- Where CLX Armor is exposed for splices and terminations provide heat shrink (Ray-Chem) material over exposed shield.
- All MV pathway to be approved by Owner.
- Fireproof cables in manholes using fireproofing tape in half lapped wrapping with banding at each end. Wrap each conductor individually. Extend fireproofing 1 inch into duct. Wrap fireproofing tape, at 18" intervals, with two layers of glass cloth adhesive tape. Individual conductors can be wrapped as a group until the breakout point at the load break junctions pending Utilities electrical supervisor approval.

e. Preparation: Use swab to clean conduits before pulling cables.

f. Field Quality Control:
- Inspect exposed cable sections for physical damage.
- Inspect cable for proper connections.
- Inspect shield grounding, cable supports and terminations for proper installation.
- Contractor shall contact cable manufacturer and arrange for one day of on-site cable installation advice prior to starting installation.

g. Feeder Identification
- At each point of termination, and every 40' along the cable, install permanent tags on each circuit's cables and wires to clearly designate their circuit identification,voltage. origin and destination.
- In manholes, the tags shall be the embossed brass type and shall also show the cable type and voltage rating.

- Position the tags so they will be easy to read.

3.2 Interface with other products

a. Provide labeling per Section 26 05 33, Identification of Electrical Systems

3.3 Testing

a. The Electrical Contractor shall engage the services of a recognized Independent testing laboratory for the purpose of performing inspections and tests per NETA ATS. The independent testing laboratory shall perform appropriate tests for the new primary cable installation. Responsibilities shall include the following:

- Medium Voltage Cable, Visual and Mechanical Inspections

  i. Inspect exposed sections from new metering cabinet to transformer vault for physical damage.
  ii. Verify cable is supplied and connected in accordance with one line diagram.
  iii. Inspect for shield grounding, cable support and termination.
  iv. Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radius.

- Electrical Tests

  i. Perform a shield continuity test by ohm meter method. Record ohmic values.
  ii. Measure shield-continuity from end to end using an ohmmeter having a minimum resolution of 0.01 ohms. Procedure for this test shall be as follows.
    ◊ Bolt the three medium voltage conductors together at the remote end.
    ◊ Measure and record the resistance between A-Phase and B-Phase terminals from the local end. Divide the measured resistance by 2. The resultant number of the calculation shall be a control reading and act as an extension of the ohm meter test lead.
    ◊ Bolt the remote end of the A Phase shield to the remote end of the A Phase conductor.
    ◊ Measure the resistance of between the local A Phase conductor and the local A Phase shield.
    ◊ Subtract the control reading from the measured resistance to determine the shield resistance.
    ◊ Repeat the above procedure for B Phase and C Phase conductors.
    ◊ Compare the results to each other and the manufacturer's data. Investigate values varying by more than 10 percent.

  iii. Hi-pot Tests: Perform very low frequency (VLF) high potential acceptance test in accordance with IEEE 400.2 as follows.
    ◊ Prerequisites:
      (i) Perform test only after the temperature-corrected cable insulation resistance test results are determined to meet the Specifications.
      (ii) Clean splices prior to test using manufacturer approved materials and methods.
      (iii) Record environmental data including temperature and humidity.
      (iv) Maintain the humidity in the test area below 70 percent.
      (v) Install corona-suppression spheres and space charge containment prior to test.
      (vi) Test shield continuity.
    ◊ Test method shall be sinusoidal or cosine-rectangular/bipolar pulse as described in IEEE 400.2. Test voltages for 15 kV conductors are as follows.
      (i) Test each conductor individually and ground conductors not under test.

(ii) Test voltage shall be 28 kV peak (20 kV RMS) in accordance with IEE 400.2, Table 5, for testing 15 kV cable using the sinusoidal method.

(iii) Test voltage shall be 28 kV peak in accordance with IEEE 400.2, Table 4, for testing 15 kV cable using the cosine-rectangular/bipolar method. Do not use RMS voltages for this method.

(iv) For cables rated other than 15 kV, refer to IEEE 400.2, Tables 4 and 5. Use acceptance test voltage.

◊ Test frequency shall be 0.1 hertz (Hz).

◊ Test duration shall be 60 minutes, continuous for each conductor.

◊ Increase the VLF test voltage from 0 to the maximum field test value as recommended by IEEE 400.2.

◊ Apply maximum test voltage for the specified duration. Gradually reduce the test voltage to zero.

◊ Ground the conductors to discharge residual and induced voltages.

- Safety Precautions: Exercise suitable and adequate safety measures prior to, during and after the high potential tests, including placing warning signs and preventing people and equipment from being exposed to the test voltage.

SECTION 33 73 13: Liquid-Filled Utility Transformers

Document revision history: 09/2026 – Original Publication

Date	Section	Description of Change

PART 1 – GENERAL

1.1 Summary

a. Work Included: Provision of materials, installation and testing of:
- Medium Voltage Oil Filled Transformers
- Pad Mounted Transformer Vaults

1.2 Submittals

a. Product Data: Provide for transformers and vaults

1.3 Qualifications

a. American Concrete Institute (ACI) Publication: ACI 318 – Building Code Requirements for Reinforced Concrete.

PART 2 – PRODUCTS

2.1 Medium Voltage Oil Filled Transformers

a. Transformers are to be specified by the design team and are to be Contractor Furnished, Contractor Installed. The following product information must be included in the design specifications.

b. Liquid Insulated Distribution Transformer, Basis of Design Manufacturer: COOPER

c. Standard Features

- Liquid filled: fr3 oil environment safe oil
- Primary volts: 12470 delta 95 kv bil
- 300 kva and larger, secondary 480/277 wye 30 kv bil
- Less than 300 kva, secondary 208/120 wye 30 kv bil
- KVA – as required for application
- Vector grouping to be DYN1
- Standard 60 hertz
- Impedance 3.75% +/- 7.5% tolerance
- Aluminum windings
- Temp 120 degrees insulation class 65 rise over 30 avg – 40 max amb
- Taps 2-2.5% fcan, 2-2.5% fcbn
- Altitude std. 3300 feet maximun
- 58 db sound level maximum

d. Required Modifications

- Doors must hinge/swing back for unobstructed access for specific project conditions.
- High voltage – dead front, radial feed,
- Three wells and three bushing well inserts

- Under oil switch two position 200a, hotstick style load-break switch
- Fuses Bay-o-Net high amp
- Two sets of spare fuses, total of 6 fuses for spares
- Low voltage bushings epoxy
- Tin plated aluminum NEMA 6 hole LV & neutral bushing spades, or as needed for the project application allowing one lug per side.
- UL listing
- Energy efficient per latest standard
- Min efficiency (50% load) = 99.36%,
- Aluminum transformer nameplate.

e. Required Options

- 1" drain valve with 3/8" sample port. Oil test port be to be accessible from outside of high voltage compartment, limiting exposure to live parts
- 1" npt fill valve
- Dial type thermometer
- Liquid level gauge, dial type
- Pressure vacuum gauge, dial type
- Standard pressure relief valve
- Pressure relief diaphragm
- Nitrogen test port, Schrader valve type
- Nitrogen air space blanket
- Paint color Munsell #7.0gy-3.29/1.5
- Pentahead bolts

f. Factory Transformer Field Acceptance Testing

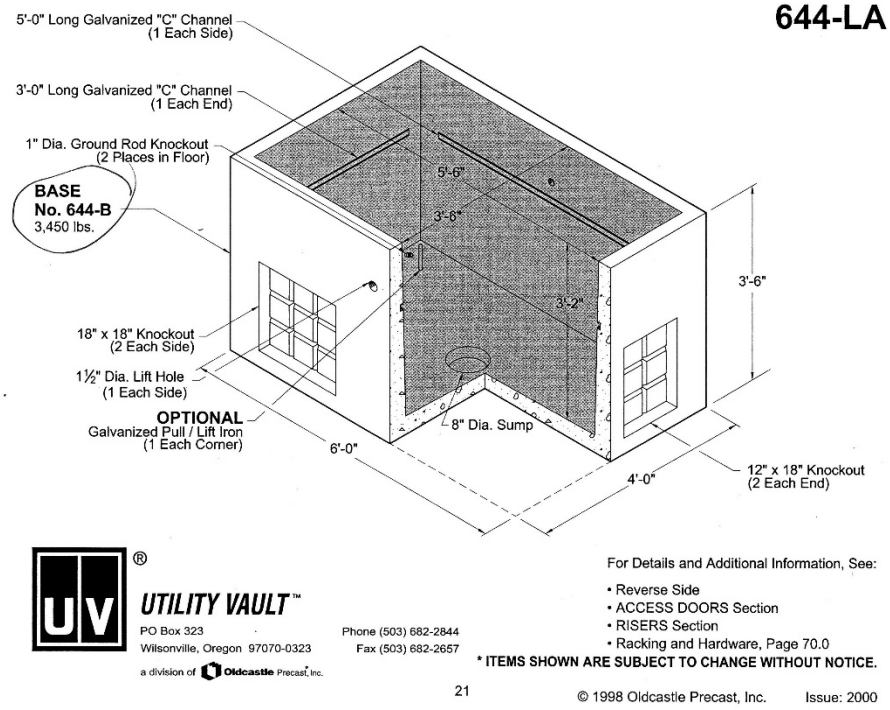
- Ratio test
- Polarity test – vector grouping needs to be supplied
- Phase relation test
- No-load loss test
- Excitation current test
- Impedance voltage test
- Load loss test
- Applied potential test
- Induced potential test
- Leak test
- Resistance measurement test
- Certified test report
- Factory QC impulse test hv only

g. Documentation

- Provide build sheet, to UO CPS Supervising Electrician, demonstrating all specs are met.

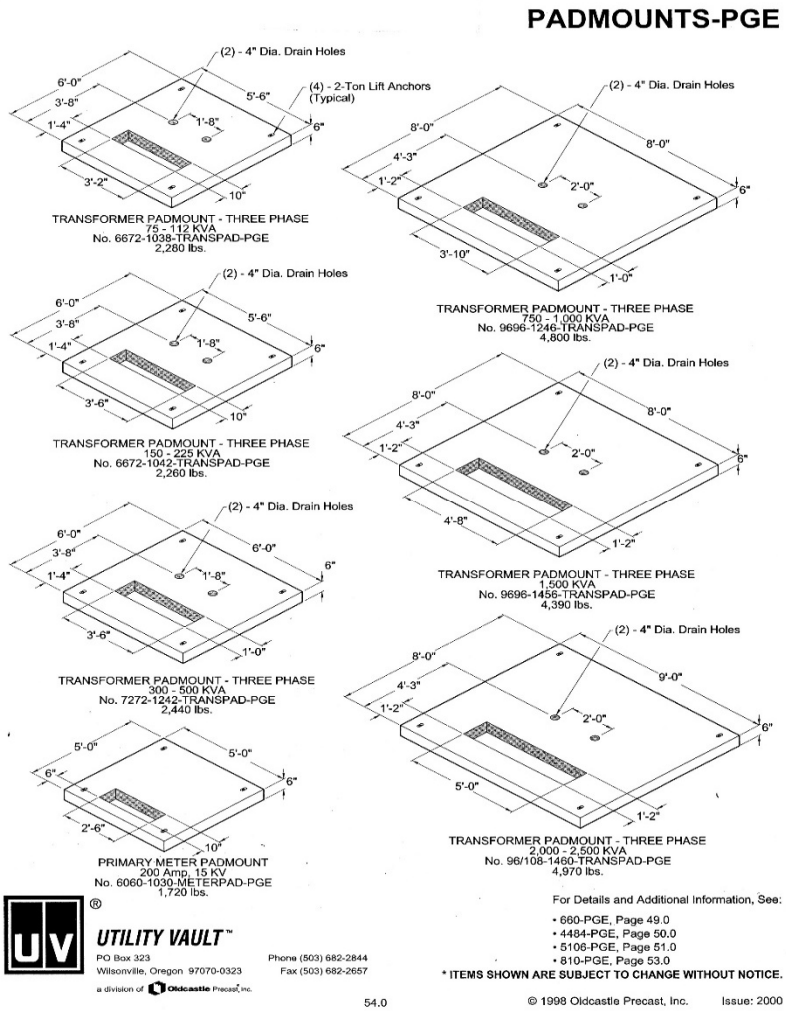
2.2 Utility Vaults and Transformer Padmounts

a. Basis of design manufacturer: Utility Vault, division of Oldcastle Precast Inc.

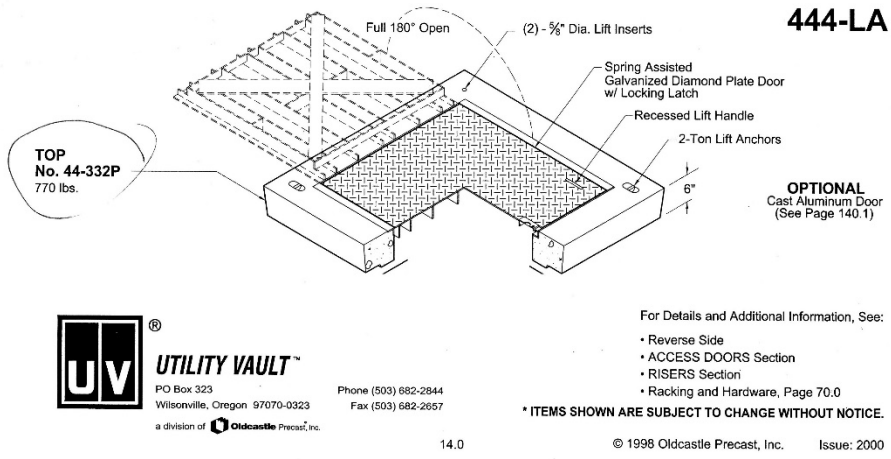


b. Preferred base: Utility Vault Model # 644-B shown below.

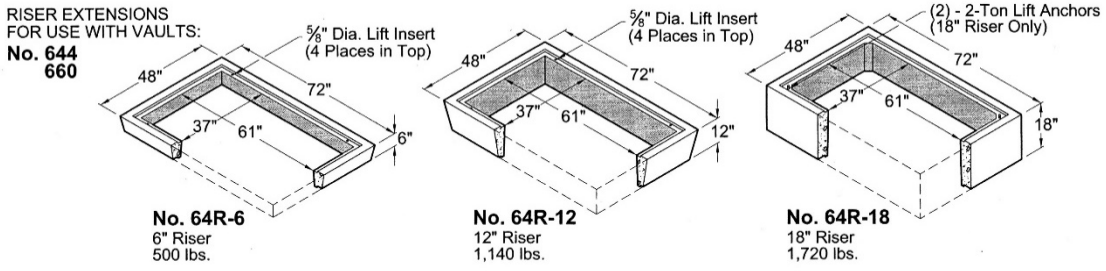
c. Preferred vault top: Utility Vault Model # 44-332P shown below.



- Lids must be galvanized steel non-slip construction. Provide lid with a Penta bolt for securing the lid.

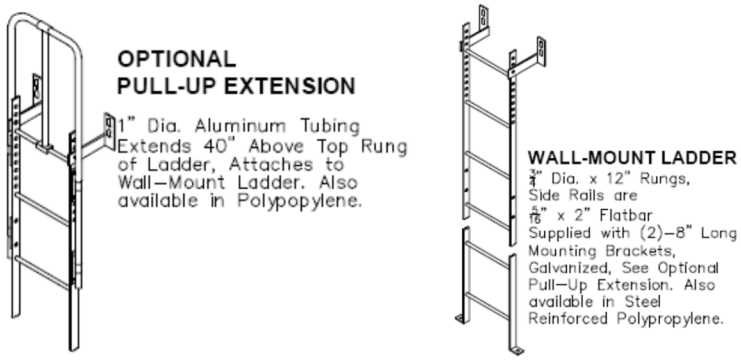


d. Preferred riser extensions for base No. 644: Utility Vault shown below.



e. Preferred vault ladders: Utility Vault Model pull-up or wall mount shown below.

- First ladder rung should be within 4" from top of vault



PART 3 – EXECUTION

3.1 Installation

a. Contractor to provide transformer testing before installation to check for damage during shipping. Provide results to UO CPS.

b. Liquid Insulated Transformers

- Above ground pad-mounted transformers require prior OWNER and CPS Electrical Superintendent review and approval. Screening strategies, maintaining appropriate service clearances, may also be required per CPS Electrical Superintendent and OWNER direction.
- Submit complete and descriptive shop drawings indicating compliance with the requirements above.

i. Concurrent CPS Electrical Superintendent review and approval is required.

- Transformer taps are to be adjusted to the proper voltage after system is installed and operating under load.
- Install secondary conductors on cable mounting bracket such that no vertical force is applied to the secondary terminals. Use extra heavy duty, black, UV resistant nylon straps.
- Where installed inside the building transformer vaults must be provided with a drain.

c. Pad Mounted Transformer Vaults

- A padmount vault is required to be installed under all outdoor transformers.
- Vaults with built-in ladders must have extensions above the opening that are OSHA compliant. Extension ladder shall extend a minimum of 40" above ground level.
- Vault doors must open completely so that in the open position there is no ceiling to the vault during maintenance.
- NO drains and/or sump pumps are to be located in pad mount transformer vaults.

d. Phase Rotation
- The Secondary phase conductors of each transformer shall have a clockwise rotation.
- Clockwise phase rotation to be tested and documented. Provide documentation of correct phasing for each transformer to Owner

e. Monitoring
- Provide a 1" conduit from each pad mounted transformer to the main electrical room for future use by UO CPS.

3.2 Interface with other products

a. Provide labeling per Section 26 05 33, Identification of Electrical Systems

3.3 Testing

a. Field Quality Control
- Engage the services of an independent Electrical Testing Organization in accordance with Section 26 00 10 to perform the following inspections and tests.

b. Performance of Acceptance Checks and Tests. Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with ANSI/NETA ATS.

c. Visual and Mechanical Inspection
- Compare equipment nameplate data with drawings and specifications.
- Inspect physical and mechanical condition.
- Inspect impact recorder prior to unloading.
- Test dew point of tank gases, if applicable.
- Inspect anchorage, alignment, and grounding.
- Verify the presence of PCB content labeling.
- Verify removal of any shipping bracing after placement.
- Verify the bushings are clean.
- Verify that alarm, control, and trip settings on temperature and level indicators are as specified.
- Verify operation of alarm, control, and trip circuits from temperature and level indicators, pressure relief device, gas accumulator, and fault pressure relay, if applicable.

- Verify that cooling fans and pumps operate correctly and have appropriate overcurrent protection.
- Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS.
- Verify correct liquid level in tanks and bushings.
- Verify that positive pressure is maintained on gas-blanketed transformers.
- Perform inspections and mechanical tests as recommended by the manufacturer.
- Verify presence of transformer surge arresters.
- Verify de-energized tap-changer position is left at the nominal tap position prior to energization.

d. Electrical Tests:

- Perform insulation-resistance tests, winding-to-winding and each winding-to-ground. Apply in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS. Calculate polarization index.
- Perform turns-ratio tests at all tap positions.
- Perform insulation power-factor or dissipation-factor tests on all windings in accordance with test equipment manufacturer's published data.
- Perform power-factor or dissipation-factor tests on each bushing equipped with a power-factor/capacitance tap. In the absence of a power-factor/ capacitance tap, perform hot-collar tests. These tests shall be in accordance with the test equipment manufacturer's published data.
- Perform excitation-current tests in accordance with test equipment manufacturer's published data.
- Measure the resistance of each high-voltage winding in each no-load tap-changer position.
- If core ground strap is located in a dry well, remove and measure core insulation resistance at 500 volts dc.
- Measure the percentage of oxygen in the gas blanket.
- Remove a sample of insulating liquid in accordance with ASTM D 923. Sample shall be tested for the following.
  i. Dielectric breakdown voltage: ASTM D 877 and/or ASTM D 1816.
  ii. Acid neutralization number: ANSI/ASTM D 974.
  iii. Specific gravity: ANSI/ASTM D 1298.
  iv. Interfacial tension: ANSI/ASTM D 971 or ANSI/ASTM D 2285.
  v. Color: ANSI/ASTM D 1500.
  vi. Visual Condition: ASTM D 1524.
  vii. Water in insulating liquids: ASTM D 1533.
  viii. Power factor or dissipation factor in accordance with ASTM D 924.
  ix. Remove a sample of insulating liquid in accordance with ASTM D 3613 and perform dissolved-gas analysis (DGA) in accordance with ANSI/IEEE C57.104 or ASTM D3612.
  x. Test surge arresters in accordance with NETA ATS.

e. Compare test results with ANSI, IEEE, and manufacturer's published tolerances. In the absence of manufacturer's published tolerances for any test, compare test results with NETA ATS.

f. Remove and replace equipment not meeting test result tolerances.

3.4 Adjusting

A. Adjust primary taps so that secondary voltage is within 2 percent of rated voltage.

3.5 Training

a. NA