Purpose and General

These design guidelines provide direction and guidance to design professionals regarding the University of New Mexico utilities systems and minimum expectations for the design of new and renovated service connections. No connection to the utility systems described herein can be made to any component of a proposed addition without the expressed written approval of the Utility Services Department. Designers and contractors should make every effort to assure that prior approval of proposed systems and components by Utility Services is obtained prior to construction of such elements. Refer to addenda, standard details and specifications for additional information relating to individual utilities.

33 01 00 Operation and Maintenance of Utilities

Operation of Utilities Equipment

Only Utility Services personnel are authorized to operate Utilities equipment. This includes valves, breakers, switches, chillers, pumps, boilers, fans, controls, metering, turbines, and any other utilities equipment used to produce or distribute steam, domestic water, chilled water, or electricity.

If utility shutdowns are required, the contractor shall submit an outage request at least 11 days prior.

Connection to Utilities

Prior to connection to UNM Utilities, the Connection Checklist and Approval must be completed. The checklists are available on the Utility Services web page at UTILITY.UNM.EDU under Standards & Guidelines.

33 05 00 Common Work Results for Utilities

Protection of Existing Utilities

Any work performed above, below or in the tunnel system, existing utility systems and structure should be protected from any form of damage. Construction equipment and materials shall not be driven, placed or stored on the tunnel top without providing PE stamped drawings from a structural engineer that will provide appropriate safeguards to protect the integrity of the tunnel.

Any penetrations to the tunnel system shall be protected from the weather, animals, flooding, and illegal entry at the end of each day until the tunnel is permanently sealed.

Do not interrupt any utilities, except when authorized by the Owner. When required, provide temporary services during interruptions to existing utilities. The cost associated with temporary utilities shall be included in the bid price.

Identification of Underground Utilities and Piping

All underground piping and utilities shall have two stages of identification and/or warning by a combination of non-detectable and tracer wire.

Identification Tape (non-detectable warning tape)

The 1st stage of identification shall be a buried non-detectable warning tape. This tape shall provide an early warning at shallow depth excavation. The tape shall be 6" wide, and buried approximately 18" to 30" above the service pipe, but a minimum of 10" below finished grade. It shall consist of multiple layers of polyethylene with an overall thickness of 3 to 5 mils. It shall be installed continuously from valve box to valve box or manhole to manhole, and shall terminate just outside of valve box or manhole wall. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color-coded background that conforms to APWA color code standards.

Tracer Wire

Wire shall be installed directly on top of the pipeline and permanently secured to the pipeline at 10' intervals.

Detectable core or tracer wire "circuit" shall be continuous from valve box to valve box or manhole to manhole for complete pipeline detection and location. Manufacturers' approved splice kits shall be used. Wire shall terminate just inside of valve box cover or manhole ring cover and be easily accessible for "clip-on" type utility location meters.

All underground utilities shall have a tracer wire installed along the length of the utility. The wire shall be attached to the utility at a maximum of 10' intervals and not allowed to "float freely" within the backfill. Tracer wire shall be single-conductor, 10 gauge minimum, copper single-conductor wire with type "UF" (Underground Feeder) insulation, and shall be continuous along the utility passing through the inside of each valve box or other connection point.

Construction Water and Power

The Contractor shall coordinate construction water service from either the UNM Utility Services Department or the City of Albuquerque. The construction water service from the UNM water system shall be equipped with backflow prevention equipment.

If connecting to UNM water, Utility Services will provide and install the construction water meter - **after an application for water and deposit is collected**. The Contractor shall be responsible for protecting and returning the meter to UNM. The Contractor shall be responsible for the loss of the meter or any damage to the meter.

The Contractor shall coordinate construction electric service with Utility Services. The construction electric service from the UNM system shall be designed to protect the integrity of the UNM electric system in the event of a fault or other anomaly in the construction site electric system. The construction electric service shall only be connected to the UNM system by Utility Services electricians and only after the system has been inspected and approved the Utility Services electricians.

Utility Services will specify the construction power meter. The Project will be responsible for the cost of the power used. The Contractor shall be responsible for installing and protecting the meter. The Contractor shall be responsible for the loss of the meter or any damage to the meter.

Excavation, Trenching, and Backfilling

BEDDING AND SHADING MATERIAL:

Bedding and shading material shall consist of the material located around the pipe from the bottom of the trench (6 inches minimum below the invert of the utility) to an elevation of 12-inches above the top of the utility.

Select Material: Select material shall be native or imported material which is free of stones larger than 2 inches in diameter, construction debris, chunks of clay, and other deleterious material. The material shall comply with the following:

Sieve Size	Percent Passing by Weight
2 inch	100
3/4 inch	60 - 100
No. 8	35 - 80
No. 200	(1)

(1) The sum of the percent passing the No. 200 sieve and the plasticity index (PI) shall not exceed 25.

Sand: Sand shall conform to the following:

Sieve Size	Percent Passing by Weight
1 inch	100
No. 4	60 - 100
No. 200	0 - 5
Max PI = 5	
Max LL = 30	

PERMITTED USE OF BEDDING AND SHADING MATERIAL:

The bedding and shading material used around new and existing utility lines shall be as follows:

1. Insulated Piping: Sand
2. Ductile Iron Pipe (DIP): Select material or sand.
3. Polyvinyl Chloride (PVC), CPVC, and C-900 Pipe: Sand.
4. Concrete Cylinder Pipe (CCP): Select material or sand.
5. High Density Polyethylene (HDPE): Sand
6. Reinforced Concrete Pipe (RCP): Select material or sand.
7. Vitrified Clay Pipe (VCP): Sand.
8. Steel Pipe with Coating: Sand.
9. Electric and Communications Ducts: Concrete encasement or sand matching the existing conditions. Concrete shall match the color of the existing encasement.

CONCRETE ENCASEMENT:

Concrete shall be 2,500 PSI at 28 days meeting. Color of encasement of electric ducts shall be red.

BASIC MECHANICAL MATERIALS AND METHODS

1. CONCRETE (not otherwise specified):
   All concrete furnished under this division and not elsewhere specified shall be 3000 psi compressive strength.
2. PIPE SLEEVES
   Pipe passing through concrete walls or slab shall be provided with pipe sleeves fitted into

place at the time of construction, or openings for sleeves shall be cut or core drilled through existing construction. Sleeves shall not be installed in structural members. Each sleeve shall extend through its respective floor, wall, or roof, and shall be cut flush with each surface. Unless otherwise indicated, sleeves shall be of such size to provide minimum of 1/4" all around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves shall be steel or cast iron pipe. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve shall be sealed or between jacket over insulation and sleeve shall be sealed. Metal jackets shall be provided over insulation passing through exterior walls, floors, or roofs, and shall be in accordance with SMACNA "Architectural Sheet Metal Manual". Annular space between pipe and sleeve in exterior walls shall be sized to allow installation of “link seal” mechanical seal, to be furnished as part of work.

3. ELECTROLYSIS PROTECTION
   Dielectric fittings such as couplings, unions or flanges, shall be installed to isolate pipe connections between non-ferrous and ferrous metals. Isolation shall be accomplished by non-metallic, unthreaded sleeves or gaskets or a combination of both. Fittings shall be so designed that the installing tools cannot come in contact with the insulating material.

4. PAINTING
   After installation, clean equipment and accessories having factory primed or finished painted surfaces, and touch-up bare or marred spots with same paint as applied at factory.

5. VALVE TAGS, DIRECTORIES, CODING AND IDENTIFYING DEVICES

   A. All valves (except fixture stops) shall be tagged with 1-1/2 inch diameter brass discs having depressed black filled letters and numbers. Identifying numbers shall be no less than 1/2 inch high and letters no less than 1/4 inch high. Numbers shall conform with valve directory listing number, location and use.

   B. Secure all tags to valves with 12" long braided copper wire meter seals.

   C. Stencil identification labels and flow arrows on all pipe and ducts after finish painting is completed. Place labels at sufficient intervals throughout the systems, adjacent to valves and fittings, at each change of direction and no more than 40 feet apart. In concealed areas provide identification at all access panels including access in removable tile ceilings. In finished areas, label exposed pipe or ducts only as directed by Architect/Engineer. All stencils shall be readable from floor level.

   D. Piping insulation is to be labeled non-asbestos containing.

   E. Direction changes in underground utilities shall be identified by surface 2” brass monumentation

6. LUBRICATION

   A. Lubricate as required, all motors, bearings, fans, etc. before equipment is put into operation.

   B. Provide lube extension fittings where required for ease of maintenance. Install all motors and bearings so that oil fill ports are vertical. Rotate motor end bells as required.

   C. Provide a final lubrication for all equipment requiring same immediately before turning

over to the Owner, submit certification.

7. TESTS
   Furnish calibrated testing equipment and the services of competent, experienced testing personnel to conduct operating and performance tests specified. Instruments shall be calibrated prior to tests.

8. MAINTENANCE MANUAL
   A. Shall be a complete, detailed guide for maintenance and operation of the new equipment and systems. Manual shall contain manufacturer's printed data and shall be sufficiently broad to serve operating staff as a permanent set of instruction which they can rely upon to understand the general theory and concept of the systems and to assist them in making operating maintenance adjustments.
   B. The manual shall contain, as a minimum, complete installation, operation and maintenance instruction books, complete parts lists and catalogs, as well as detailed descriptions of special precautions, sequence of assembly and disassembly, and methods of adjustment of all parts requiring adjustment, and a list of recommended spare parts. The manual shall also include contact information for the manufacturer.

9. CLEAN-UP:
   All work, equipment and materials shall be cleaned of all debris, plaster, paint, etc., and upon completion of the project, shall be turned over to the Owner in a clean and first-class condition.

CHEMICAL WATER TREATMENT

EXECUTION

PREPARATION (CONTRACTOR RESPONSIBILITY):

A. Systems shall be operational, filled, started, and vented prior to cleaning.

CLEANING SEQUENCE (CONTRACTOR RESPONSIBILITY):

A. Description:
   1. Systems to be cleaned include:
      a. Steam and condensate
      b. Chilled water
      c. Condenser water
      d. Heating water
      e. Domestic water (including irrigation water)

B. Responsibility:
   1. Contractor shall be fully responsible for cleaning and flushing of systems.
   2. Contractor shall procure sufficient chemicals from Owner’s Chemical Treatment Vendor, and shall coordinate with vendor on all matters related to use of chemicals and cleaning procedure.
   3. Chemical Treatment vendor shall be available to be on-site throughout cleaning and flushing procedure and shall observe condition prior to start.

C. Initial Fill:

1. Circulate for 1 hour minimum or until strainers are clean. Chillers are isolated on both condenser and chilled water sides.
2. System filled with domestic water and hydro tested (as many times as required for successful test).

D. Flushing:

1. Flush the system until clear by continuous bleed and make up. Coordinate with UNM EHS about water use restrictions and discharge points.

E. Cleaning:

1. Drain enough water to sewer for cleaner to be added to system.
2. Add cleaner **CL-490** to the system
3. Circulate for 24 hours (5-6 fps velocity)
4. Drain cleaner fluid to sewer – system must be drained completely, adjust pH to between 5 and 9.

F. Water Treatment Provider (WTP) Monitoring:

1. During clean-up procedure WTP will monitor the concentration of **CL-490** cleaner in the system by monitoring make-up water.
2. WTP will also be responsible for monitoring system's water during clean up procedure.
3. During discharge to the sewer system, WTP will ensure pH adjustment of all wastewater to city sewage.

G. Passivation:

1. Fill the system with clean water and **CS-5584** or approved equivalent.
2. Adjust/maintain the system pH at 6.5 – 7.5.
3. Maintain the **CS-5584** treatment concentration at **700 ppm**.
4. Circulate for 48 hours minimum.
5. Drain (or bleed off pH adjust and discharge to sanitary sewer) until inorganic phosphate level is between 5 – 10 ppm using ICW water fill for system make up.

33 06 00 Schedules for Utilities
33 08 00 Commissioning of Utilities

33 09 00 Instrumentation and Control for Utilities

Metering

Overview

The UNM Utility Services Department (US) manages and operates a District Energy System (DES) on the Main and North Campuses that provides the utilities listed in 2.1B below. US requires that any facility that connects to at least one of these DES utilities be provided with whole facility instrumentation and metering devices meeting this guideline. Facilities that do not connect to the DES utilities may be required to meet this guideline based on the project scope and program.

The Energy Metering System (EMS) is a networked metering, monitoring, and verification system comprised of facility hardware, facility software, network equipment, EMS servers, and EMS software. This guideline includes the facility hardware and software, but the project budget must fund all components of installation including hardware, software, commissioning, and installation. US will provide the project manager with estimates of the cost of those items provided and installed by US.

The facility is instrumented locally for each of the DES utilities to which it is connected. The instruments are wired to a Building Utilities Metering Panel (BUMP) provided by the project per US guidance. This panel contains a programmable logic controller and other hardware necessary to provide and display continuous historical and instantaneous metering of the facility. The BUMP reports data over the campus WAN on a secured network to the remote EMS servers where it is stored for management information and reporting purposes. The contractor who provides the utility metering for the facility are required to coordinate with the US personnel and contractors to assure a complete working system.

GENERAL

1.1 SECTION INCLUDES

A. This document covers the metering guidelines for:
   1. Chilled Water
   2. Steam
   3. Natural Gas
   4. Domestic Water
   5. Electricity including Solar PV Systems

2.1 GENERAL REQUIREMENTS

A. The exact location and arrangement of pipe upstream and downstream of the flow sensors shall be based on the manufacturer's recommendations, requirements, and specifications.

B. Typical operating range design information is as follows:
   - Chilled Water
     Temperature Range: 35-100 degrees F
     Pressure Range: 20-80 psig
   - Steam
     Temperature Range: 100-400 degrees F
     Pressure Range: 0-150 psig
   - Natural Gas
     Pressure Range: 0-20 psig
   - Domestic Water
     Pressure Range: 0-100 psig
   - Electric: as required by the building design, but generally transformed from primary 12.47 KV to 208/3p/4W or 480/3p/4W.

C. All transmitters shall have the following characteristics with no exception (unless otherwise indicated within this guideline)
   - Input power: 24VDC
   - Output Signal: 4-20mA

D. Each instrument shall be labeled indicating calibration range, building number, and service

E. Calibration label on instrument shall indicate last factory calibration date.

F. All instrumentation shall be calibrated using local barometric pressure.

G. Each instrument shall have a local readout installed in an easily accessible location irrespective of the actual instrument location.

- Each instrument shall transmit both instantaneous (4-20ma) and totalization signals (pulse). Instantaneous and totalization values will be displayed on the local readout.

H. All instrumentation shall be rated to operate in an ambient temperature of 32 - 140 degrees F and calibrated for an altitude of 5200'.

I. All transmitter enclosures shall be rated at a minimum of NEMA 4 with a minimum of two ¾" electrical hubs with plugs.

J. All instrumentation shall be Hart-compatible.

K. All instrumentation wiring shall be 18 gauge, twisted, shielded pair

2.2 CHILLED WATER METER FLOW METER AND TRANSMITTER

A. Flow sensor and transmitter shall be Foxboro (Siemens) or prior approved equivalent meeting the following:

- Flow sensor shall be corrected mass-flow, flanged in-line "magpipe" electro- magnetic technology.
- Maximum pressure drop across meter assembly at maximum design flow of 1.0 psi.
- Accuracy: ±1.0% of flow across full range for given pipe size.
- Minimum turndown ratio: 100:1.
- Meter size shall be appropriate for expected maximum flow.

2.3 STEAM METER FLOW SENSOR AND TRANSMITTER

A. Flow sensor and transmitter shall be Foxboro (Siemens) or prior approved equivalent meeting the following:

- Flow sensor shall be capable of mass flow (corrected for temperature and pressure), flanged in-line vortex-shedding technology, but shall be calibrated for volumetric flow (mass flow conversion and correction occurs in the BUMP).
- Maximum pressure drop across reduced-size meter assembly at maximum design flow: 5.0 psi.
- Accuracy: ± 1.0% of flow across full range for given pipe size.
- Minimum turndown ratio: 100:1.
- Flow Sensor Material: 316 Stainless Steel.
- Flanges and piping shall be of Class (generally 150 or 300) and Schedule (generally 40 or 80) matching that of the piping in which it is installed.

- Pipe size adjacent to meter shall conform with manufacturer specification for meter expected maximum flow.

2.4 DOMESTIC AND IRRIGATION WATER METER AND TRANSMITTER

A. Flow sensor and transmitter shall be Onicon Turbine Meter or prior approved equivalent meeting the following:

- Flow sensor shall be in-line turbine type flow meter.
- Maximum pressure drop across reduced-size meter assembly at maximum design flow: 1.8 psi.
- Accuracy: ± 1.5% of flow across full range for given pipe size.
- The domestic water meter will be provided with a strainer on the utility side of the meter. The strainer will be installed so as to allow ease of maintenance.

2.5 NATURAL GAS METER

A. Flow sensor and transmitter shall be American Meter Company or prior approved equivalent meeting the following:

- Flow sensor shall be in-line diaphragm type flow meter.
- Maximum pressure drop across reduced-size meter assembly at maximum design flow of 2" W.G..
- Accuracy: ± 1.0% of flow across full range for given pipe size.
- The housing will be die-cast aluminum case. All bearings shall be oil-impregnated self-lubricating bearings. All seals shall be long-life grommet seals. The housing and all parts will be rated for outdoor.
- Gas meter shall have a pulse output with "pulse to 4-20mA converter"

2.6 ELECTRIC METER

A. Meter shall be a Shark 250 with Ethernet card or prior approved equivalent meeting the following:

- Electrical meter shall be installed in the main electrical distribution panelboard with local scrollable display.
- Where required by the project, additional submetering may be necessary on building branch circuits. All such meters shall meet this guideline.
- The meter shall be capable of measuring current and voltage on all phases including neutral. Meter shall be rated for 60 Hz power.
- All shorting blocks will be provided with the meter. Shorting blocks shall be capable of being remotely located within the electrical equipment.
- The meter will be provided with matching CT's and any required PT's and fuses for a complete installation. All CT's will be removable for ease of maintenance.
- Accuracy: ± .075% of full-scale reading.

- Meter sampling will be zero blind rate 128 samples/cycle.
- Meter shall be able to provide up to 63rd harmonic content of current.
- Meter shall be able to provide waveform capture of a minimum of 3 cycles at 128 samples/cycle.
- The meter will have the following data capable of being transmitted to an Ethernet switch via the Ethernet card:
  a. All Phase Currents (A, B, C, N in Amps)
  b. All Phase-Phase and Phase-Neutral Voltages (in Volts)
  c. KW Demand (KW)
  d. Accumulated Power (Megawatt-hours)
  e. Harmonic Content, (A, B, C, N in Percent)
- Meter will have the following alarm capable of being transmitted to the Ethernet switch
  a. All Phase Faults (A, B and C)
  b. All Phase Voltage spikes
  c. Meter General Alarm
- Meter shall comply with UL 508 and require a 120V power circuit
- Output communication of the meter shall be Modbus over IP via the Ethernet card.

B. The electric meter may not directly connect to the BUMP. Rather it connects to the Ethernet switch via Cat 5/6 cable (to match the building standard).
   - The Ethernet switch is that for the US VPN, usually located in a UNM-IT wiring closet (TR). Depending on equipment locations the Ethernet switch within the BUMP may be used instead.

2.7 SOLAR PV SYSTEM METERING

A. Solar PV systems will have a submeter matching the electric meter specifications.

B. In addition, solar PV systems will be equipped with an Egauge 3 series meter with an independent Ethernet connection to the nearest TR.

2.8 TEMPERATURE SENSOR, TRANSMITTER AND WELL

A. Sensor, well and transmitter shall be Rosemount, Foxboro (Siemens), or prior approved equivalent.

B. Temperature sensor shall be well type 3-wire, platinum, 1000 ohm RTD.

C. The sensor shall include well. Temperature wells shall be constructed of Type 304 stainless steel to the proper depth, with ¾" NPT pipe connections, and extension neck for insulated lines. Wells shall be furnished with screw plug attached to wells with chain to keep dirt out when not in use. ¾" thread-o-lets shall be welded to the pipe to receive wells.

D. Accuracy: ± 0.075% of calibrated span.

E. Minimum Update Rate: 20 times per second.

F. Individual well type temperature sensors and transmitters will be provided for:
    - Chilled Water Return
    - Chilled Water Supply
    - Steam

2.9 PRESSURE SENSOR AND TRANSMITTER

A. Sensor and transmitter shall be Foxboro (Siemens).

B. Minimum Update Rate: 20 times per second.

C. Meet NFPA 70 501-5.

D. Pressure assembly shall include appropriate tap, stop valve, snubber, and block and bleed valve along with sensor.

E. Individual pressure sensors and transmitters will be provided for:

    a. Chilled Water Return
    b. Chilled Water Supply
    c. Steam

2.10 BUILDING UTILITY METERING PANEL CONNECTION REQUIREMENTS

A. Provide a separate 120VAC, 20 A, GFCI, isolated, surge-suppressed and, if available, emergency-powered circuit for the BUMP.

B. Provide a UNM network connection (cat6) from the EMCS VPN to the TR.

C. Provide a network connection (cat6) between the EMCS VPN and the BUMP.

D. Provide a network connection (cat6) from the EMCS VPN to the communications panel.

2.11 COMMUNICATION PANEL, NETWORK EQUIPMENT, AND RACKS

A. Provide a separate 120VAC, 20 A, GFCI, isolated, surge-suppressed and, if available, emergency-powered circuit for the Communications Panel.

B. Provide three power circuits in conduit from the Communications Panel to the IT Equipment Rack.

C. UNM-IT closet installation- approximately 16U of space at bottom of rack that does not contain patch panels, typically rack #3 or #4, see diagrams below. UMN-IT closet installation diagram (typical)-

EXECUTION

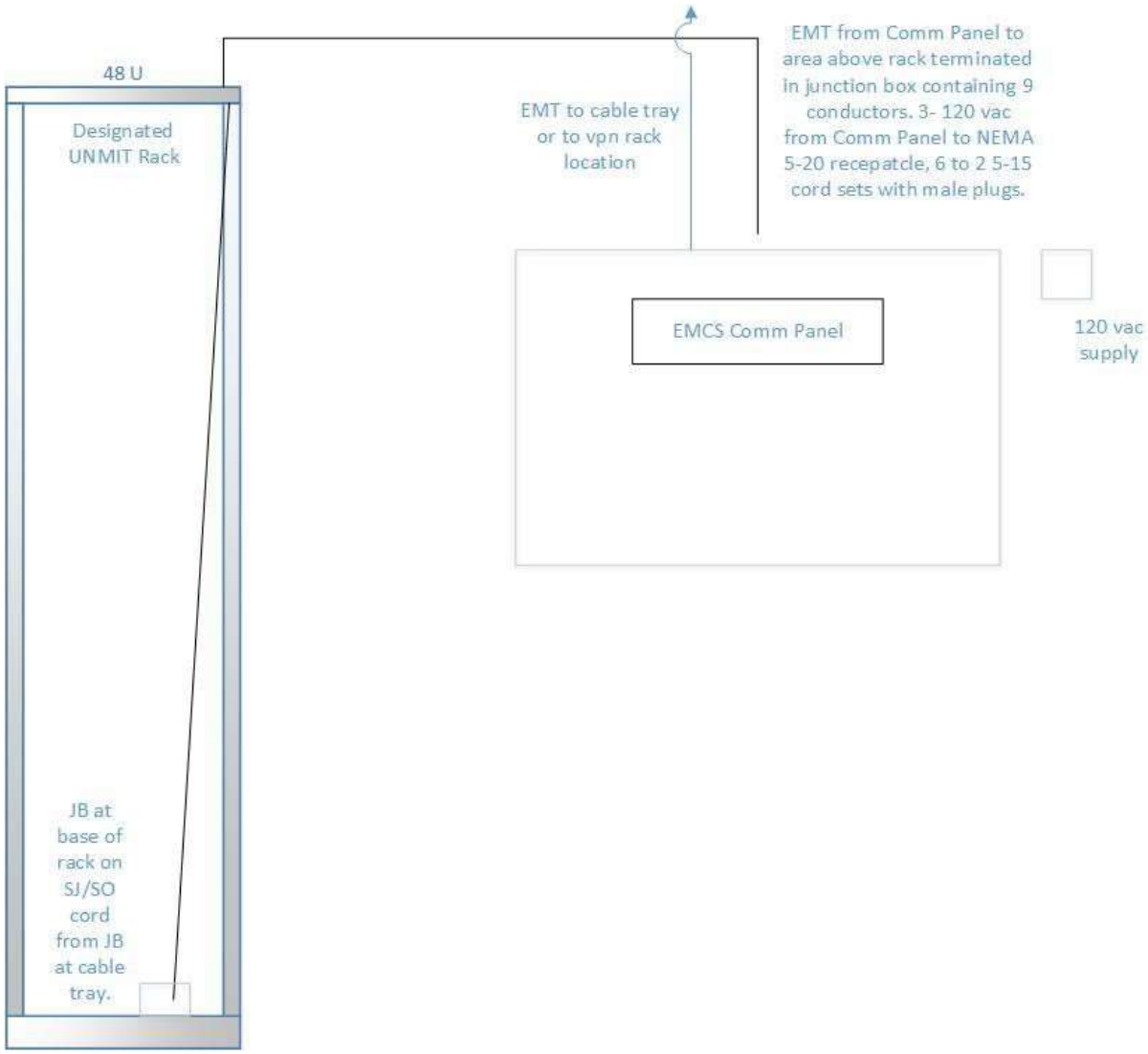
3.1 BUMP INSTALLATION:

A. Contractor shall mount BUMP on wall in accordance the construction documents and US guidance.

B. All terminations shall be wired and installed in separated gutter (see drawing below) located above the designated BUMP location meeting the facility construction specifications for combined power and instrumentation wiring. The building

contractor shall leave six (6) feet of coiled wire for each termination.

C. All wiring shall be tagged with sufficient information to determine the instrument to which it is connected.

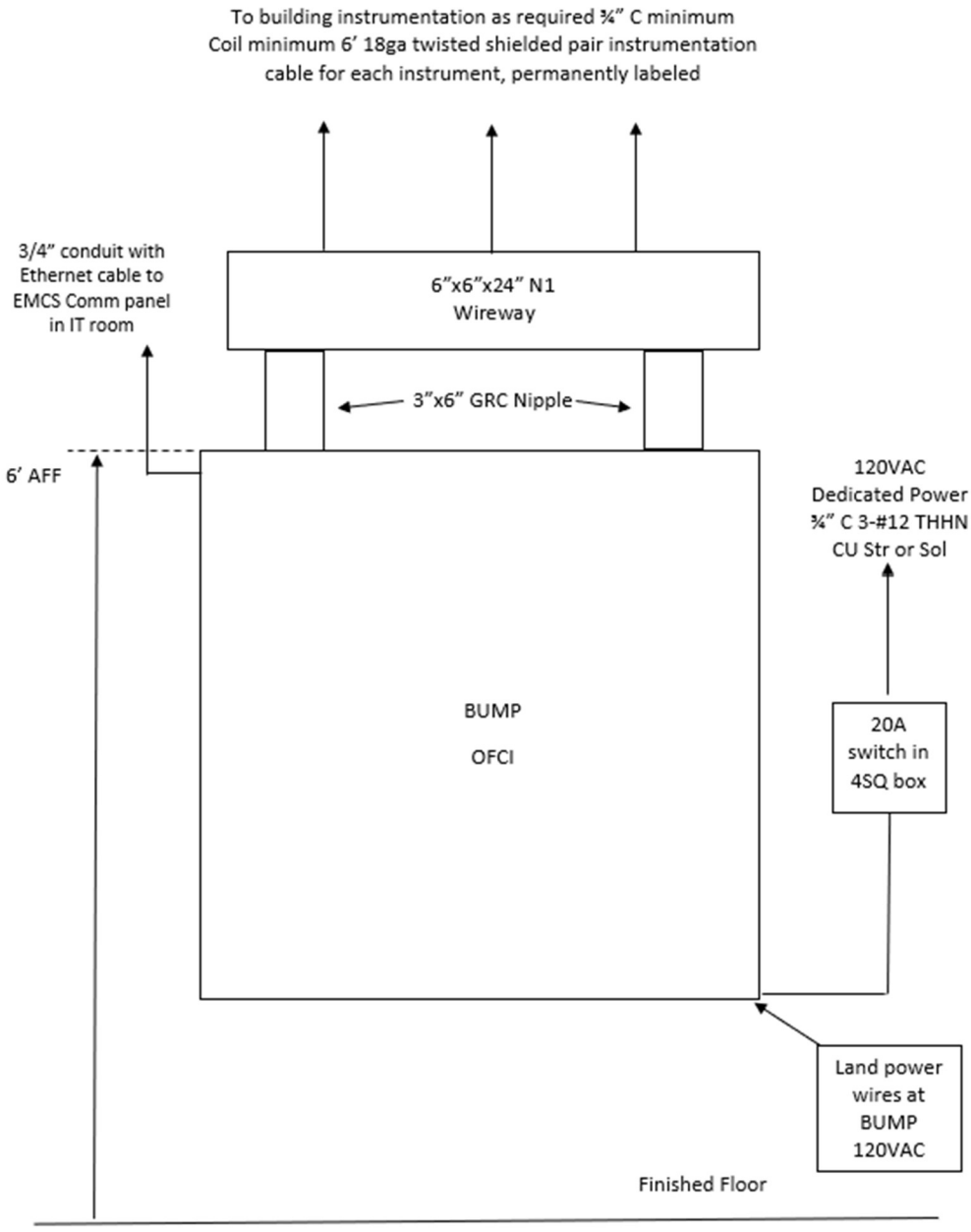


D. When so notified by the project manager that the installation is complete, and it is safe for the BUMP to be installed, US shall furnish and project installs the BUMP.

E. The contractor shall coordinate, cooperate, and provide all necessary assistance during the commissioning and startup of the facility metering system by US.

F. BUMP installation diagram:

Typical BUMP (Building Utility Metering Panel) Installation



3.2 APPROVALS

A. Utility Services must approve all drawings and specifications at each design stage in writing before proceeding to the next stage of design. Approval of the building design stage does not imply approval of the metering system design.

Equipment not mentioned in this guideline must be approved by Utility Services. The submittal must include model number, specifications, performance, cut sheets, and all necessary information that unambiguously shows that the proposed equipment meets the full requirements of this guideline. The supplier must also show that the equipment will communicate properly with the BUMP, either by demonstration or proof that such equipment has performed as required by this guideline in equivalent installations. The determination of equivalence and approval is by Utility Services.

INSTRUMENTATION & CONTROL (I&C) CONNECTION CHECKLIST AND APPROVAL

Electrical

Item	Notes	By	Date
CTs, PTs, ethernet card, fusing, and shorting blocks in place and operation verified			
Ratios clearly marked	CT ratio: PT ratio:		
Meter display safely accessible and visible			
BUMP readings match meter readings			
Meter information	Manufacturer: Model: S/N:		

Domestic Water

Item	Notes	By	Date
Flow meter proper model			
Flow meter properly located	Check upstream/downstream diameters Check direction of flow and orientation		
Bypass and isolation provided for in-line flow meter			
Flow meter factory calibrated			
Flow meter configured for expected flow rates	Output in cubic ft/hr Expected max flow:		
Flow meter display clearly visible			
BUMP readings match flow meter readings			
Meter information	Manufacturer: Model: S/N:		

Natural Gas

Item	Notes	By	Date
Flow meter proper model			
Flow meter properly located	Check upstream/downstream diameters Check direction of flow and orientation		
Bypass and isolation provided for in-line flow meter			
Flow meter factory calibrated			
Flow meter configured for expected flow rates	Output in cubic ft/hr Expected max flow:		
Flow meter display clearly visible			
BUMP readings match flow meter readings			
Meter information	Manufacturer: Model: S/N:		

Chilled Water

Item	Notes	By	Date
Flow meter proper model			
Flow meter properly located	Check upstream/downstream diameters Check direction of flow and orientation		
Bypass and isolation provided for in-line flow meter			
Flow meter factory calibrated			
Flow meter configured for expected flow rates	Output in cubic ft/hr Expected max flow:		
Flow meter display clearly visible			
BUMP readings match flow meter readings			
Flow Meter information	Manufacturer: Model: S/N:		
Pressure transmitters proper model			
Pressure transmitters properly located	Check upstream/downstream diameters Check direction of flow and orientation		
Isolation valves provided for pressure transmitters			
Pressure transmitters factory calibrated			
Pressure transmitters configured for expected range	Low pressure: High pressure:		
Pressure transmitter displays clearly visible			
BUMP readings match pressure transmitter readings			
Pressure Transmitter information	Manufacturer: Model: S/N:		
Temperature transmitters proper model			
Temperature transmitters properly located	Check upstream/downstream diameters Check direction of flow and orientation Check size of thermo-well		
Temperature transmitters factory calibrated			
Temperature transmitters configured for expected range	Low temperature: High temperature:		
Temperature transmitter displays clearly visible			
BUMP readings match Temperature transmitter readings			
Temperature Transmitter information	Manufacturer: Model: S/N:		

Steam

Item	Notes	By	Date
Flow meter proper model			
Flow meter properly located	Check upstream/downstream diameters Check direction of flow and orientation		
Bypass and isolation provided for in-line flow meter			
Flow meter factory calibrated			
Flow meter configured for expected flow rates	Output in cubic ft/hr Expected max flow:		
Flow meter display clearly visible			
BUMP readings match flow meter readings			
Flow Meter information	Manufacturer: Model: S/N:		
Pressure transmitters proper model			
Pressure transmitters properly located	Check upstream/downstream diameters Check direction of flow and orientation		
Isolation valves provided for pressure transmitters			
Pressure transmitters factory calibrated			
Pressure transmitters configured for expected range	Low pressure: High pressure:		
Pressure transmitter displays clearly visible			
BUMP readings match pressure transmitter readings			
Pressure Transmitter information	Manufacturer: Model: S/N:		
Temperature transmitters proper model			
Temperature transmitters properly located	Check upstream/downstream diameters Check direction of flow and orientation Check size of thermo-well		
Temperature transmitters factory calibrated			
Temperature transmitters configured for expected range	Low temperature: High temperature:		
Temperature transmitter displays clearly visible			
BUMP readings match Temperature transmitter readings			
Temperature Transmitter information	Manufacturer: Model: S/N:		

Acceptance of I&C Installation and Approval to Connect to UNM Utilities:

UNM Utilities Representative:

Name & Position:_____

Signature & Date:_____

Contractor Representative:

Name & Position:_____

Signature & Date:_____

33 10 00 Water Utilities

Domestic Water & Sewer

General

The domestic water system at UNM consists of wells and pumps, interconnections to the Albuquerque Bernalillo County Water Utility (ABCWUA) system, a 1.2 million gallon storage reservoir, and 65 psig distribution piping.

The Main campus is served by an exterior direct buried loop system in the Redondo/Campus loop road. This system augments an older interior system which is distributed primarily in the UNM tunnel system. Best service is obtained by a direct connection to the exterior loop, but adequate service is generally available on the interior loop. The designer of a new or renovated building system should coordinate with the staff of the Utility Services Department for the particulars of the specific domestic water assets in the vicinity of the project under design. The particular project location will determine if the project will need to be connected to the interior, exterior or ABCWUA systems. The ABCWUA provides backup water supply to the campus system. The condition of the well or distribution system pumps is monitored at the Ford Utilities Center. The system can be switched manually or remotely to the ABCWUA system on a failure of the UNM facilities.

The system serves the North Campus with redundant piping in the utility tunnels. An exterior direct-buried loop has been started at the north end of the tunnel system. University of New Mexico Hospital (UNMH) is connected to both the UNM and ABCWUA systems.

The sanitary sewer system is provided through a private (university-owned) collection system connected to the City of Albuquerque Sanitary Sewer System.

Design Guidelines

Individual metering and cross-connection protection are required for each individual building. Intra-building cross-connection protection should follow ASPE and UPC cross-connection prevention guidelines. Building meters may be inside the building but must be accessible to maintenance personnel. **A reduced-pressure backflow device must be provided at every connection to the water system. Double check valves are not allowed.**

33 11 00 Groundwater Sources – see 33 10 00
33 12 00 Surface Water Sources – N/A

33 14 00 Water Utility Transmission and Distribution

LIMITATIONS:

A. No piping will be energized until such time that the new piping has been tested, flushed, disinfected, and accepted for operation by the owner.

B. No water main shall be taken out of service unless all piping, fittings, and appurtenances required to construct the modifications to the lines are available on the project site.

SUBMITTALS:

A. Product Data: Submit manufacturer's product data for each product specified for the potable water system.

B. Certification from the valve manufacturer that all valves are bubble tight at a 200 PSI test pressure.

C. Disinfection reports.

PRESSURE PIPE AND FITTINGS:

A. Underground - C900 and PEX

1. C900 shall be manufactured and tested in accordance with the AWWA. Transitions to ductile iron shall be manufactured in accordance with AWWA C115.

a. Joint lock fittings are required for all change of directions, tees, and transitions to a different material
b. Slip joint restraint devices are required for all hub and socket joints in straight runs of pipe

2. PEX is only acceptable for 4" pipe or smaller.

3. Bolts shall be high strength, low alloy steel bolts complying with AWWA C111.

B. Tunnel – HDPE

1. HDPE shall be manufactured and tested in accordance with the AWWA. Transitions to ductile iron shall be manufactured in accordance with AWWA C115.

2. C900 and CPVC are acceptable with approval from Utility Services.

C. Ductile Iron Fittings:

1. Ductile iron fittings shall be manufactured and tested in accordance with the AWWA C110 or AWWA C153.

2. Fittings and specials shall be cement-mortar lined in accordance with AWWA C104.

JOINT RESTRAINT DEVICES:

A. All joints, fittings, and valves within the limits for joint restraint schedule shown on the drawings shall be fully restrained. The specific joint restraint devices shall be compatible with the type of piping material, style of joint, and type of fitting at the joint.

B. Acceptable joint restraint devices include the following:

1. Mechanical style joints - EBAA Iron Sales, Inc. "Megalug" joint restraint system, Series 1100, approved equal.

2. Integral joint restraint type - U.S. Pipe "TR Flex". Or Pacific States "Perma-Loc" restrained joint pipe and fittings, or approved equal. Joint restraint system shall be compatible with factory ends and field cut pipe ends.

C. Mechanical joint restraint devices shall be rated for a minimum working pressure of 250 PSI, with a minimum safety factor of 2:1

D. Field welding of ductile iron pipe for joint restraint shall not be permitted.

MECHANICAL COUPLINGS:

A. Couplings shall comply with AWWA and conform with manufacturer guidelines.

B. Couplings shall be the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall have a rated working pressure not less than the adjoining pipeline.

GATE VALVES:

A. Gate valves shall be resilient seated gate valves meeting the requirements of AWWA C509. The valves shall be certified bubble tight at 200 PSI. The exterior and interior shall be coated with a thermo-setting, or fusion bonded epoxy coating meeting the requirements of AWWA C550. The dry coating thickness shall not be less than 12 mils. Valves shall have mechanical style connections, except flanged joints may be used on the side of the valve that connects directly to a tee or tapping sleeve. Direct buried valves shall have a 2-inch square operating nut. Valves shall open counter-clockwise.

B. Except at locations were valves bolt to flanged tees, valves shall have mechanical joint ends.

VALVES BOXES:

A. Valve box and cover shall consist of a cast iron box and cover and blue colored PVC riser or coated corrugated steel riser.

B. Valve stem extensions are required for any valve more than 4 feet below grade.

TAPPING SLEEVES:

A. All tapping sleeves shall be stainless steel and conform to AWWA.

GENERAL INSTALLATION REQUIREMENTS:

A. Install the potable water piping system in compliance with AWWA.

B. All crews shall be skilled and knowledgeable of the installation procedures for the work that they are performing. Should the Owner feel that this requirement is not being met, they may require the Contractor to arrange for a representative of the pipe manufacturer to visit the site to confirm that proper installation procedures are being followed. The cost associated with the visit by the manufacturer's representative shall be borne solely by the Contractor.

C. Do not make the connections to the existing system until such time that the system has been cleaned, all hydrostatic testing has been completed, and disinfection of the system has been accepted by the Owner. Do not install air relief valves until all hydrostatic testing has been completed.

PIPE INSTALLATION:

A. Install in accordance with the recommended procedures set forth in AWWA.

B. The maximum allowable joint deflection shall be the lesser of the joint deflection specified in AWWA C600 or the pipe manufacturer’s data.

C. Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. After completing the field cut, the Contractor shall bevel the outside of the cut end per the manufacturer's recommendations.

D. Pipe, fittings, and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or similar equipment. Under no circumstances shall any of the piping materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except as authorized by the Owner, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the bedding material, with recesses excavated to accommodate bells, joints, and fittings. Pipe that has the joints disturbed after installation shall be taken up and re-laid. Pipe shall not be laid when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, soil, or debris can enter the pipes or fittings. Where any part of the pipe is damaged, the Contractor shall repair the damage to the satisfaction of the Owner. Pipe stub-outs for future connections shall be capped and fully restrained.

JOINT RESTRAINT:

A. Install all joint restraint devices in accordance with the manufacturer's instructions and prior to pressure testing of the system. A certified torque wrench must be used.

B. If the system is pressure tested in sections, the Contractor shall install all necessary temporary joint restraint devices and/or blocking required to safely conduct the test.

VALVES AND BOXES:

A. Inspect the interior of the valve and clean. Operate valve to ensure that there is no damage to the resilient seat. Install gate valves plumb and in accordance with the manufacturer’s recommendations. Make pipe connections to the valve and block under valve with a 2500-PSI concrete base support wrap pipe in polyethylene prior to placing concrete. Operate valve after installation to ensure that it smoothly operates through the entire range of opening and closing.

B. When the top of the operating nut is 4 feet or greater below finish grade, install a valve nut extension as detailed on the drawings.

C. Set valve box riser plumb and centered over the operating nut. Do not allow the riser to bear directly onto the valve body. Clean all debris from within the riser. Set the frame and cover to finish grade. Install a concrete collar and identification plates as shown on the drawings.

D. Install locator wire in valve box and coil 3 feet of wire under cover. Locate wire so it does not conflict with the operation of the valve.

E. Install concrete collar around valve box as detailed on the drawings. Concrete shall be 3,000 PSI.

INTERIOR INSPECTION:

A. Inspect pipe and fittings prior to installation to determine whether has occurred. If the inspection indicated debris, damaged lining, or other defects, correct such defects to satisfaction of Owner

CLEANING AND FLUSHING:

A. It shall be the responsibility of the Contractor to keep the lines clean of all foreign materials during construction.

B. Should dirt, debris, and/or foreign material be allowed to accumulate in the lines, the Contractor shall be responsible to remove all such material from the line by flushing the lines or other approved methods.

C. Flush all potable water lines at 2.5 FPS in accordance with the rules and regulations of the New Mexico Environment Department, Drinking Water Bureau. The Contractor shall provide the water source for the flushing of the system and safely dispose of all water in accordance with all governing regulations.

D. Contractor shall install 2" pipe taps at inlet and outlet of pipe. The taps must be properly sealed and coated before putting the pipe in service.

HYDROSTATIC TESTING (PIPE 4-INCH AND LARGER)

A. Hydrostatic testing shall conform with AWWA C600 and as specified herein.

B. The Contractor may conduct tests on segments of the system. All temporary thrust restraint and blocking shall be the responsibility of the Contractor.

C. Pressure Test: After the pipe is laid, the joints completed, thrust restraint installed, taps made, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any section of piping, shall, unless otherwise specified, be subjected for 2 hours to a hydrostatic pressure test of 200-PSI (185-PSI minimum pressure at the highest elevation). The pressure shall not vary by more than ±5-PSIG for the duration of the test. The contractor shall use certified and calibrated gauges with a maximum pressure of 300 PSI. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, and valves, discovered in consequence of this pressure test, shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory.

E. Leakage Test: The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to 200 PSI pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = 0.000130ND\,P^{1/2}$$

In which L equals the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the foregoing formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Owner.

F. Concurrent Tests: The Contractor may elect to conduct the hydrostatic tests (pressure tests, and leakage test) concurrently. Regardless of the sequence of tests employed, the results of pressure tests, and leakage tests, shall be satisfactory as specified. All replacement, repair or re-testing required shall be accomplished by the Contractor at no additional cost to the Owner.

DRAINING LINES:

A. In the event that any portion of the system is required to be drained, the Contractor shall notify the Owner of the time which such draining operations will occur and the method for disposal of the water. Should the Owner consider such operations to pose an adverse impact on the site, the Owner may require the Contractor to discharge the water into the sanitary sewer. The Contractor shall obtain all permits, and pay all fees required.

CONNECTIONS TO THE EXISTING SYSTEM:

A. Unless specifically approved by the Owner in writing, connections to the existing system shall be made only after all pipes have been flushed, and the hydrostatic testing and disinfection have been accepted by the Owner.

FINAL TURN-OVER OF THE PIPING:

A. The system shall be turned-over to the Owner completely filled with water with all air removed. The quality of the water shall be of a quality acceptable to the Owner.
B. The Utility Services start-up checklist must be provided to Utility Services prior to energizing the pipe.

DISINFECTION AND FLUSHING:

A. After completion of hydrostatic testing, flush and disinfect all water lines per State of New Mexico, Department of the Environment, Drinking Water Bureau Rules and Regulations. Submit copies of all test results to the Owner. It shall be the sole responsibility of the Contractor to arrange for and pay all bacteriological testing, which shall be arranged with Utility Services. The potable water line will not be put into service until test results indicate an “absent” reading for bacteriological contamination.

VALVE BOX ADJUSTMENT:

A. Adjust all water valve boxes (new and existing) within the construction area to finish grade.

DOMESTIC WATER CONNECTION CHECKLIST AND APPROVAL

Item	Notes	By	Date
Disinfection complete and microbiological results acceptable			
Flushing Complete			
Pipe labeling complete and correct	Check for clear distinction between fire protection and domestic water in mechanical room(s)		
Pipe hangers & anchors in place			
Pressure test complete	Beginning pressure: Ending pressure:		
UNM inspection complete	Inspector Name:		
Underground piping warning tapes in place			
Backflow Preventer in place for fire protection			
Backflow Preventer in place for irrigation			
Backflow Preventer in place for makeup water			
Metering in place and operational	Refer to I&C Connection Checklist Totalizer reading:		

Acceptance of Domestic Water Installation and Approval to Connect to UNM Utilities:

UNM Utilities Representative:

Name & Position:_____

Signature & Date:_____

Contractor Representative:

Name & Position:_____

Signature & Date:_____

33 14 01 Fire Suppression Utility Water Distribution Piping

1. All design calculations shall be based on a system static pressure up stream of the backflow preventer of 65 psi.
2. Specify lined ductile iron pipe (DIP) for fire supply piping Corrosion protective encasement for direct-buried piping (PE film) is required.
3. Specify non-rising stem, resilient seat, mechanical joint gate valves, 250 psig.
4. Specify tees, not tapping sleeves. Note: Hot taps permitted only with prior approval of UNM Utility Services.
5. Drains and test connections shall be grouped in a reasonable fashion for ease of testing and control of discharged water. Hose connections will be provided.
6. Post Indicator Valves are required for fire suppression water lines.

33 16 00 Water Utility Storage Tanks – see 33 10 00
33 19 00 Water Utility Metering Equipment – see 33 09 00

33 30 00 Sanitary Sewerage

1. Provide manholes at every direction change.

33 31 00 Sanitary Sewerage Piping
33 32 00 Sanitary Sewerage Equipment
33 34 00 Onsite Wastewater Disposal – N/A
33 36 00 Wastewater Utility Storage Tanks – N/A
33 37 00 Overflow Control

33 40 00 Stormwater Utilities

1. All projects must include a drawing indicating existing conditions. Contour lines must be included with flow areas and locate and call-out all drainage infrastructures.
2. On a separate drawing the proposed improvements must be shown with revised contour lines and flow arrows. The drawing should show all new infrastructure and indicate how that infrastructure will connect to existing infrastructure.
3. All drainage calculations shall be in accordance with the City of Albuquerque's DPM Section 22.2
4. All projects shall have a table on the proposed improvements must have a table illustrating the existing condition and the 20 and 100 year drainage calculations for the current situation and the proposed project.
5. Include all site surface drainage structures, inlets, etc. in the project.
6. Indicate the site surface drainage course(s). Provide adequate drainage away from the building: including but not limited to roof drains, landscaped areas, drive pads, sidewalks
7. Indicate required subsurface drainage: drop inlets, drain inlets, manholes, storm sewers, etc. Subsurface drainage should be outside the building structures foundations area of influence.

8. Indicate finished floor elevations relative to grade at building. Avoid setting elevations too low.
9. Indicate an adequate water-harvesting plan consisting of swales, retention facilities, volume control, overflow considerations, etc. Roof drains should direct water into plantings or be used for other beneficial uses whenever possible before discharge to the storm disposal system.
10. Indicate new and existing inverts and grades
11. Avoid situations requiring a sump pump
12. Provide manholes at all direction changes
13. Use of sump pump should be the alternative of last resort. In order to use this approach a life cycle cost estimate of a sump pump and any other alternative must be completed. If the sump pump life cycle cost is not the lowest cost to UNM they may not be used.

33 41 00 Subdrainage
33 42 00 Stormwater Conveyance
33 44 00 Stormwater Utility Equipment
33 46 00 Stormwater Management

33 50 00 Hydrocarbon Utilities

Natural Gas

General

Limited natural gas service is available at 5 psig throughout most of the North and Main campuses from a UNM-owned distribution system in the tunnels.

Natural gas is also available on the North and South campuses directly from local utility company lines. Metering and lateral piping into each new building should be included in the contract.

Design Guidelines

1. Connect to UNM system if at all possible
2. Avoid installing new gas piping in the utility tunnel
3. Piping and shut-offs to comply with code
4. Gas Distribution Piping - Any gas distribution network must include a pressure-reducing station that is valved on both sides. All gas meters should be located on the outside of the building. A 3-valve bypass piping arrangement should be supplied around the meter

33 51 00 Hydrocarbon Sources – see 33 50 00
33 52 00 Hydrocarbon Transmission and Distribution – see 33 50 00
33 53 00 Hydrocarbon Utility Pressure Regulation – see 33 50 00
33 54 00 Hydrocarbon Utility Safety Equipment – see 33 50 00
33 56 00 Hydrocarbon Storage – see 33 50 00
33 57 00 Bulk Hydrocarbons Receiving/Dispensing Equipment – see 33 50 00
33 59 00 Hydrocarbon Utility Metering – see 33 09 00

33 60 00 Hydronic and Steam Energy Utilities

Steam and Condensate

General

North/Central Campus Steam Distribution - Steam is generated and distributed at service pressures of 125 psig and 40 psig. Steam is available year-round, but the pressures may vary up to 20% during peak loads. The low-pressure heating mains will normally maintain a minimum of 25 psig at the buildings; the pressure will vary depending upon demand. The most common building pressures are 40 psig and 15 psig.

Design Guidelines

The standard design manual for steam, water, and gas piping is the American Society of Plumbing Engineers Data Book and associated supplements.

Documentation of designs shall include detailed information on as-built existing conditions of distribution systems being connected to, and should provide the same level of detail on new installations. Profile drawings of new underground utilities are required, as are locations of existing utilities which may be disturbed or encountered during excavation.

All steam, condensate, and domestic water lines within the building envelope shall be insulated. Uninsulated mains or run-outs shall not be used as heat sources. Chases and stack areas carrying heating lines in the building should be adequately ventilated to prevent overheating due to piping losses.

All connections to mains shall be valved, both sides of the connection to the main and on the pipe to the building. The valves shall be as close as feasible to the POC.

The heating system should not be depended upon to provide process steam.

Piping and Connections - All new buildings must be provided with steam meters. Steam should be metered directly. Wherever possible, steam and condensate piping shall be installed in such a manner as to allow for gravity return of condensate. The designer must design drip lines and air vents as needed to assure ease of operation. The project manager shall coordinate all connection of new services to the steam mains with US personnel.

No connections to the steam mains shall be made without proper approval and inspection by US. The building steam system shall not be energized without final inspection and approval of US, who shall operate all valves during start-up. The US Steam Startup Checklist must be completed and submitted.

Steam reducing stations should configured in a 1/3 and 2/3 flow arrangement for both regulators and control valves

STEAM and CONDENSATE CONNECTION CHECKLIST AND APPROVAL

Item	Notes	By	Date
Pipe labeling complete and correct			
Pipe insulation in place			
Pipe hangers & anchors in place			
Pressure test complete	Beginning pressure: Ending pressure:		
UNM inspection complete	Inspector Name:		
Underground piping warning tapes in place			
Condensate Return Unit in place and properly operational			
PRV station properly set			
Steam traps in place and properly piped			
Relief piped to outside			
Metering in place and operational	Refer to I&C Connection Checklist Totalizer reading:		

Acceptance of Steam and Condensate Installation and Approval to Connect to UNM Utilities:

UNM Utilities Representative:

Name & Position:_____

Signature & Date:_____

Contractor Representative:

Name & Position:_____

Signature & Date:_____

Chilled Water

General

1.1 The central chilled water systems at UNM has direct pumped primary chilled water distribution piping from central plants and limited standalone building chillers. This guideline is intended to assist the designer in designing a new or renovated building system that will be compatible with current or future connection to the UNM district cooling system.

1.2 The designer of a new or renovated building system must coordinate with the staff of the Utility Services Department for the project under design. The particular project location will determine if the project will provide a building chiller or connect to existing chilled water distribution piping.

1.3 Central chilled water will be operated year-round with a supply temperature of 42 ^{o}F in the summer, up to 50 ^{o}F in the winter.

1.4 Each building will use a direct connection to the district cooling system without the use of building pumps. The building coils shall be controlled at the coil air discharge such that the temperature rise shall not be less than 16 ^{o}F with the supply temperatures given in 1.3.

1.5 Pumps and plate heat exchangers will only be allowed for buildings with height restrictions that would prevent filling the system completely from the district cooling system.

1.6 If process chilled water is needed, a plate and frame heat exchanger shall be installed to separate it from the campus chilled water system. No guarantee is made of uninterruptible system reliability for such applications.

Design Guidelines

2.1 General

The designer's goal should be to design a building system that can function as closely as possible as a variable flow, constant temperature rise system over the entire load range for all seasons.

Design pressure for all components shall be at least 250 psig at 100°F.

Design fill pressure shall be 65 psig.

Pipe all system drains to sanitary sewer. Provide brass hose adapter, cap and chain on all vents and drains.

2.2 Coils

All chilled water coils shall be selected on the basis of 42° F summer, 50° F winter entering water temperatures and 58° F leaving water temperature. Minimum tube velocity shall be 4 fps at full load condition. Select coils to maintain a 16 ^{o}F Delta-T from 100% load down to 25 % part load.

Specify two-way control valves for all coils and provide variable flow loop for

the building or process loop. All control valves and operators shall be selected for the full possible pump head on the loop.

All coils shall have non-ferrous headers and tubing.

2.3 Direct Buried Piping System – See Section **33 61 00**

2.4 System Pressure and Leak Test

Length of test shall be a minimum of 4 hours. Contractor shall have conducted a preliminary pressure test prior to final acceptance test to locate and correct any pipe leaks.

Chilled water piping shall be leakage rate tested. Leakage rate test shall be conducted at the same time as the hydrostatic pressure test. Leakage rate is defined as the quantity of water that must be supplied into respective underground piping system to maintain pressure within 5 psig of the specified hydrostatic test pressure after system has been vented and filled. Contractor shall document test results and sign/date each test.

The maximum allowable leakage is determined by the following formula: $L = N*D*(\sqrt{P}) / 7,400$

Where,

L = allowable leakage (GPH)N = number of joints in length of pipe line tested

D = nominal pipe diameter (inches)P = average test pressure during leakage test (psig)

If measured leakage rate exceeds maximum leakage rate, repair with new materials and repeat test until satisfactory results have been obtained.

2.5 Control Logic

The discharge air leaving each building coil shall be maintained at the design temperature

Additional logic assuring leaving chilled water temperature of no less than 58^{O}F without compromising building cooling capacity is encouraged.

2.6 Connection to Mains

All connections to mains shall be valved, both sides of the connection to the main and on the pipe to the building. The valves shall be as close as feasible to the POC.

2.7 Building Service Entry

Each building shall include as a minimum, shutoff valves, temperature and pressure gauges, system drains and metering in accordance with metering guideline.

CHILLED WATER CONNECTION CHECKLIST AND APPROVAL

Item	Notes	By	Date
Passivation Complete with nitrate to 760 ppm			
Flushing Complete			
System filled from domestic via backflow preventer			
Water division notified for post-connection nitrate check and addition			
Pipe labeling complete and correct			
Pipe insulation in place			
Pipe hangers & anchors in place			
Pressure test complete	Beginning pressure: Ending pressure:		
UNM inspection complete	Inspector Name:		
Underground piping warning tapes in place			
Metering in place and operational	Refer to I&C Connection Checklist Totalizer Reading:		

Acceptance of Chilled Water Installation and Approval to Connect to UNM Utilities:

UNM Utilities Representative:

Name & Position:_____

Signature & Date:_____

Contractor Representative:

Name & Position:_____

Signature & Date:_____

DIRECT BURIED CHILLED WATER SYSTEM AND HOT WATER PIPING

GENERAL

All underground piping must be approved by Utility Services. The pipe shall have a minimum diameter of 4” and shall be pre-insulated HDPE piping. Furnish a complete system of factory pre-insulated polyethylene piping for the specified service. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the Pre-insulated Piping System manufacturer.

Straight sections shall be prefabricated in 20 or 40 foot random lengths. Standard fittings, takeoffs, expansion loops, anchors, etc., shall be factory fabricated and insulated. Expansion loops and expansion 1" and 2" bend sections shall be provided with external expansion compensation bolsters, single or multiple layers, as required. Fittings shall be prefabricated with short tangent lengths attached to simplify field installation. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 100 mils

Pipe Restraint: All distribution piping should be fully mechanically restrained, requiring no thrust blocking.

HDPE: Pipe shall conform to the following standards:

- Chilled Water
  - ASTM D3350
  - Plastic Pipe Institute PE 4710
  - HDB value of 1600 psig at 73°F
- Hot Water (greater than 100°F)
  - Polyethylene Raised Temperature Pipe (PE-RT) and Fittings meeting ASTM F2769
  - ASTM D3350 minimum cell classification of 445474C
  - Plastic Pipe Institute PE 4710
  - HDB value of 800 psig at 180°F

Quality Assurance: Design Working Pressure shall be 125 PSIG.

On Site Supervision of Underground Piping Installation: Provide services of a factory trained representative of the pipe manufacturer, to include pre-installation, installation and testing periods. Pipe manufacturer's representative shall provide written reports following each site trip. The report shall be signed by the manufacturer's representative. The report shall state whether or not the condition and quality of the materials used and the installation of the system is in accordance with the plans, specifications, and published standards of the manufacturer, and is satisfactory in all respects. If anything connected with the installation is unsatisfactory, the report shall state that corrective action has been taken or shall contain the manufacturer's recommendations for corrective action. The report shall cover any condition that could result in an unsatisfactory installation.

Upon completion of the work and before final acceptance, provide written certification signed by an officer of both the pipe manufacturer and the contracting firm, that the installation is satisfactory and in accordance with the plans, specifications, and manufacturer's standards.

Backfill Material: Material shall be provided for bedding and backfill 12” above pipe.

Depth of Bury: Unless otherwise indicated, piping shall be placed in trenches with a minimum of 36-inches of cover above the top of the jacket.

System drains and vents: Provide at all low and high points.

Mechanical Joint Fittings: Comply with AWWA C110. Where restrained joints are identified, use Megalug Series 1100 system or approved equal. Gasket material shall be SBR

Push-on Joint: Comply with AWWA C111

Butterfly Valves: Comply with AWWA C504. Valve shaft to be type 304 stainless steel. Cast valves from gray or ductile iron. Provide interior coating of body and disk. Valves shall be furnished with buried service gearbox operator, shaft extensions, ground level position indicators and valve boxes. All flanges connecting to butterfly valves shall provide sufficient clearance to fully open and close valve. Bevel the inside diameter as needed to obtain clearance.

Valve Boxes: Valve boxes shall be 2 piece cast iron with heavy duty traffic weight lid marked with valve number as shown on drawings (such as CWS – 22). Valve boxes not in paving shall be supplied with a pre-cast concrete mowing ring.

CONTROL VALVES:

A. Butterfly valves (16” and larger) shall be rubber seated conforming to AWWA C504. The valves shall be designed for direct buried service. The valves shall be supplied with a minimum of 10 mils interior epoxy coating and a 12 mils exterior epoxy coating. Coatings shall conform to AWWA C550 and AWWA C504.

B. Valves shall have a vertical shaft, manual actuator, and an AWWA 2-inch square operating nut. Valves shall open counter-clockwise.

VALVE BOXES:

A. Valve box and cover shall consist of a cast iron box and cover and PVC riser as detailed on the drawings. The valve box and cover casting shall be manufactured in conformance with ASTM A48, Class 30B.

B. Valve stem extensions shall comply with City of Albuquerque Standard Specification and as detailed on the drawings.

AIR RELIEF VALVE VAULTS:

A. All cast-in-place concrete shall conform to City of Albuquerque Standard Specifications (3000 psi).

B. Reinforcement shall conform to COA Standard Specification (Epoxy Coated), Grade 40.

C. Pre-cast manhole section shall have an inside diameter of 6 feet and conform to the requirements of ASTM C478.

D. The frame and cover shall be 30 inch diameter, traffic rated (HS20), and have a bolted watertight lid. The frame and cover shall be Neenah Catalog No. R-1916-H or approved equal.

AIR RELIEF VALVES:

A. Vacuum and air relief valves shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow.

B. The outlet of the valve shall be equipped with a gooseneck and stainless steel screen as indicated on the drawings.

C. Do not install vacuum and air relief valves until the system has been cleaned and tested.

EXECUTION

GENERAL INSTALLATION REQUIREMENTS:

Do not make the connections to the existing system until such time that the system has been cleaned and all hydrostatic testing has been completed. Do not install air relief valves until all hydrostatic testing has been completed.

VALVES AND VALVE BOXES:

A. Inspect the interior of the valve and clean. Operate valve to ensure that there is no damage to the resilient seat. Install gate valves plumb and in accordance with the manufacturer's recommendations. Operate the valve to ensure that it operates smoothly through the entire range of opening and closing.

B. When the top of the operating nut is 4 feet or greater below finish grade, install a valve nut extension.

C. Set valve box riser plumb and centered over the operator nut. Do not allow the riser to bear directly onto the valve actuator. Clean all debris from within the riser. Set the frame and cover to finish grade. Install a concrete collar and identification plates.

AIR RELIEF VAULT:

A. Construct concrete base per COA Standard Specification.

B. Install manhole section, top slab, and the frame and cover per COA Standard Specification, grout opening around lid.

INTERIOR INSPECTION:

A. Prior to installation inspect pipe and fitting to determine whether damage has occurred. If the inspection indicated damaged lining, debris, or other defects, correct such defects to satisfaction of Owner

CLEANING AND FLUSHING:

A. It shall be the responsibility of the Contractor to keep the lines clean of all foreign materials during construction.

B. All lines shall be mopped or swabbed and a pig shall be pulled through the lines to remove debris, dust, and sand, and dirt.

C. Should dirt, debris, and/or foreign material be allowed to accumulate in the lines, the Contractor shall be responsible to remove all such material from the line by flushing the lines or other approved methods. In the event that such measures are required, the Contractor shall provide a written proposal to the Owner stating the methods to be utilized. In review of the proposal, the Owner will consider the potential for adverse impacts on the Campus.

SEPARATION BETWEEN CHILLED WATER LINES AND POTABLE WATER LINES:

A. The minimum separation between chilled water lines and potable water mains shall be 1.5 feet vertically and be 1.5 feet horizontally under all conditions.

B. The 1.5 feet horizontal and the 1.5 feet vertical dimension shall be measured from outside of pipe to outside of pipe.

HYDROSTATIC TESTING:

A. Hydrostatic testing shall conform with the manufacturer's specifications.

B. The Contractor may conduct tests on segments of the system.

C. Pressure Test: Plastic pipe must be tested with water at 1.5 times the operating pressure. Metal pipe can be tested with air or water.

FILLING LINES:

A. The pipe shall be filled with potable water as recommended by the manufacturer before being subject to the hydrostatic tests. The Contractor shall arrange for the water source and the Contractor shall coordinate and pay all fees assessed by the water company.

DRAINING LINES:

A. In the event that any portion of the system is required to be drained, the Contractor shall notify the Owner of the time which such draining operations will occur and the method for disposal of the water. Should the Owner consider such operations to pose an adverse impact on the site, the Owner may require the Contractor to discharge the water into the sanitary sewer. The Contractor shall obtain all permits, and pay all fees required by the City of Albuquerque.

BEDDING AND SHADING AROUND INSULATED PIPING:

A. Care shall be given during bedding and shading operations and compaction operations to avoid damaging the insulation. Only clean bedding and shading material shall be placed adjacent to the insulation. Mechanical compaction equipment shall be kept a minimum of 3-inches away from the insulation. Do not place bedding and shading material around the piping until such time that the insulation has cured.

MECHANICAL SYSTEMS INSULATION

PRODUCTS, EXECUTION, AND INSTALLATION MUST ALL BE ACCORDING TO MANUFACTURER'S SPECIFICATION.

The minimum insulation thickness shall be as follows:

Pipe Size (inches)	Insulation Thickness (inches)
3 – 5	1.0
4 – 6	1.5
8 – 14	2.0
16 – 20	2.5
24 – 36	3.0

33 63 00 Steam Energy Distribution

STEAM AND STEAM CONDENSATE PIPING AND VALVES

GENERAL
All materials shall be US made or domestic.

Campus Steam Distribution

Exterior steam and condensate lines shall be installed, in order of preference, in fully accessible walkable concrete utility tunnels or accessible shallow trenches.

Pre-insulated direct buried piping systems will be reviewed on a case-by-case basis, typically for service from the main connection to the building. Carrier pipes will be separately cased. Multiple carrier pipes in a single casing shall not be used

Expansion loops or accessible expansion joints shall be used for expansion compensation in shallow trenches. Expansion joints will be used in tunnels.

Steam pipe shall be schedule 40 black steel pipe with 250 pound rated fittings in the distribution to the first pressure reducing station in the building. Steam piping shall be all welded construction.

Condensate pipe shall be schedule 80 black steel pipe with schedule 80 fittings. Condensate piping shall be all welded construction to the first valve in the drip leg. Threaded fittings are permitted for use on the drip leg after the first valve.

Ball Joints must be able to be re-packed. If installed in the vertical position, choose ball joints that have the male end pointed down.

Strainers on the 125 psig system shall be 150 psig rated cast steel, 150 lb flange rating, with a stainless steel standard screen.

Hand Valves:

Shutoff service: Rising stem, steel forged gate valves are preferred

Flow control service: globe valves are preferred

Drip Legs and Steam Traps

Inverted bucket or thermodynamic F&T traps shall be used on drip legs.

Each trap will be sized based on the amount of condensate calculated for the distribution.

High-pressure condensate from the drip legs shall not be directly introduced to the pumped wet condensate return system.

Stainless steel spring checks are to be used on the condensate return system.

Threaded steel forged valves are to be used on steam trap assemblies.

No copper piping or checks with Teflon seats are authorized on steam trap assemblies.

Insulation

Insulation material on steam and condensate piping in tunnels shall be calcium silicate. Insulation thickness shall be as required by the latest ASHRAE Standard for buildings, but applied to utility construction.

Insulation shall be provided on all piping, flanges, valves, etc. to reduce heat gain in the tunnels.

Aluminum jacket shall be used in tunnels and plants on all piping, fittings, etc. Aluminum jacket shall be provided on valve bodies up to the flanges for the gland packing to allow for service of the gland.

Use 30-pound asphalt-impregnated felt jacket or other suitable material to protect insulation of pipes in concealed spaces from abuse during construction and from future deterioration. In high traffic areas, where insulated pipes are subject to mechanical abuse, metal covering or structural protection shall be provided. Wire used for securing pipe coverings shall be solid copper, stainless steel, or other non-ferrous material with a long service life.

Materials

Steam Piping Materials Schedule

Item	Size	Description
Piping	All sizes	Seamless sch-80 – Carbon Steel Pipe
Piping	All sizes	150 psig – Design Pressure
Piping	All sizes	550 °F – Design Temperature
Piping	All sizes	1.5 times working pressure – Hydrostatic Test Pressure
Fittings	2" and under	Malleable steel - screwed or welded
Fittings	2 1/2" and over	Malleable steel – welded
Flanges	All sizes	150 lb. raised face
Bolting	All sizes	Alloy steel ASTM A193 grade B7 bolts and studs with A194 grade 2H nuts
Unions	2" and under	150 lb., raised face, SW, integral SS
Gaskets	All sizes	150 lb., 3/16" thick, spiral wound with 1/8" thick outer guide ring, 304 SS with Verdicarb Filler

Take-off	2" & under main 2" & under branch	Socket weld tees
Take-off	2½" & over main 2" & under branch	Reducing tee forged steel sock-o-let
Take-off	2½" & over main 2½" & over branch	Equal or reducing tee, nozzle weld with reinforcing as required, forged steel weld-o-lets

Condensate Piping Materials Schedule

Item	Size	Description
Return Pipe	All sizes	Seamless sch-80 – Carbon steel
Transfer Pipe	All sizes	Seamless sch-40 – Carbon steel or high temperature PEX
Pumped Pipe	All sizes	Seamless sch-40 – Carbon steel
Piping	All sizes	Design Pressure - 100 psig Design Temperature - 220 °F
Fittings	All sizes	Malleable steel – screwed or welded
Unions	2" and under	300 lb., raised face, screwed, integral SS seat

PROJECT SPECIFIC WELDER CERTIFICATION PROCEDURE:

A. All welding shall be in accordance with ASME Section IX.

B. All workers performing pipe welds for this project, either in off site shop fabrication or in field assembly shall be certified to a set of job specific Welding Procedure Specifications (WPS).

C. The individual qualifications of the workers shall be performed by an independent testing agency approved by the owner. The individual qualifications will be done on the project job site, in an area established by the contractor, and using the contractors equipment and materials.

D. Every steam pipe weld on UNM's high pressure system (125 psig or greater) shall be stamped. Contractor shall submit prior to commencing any work and provide monthly updates of names and stamp identification for all pipe welders working on this project.

PRODUCTS

PIPE HANGERS AND SUPPORTS:

A. Conform to ASME B31.9

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

C. Hangers for Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

D. Hangers for Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

E. Multiple or Trapeze Hangers for Pipe Sizes to 4 inches: Steel channels with welded spacers and hanger rods.

F. Multiple or Trapeze Hangers for Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods; cast iron roll and stand.

G. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

H. Wall Support for Pipe Sizes 4 to 5 Inches: Welded steel bracket and wrought steel clamp.

I. Wall Support for Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.

J. Vertical Support: Steel riser clamp.

K. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

L. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

N. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

O. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

VALVES:

A. Globe Valves: Crane or approved equal

B. Gate Valves: T&S rising stem Crane or approved equal

C. Check Valves: Crane or approved equal

EXECUTION

A. Install gauges, thermometers, valves and devices and equipment to facilitate ease in reading operating and maintaining said devices. Locate and position thermometers and gauges for easy readability by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

B. Provide small piping required in connection with instruments gauges, reducing valves, traps and other mechanical equipment not indicated on drawings. Provide drains, shut-off valves and cocks, syphons, and pulsation dampers.

C. Install piping to conserve building and tunnel space and not interfere with use of access space.

D. Pipe Hangers and Supports:
- Install in accordance with ASTM B31.9 and manufacturer's recommendations
- Design hangers for pipe movement without disengagement of supported pipe. All hangers and supports shall be capable of screw adjustment after piping is connected and shall be finally adjusted vertically and horizontally under operating conditions.
- Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
- Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

E. Provide clearance for installation of insulation and access to valves and fittings.

F. Slope steam piping one inch in 40 feet in direction of flow or as indicated. Use eccentric reducers to maintain bottom of pipe level.

G. Slope steam condensate piping one inch in 40 feet or as indicated. Provide drip trap assembly at low points and before control valves. Run condensate lines from trap to nearest condensate receiver. Provide loop vents over trapped sections.

H. Install valves with stems upright or horizontal, not inverted.

I. Protect pipe covering at each support with steel protection saddles or rigid insulation inserts and minimum 18 ga. Shields that will transmit the load of the pipe line directly to the support without damage to the covering.

WELDING OF STEEL PIPE:

A. All welds are subject to inspection by UNM. Non Destructive Evaluation (NDE) including radiographic testing by an independent testing laboratory, may be done at Owner's option. Costs for initial testing will be borne by Owner. If the weld is not satisfactory, the unacceptable area will be removed and rewelded by the Contractor, at no additional cost to the Owner. Costs for retesting of the weld will be borne by Contractor. Pipe and attachment welds are also subject to dye penetration testing, at the discretion of UNM AHJ or Inspectors.

TESTS:

A. General: All piping shall be tested as specified herein and approved by Owner before being insulated or otherwise concealed in any way. All tests will be performed with the Owner present.

B. Specific Tests:
1. Steam Piping: Test to 1.5 times operating pressure with no pressure drop in one (1) hour.
2. Condensate Piping: Test to 70 psi, hydrostatic pressure with no pressure drop in one (1) hour.

B. Test Instruments:
Calibrated instruments, equipment, and labor required to properly conduct tests shall be provided by Contractor for tests and all repeat tests due to failures.

E. Reports: Submit written certification of date and time of acceptance of testing procedures to Utility Services.

CLEANING PIPING SYSTEMS:

A. After piping systems have been tested and proven tight, clean piping systems of dirt, scale, oil, grease, waste and other foreign substances which may have accumulated during process of installation. Strainer screens shall be removed, cleaned and replaced after cleaning flushing process is completed.

B. After each system has been thoroughly and satisfactorily cleaned all low points "blown-down", interiors of strainers reinstalled, all temporary by-passes removed, systems filled with clean water, chemical treatment added and control valves adjusted, all systems shall be permanently connected.

C. Provide Owner 48 hour advance notice prior to any pipe cleaning and provide written certification that cleaning has occurred, and that strainer screens have been cleaned, prior to system activation.

STEAM AND STEAM CONDENSATE SPECIALTIES

FLOAT AND THERMOSTATIC TRAPS (INCLUDING CHILLER TRAPS):

A. Manufacturers:
1. Armstrong or approved equal

B. Trap:
1. Inverted bucket traps with cleaning pin designed for amine use
2. Rating: 15 psig, 125 psig as required.
3. Features: Access to internal parts without disturbing piping, bottom drain plug.
4. Accessories: Gage glass with shut-off cocks.

FLASH TANKS:

A. Tank:
1. Closed type, tested and stamped in accordance with ASME SEC 8-D, welded steel construction, cleaned, prime coated, and supplied with steel support legs.
2. Working Pressure: 125 psig.
3. Construct with nozzles and tappings for installation of accessories and piping connections.

CONDENSATE RETURN UNIT:

A. Furnish and install a steam powered condensate return unit. If it must be electric, provide a Federal Duplex condensate return units(s) or approved equal.

PRESSURE REDUCING VALVES:

A. Pressure regulators shall be Fisher or prior approved equal.

EXPANSION COMPENSATION:

A. Steam: Hyspan Series 8500, models 8503 – 8506 with 4 to 6 inches of travel or approved equal

B. Condensate Return: Hyspan Series 3500, models 3501 – 3506 or approved equal. All condensate expansion joints shall be capable of 2 to 4 inch travel.

C. Guides and supports must be installed adjacent to the compensator to ensure axial travel only.

EXECUTION

INSTALLATION:

A. Steam Traps:
   1. Provide minimum 3/4 inch size on steam mains and branches.
   2. Install with union or flanged connections at both ends.
   3. Provide ball valve and strainer at inlet, and ball valve and check valve at discharge.
   4. Provide minimum 10 inch (250 mm) long, line size dirt pocket between apparatus and trap.

B. In high pressure and medium pressure mains, provide 3/4 inch nipple in bottom of main, extending 3/4 inch into and above bottom of pipe. Provide dirt pocket with 1/2 inch high pressure thermostatic trap.

C. Provide pressure reducing stations with pressure reducing valve, strainer and pressure gage on upstream side, relief valve and pressure gage on downstream side of pressure reducing valve.

D. Terminate relief valves to outdoors 2 feet (600 mm) minimum above roof. Provide drip pan elbow with drain connection to nearest floor drain.

33 70 00 Electrical Utilities

Electric Generation and Distribution

General

UNM's electrical system consists of electrical production facilities, paralleling interconnections to PNM, and a 12.47 KV dual radial distribution system.

UNM owns the North and Central Campus substations. The substations receive power from PNM at 115 KV and transform it to 12.47 KV for campus distribution. The substations have tie feeders to provide redundant transformer capabilities.

UNM requires that ALL electrical contractor personnel performing the 12.47 kV electrical site work must have EL-1J licenses, not just the supervising electrician. Additionally, all electrical

contractor personnel performing splicing or termination of primary cable must have current certification from the manufacturer of the rubber goods being installed. Submit employee licenses and certifications as part of the bid evaluation documents.

Work in power manholes can only be performed after UNM Utility Services de-energizes all feeders in the manhole. Refer to the Utility Services ELECTRICAL CONNECTION CHECKLIST AND APPROVAL for additional requirements. The contractor shall submit completed checklist for approval. Entry into UNM manholes requires written authorization from Utility Services per the ELECTRICAL MANHOLE ACCESS procedure. These documents are located on the Utility Services website.

Design Guidelines

The designer of a new or renovated building system should coordinate with the staff of the Utility Services Department. The particular project location will determine if the project will be connected to PNM or the UNM electrical system. UNM prefers to own, rather than lease, the facility transformer when connected to PNM.

The UNM distribution system consists of two 500 MCM, 15 KV circuits distributed in buried ductbank to facilities on two switched “A” and “B” radials.

The designer must include provisions for underground duct bank, manholes, pad-mounted transformers, switching devices, cables and standby generation to be included in the construction.

The university will provide the switches and transformers but this equipment must be funded by the project. **Only Utility Services employees are authorized to operate the 15 KV switches.**

BASIC ELECTRIC METHODS AND REQUIREMENTS

ELECTRIC WORK

ELECTRICAL COMMISSIONING

33 71 00 Electrical Utility Transmission and Distribution

DUCTBANK

1. The depth of excavation for the ductbank and manholes will vary depending on existing utilities and the necessity to install the ductbank under the UNM utility tunnel. The Contractor shall anticipate that some excavation will be deep and shall include all excavation costs in the bid. Some modification to ductbank configuration will be considered so long as code allows and when approved by the Owner’s representative consideration will also be given to relocating existing utilities in lieu of excessive excavation when approved by the Owner’s representative.

2. The vertical and horizontal excavation offset shall not exceed 22 degrees and must run flat for not less than 15 feet before a second offset in any direction is constructed. Offsets shall be limited so as to limit cable-pulling pressure/force. Also manholes located near the tunnel or “deep” obstructions shall be set deeper so as to limit conduit bends and offsets and thereby limit cable pulling tension and sidewall pressure. The design limits conduit bends to a total of

270 degrees between manholes. If this is exceeded due to the Contractor's plan for work he shall provide additional approved manhole pull boxes at no extra cost to the Owner.

3. Ductbank shall be installed at least five (5) feet away from the exterior tunnel wall. This is to provide for future utility piping exiting from the tunnel.

4. Excessive trench opening and the associated safety hazards and danger shall be avoided. Also, all trenches shall be fenced all around. As soon as reasonable backfill shall be completed, excess earth hauled away and the fencing removed.

5. Utility Services shall approve the location of each manhole and cover. Manhole rims shall be surrounded by a square concrete collar, 6" thick with a minimum plan dimension equal to the largest rim width dimension plus two (2) feet. #3 rebar on 6" centers all around and diagonal at the corners will be provided in the concrete collars.

6. Sufficient trench between manholes and termination points shall be opened before any conduit is installed in order to determine if any obstructions exist. All existing utility line crossings are to be verified and hand excavated. Install duct bank minimum 42" below grade, to top of duct bank.

7. Duct banks shall have conduit joints and couplings staggered at least six inches horizontally.

8. Spacers shall be used where more than one duct is installed and shall be the standard product of the duct manufacturer for the type and size duct. They shall be located at five-foot intervals, secured to the ducts with 316-gauge iron wire. The spacers shall be securely anchored to the bottom of the trench to prevent ducts from floating during concrete pouring. Unless otherwise noted on the drawings, four-inch conduit shall have a minimum eight-inch spacing center-to center and 5" conduits shall have a minimum of 10" spacing center-to center.

9. Continuous vibrating of concrete during pouring shall be performed to ensure complete coverage between and under ducts to eliminate voids. Mechanical vibrator shall be used.

10. Terminate conduits in an end bell at manhole penetrations.

11. Stub-ups at equipment pads shall be rigid or IMC conduit with threaded insulated grounding bushings.

12. Apply corrosion protection tape, half lapped, to non-PVC-coated underground metallic conduit and fittings that are in direct contact with earth and concrete only. Ground as required by the NEC.

13. Duct runs shall be graded to drain toward one or both terminal points of the duct run. The slope shall not be less than two inches for every 100 feet of length. Where termination points are at manholes or any other structure, provide proper drainage where low points in duct runs cannot be avoided.

14. Empty ducts shall have a ¼" polypropylene rope provided with two feet of slack at each end with both ends secured.

15. Conduit or duct banks shall maintain one-foot vertical and one-foot horizontal separation from other utility lines where possible.

16. A warning tape shall be installed 12” above the duct bank. The warning tape shall be of inert plastic film 4 mils thick specifically formulated for prolonged use underground, resistant to alkalis and acids found in soils. The tape shall bear a continuously printed message repeated every 36”. The tape shall be Terra Tape Standard 250 manufactured by Reed Industries, Inc., or approved equal.
17. A mandrel ¼” – 3/8” smaller than the conduit shall be pulled through each conduit. A circular wire brush the same diameter of the conduit shall be pulled through the conduit after the installation is complete.
18. Conduit stub-outs shall be RGS with threaded metallic caps. Stub-outs shall be capped and not encased in concrete for future accessibility. Capping shall prevent moisture or debris from entering the duct system.
19. Under tunnel crossings must be approached with special care. The ductbank must be reinforced. When crossing under any tunnel at approximately a 90 degree angle (perpendicular to tunnel), the excavation must take place in the middle/between existing tunnel construction joints, must be as narrow as possible, must be completed as fast as possible and must not have any load imposed on the tunnel section. When crossing any tunnel at less than a 60 degree angle, the excavation must take place in the middle/between existing tunnel construction joints, must cross only half-way at a time, must be as narrow as possible, must be completed as fast as possible and must not have any load imposed on the tunnel section. In effect, only one tunnel strip footing will be undermined at a time and only mid-way across the tunnel. The first half must be restored and adequately underpinned before the second half may be started. Specifically obtain owner’s approval before starting any tunnel crossing work.
20. The bottom of the trench must be clear of loose earth and must be compacted to 95%.
21. Ductbanks shall be reinforced when crossing roadways, parking lots, large pipes, underground structures, over, and under tunnels. Reinforcing shall extend five feet beyond the edge of the structure or tunnel. Reinforcing shall consist of four longitudinal #4 rebars, one in each corner and #3 rebar non-continuous stirrups on 12” centers, all tied into place. A minimum of 2” of concrete cover is required. Depending on the size of the ductbank, additional reinforcing may be required.
22. 3000-PSI concrete shall be used for the ductbank encasement. A slump of not more than four inches is acceptable. Concrete shall be mechanically vibrated into place. Exposed concrete shall be air entrained.

MANHOLES

1. Manholes shall be concrete. Manholes shall meet applicable standards of ASTM C857, ASTM C858, and ANSI C2. Submit drawings on manholes for approval including location of: duct entries, non-load junction modules, pulling irons, lifting eyes (if applicable) sump, manhole covers, etc.
2. Precast concrete manhole manufacturers shall have documented experience in the manufacture of manholes for a minimum of three years. Submittals for the pre-cast manhole shall bear the stamp of a registered professional engineer. The submittal drawing must show the ASTM load designation, the % increases in live load for impact and the working load of the pulling irons. The weight of each portion of the manhole must be shown

3. Base course material under each manhole shall be sand or gravel, three inches minimum compacted 95%.
4. Precast concrete shall be air-entrained, 4000 PSI minimum compressive strength at 28 days.
5. Manhole shape and dimensions shall be specified.
6. Unless otherwise indicated provide two (2) 2-foot square diameter knockouts on each wall.
7. Ram-Nek, Kent seal or approved equal sealants shall be used to seal the joints in the manhole and rim to manhole cover.
8. Provide four (4)-lifting eyes in the top half and eight (8) lifting eyes on the sides of the bottom half of each manhole. Also, provide four (4)-lifting eyes at intermediate sections where applicable. Lifting eyes shall be in accordance with ASTM C857.
9. Manhole accessories shall be as follows:
    1) Electric manhole frames and covers: ASTM A48, Class 30B gray cast iron, machine finished with flat bearing surfaces. Covers shall be 38" round and shall have "HIGH VOLTAGE 12.47 KV MH#_____ cast into the cover. Letter shall be minimum 2" high. CKT# shall be on a brass tag attached to the lid. Ring and lid shall be "NEENAH" #R-1640D or approved equal.
    2) Sump Covers: ASTM A48, Class 30B gray cast iron, 12" x 12".
    3) Pulling irons shall be minimum 7/8-inch diameter steel bar forming a triangle of 9 inches per side when set. Galvanize to ANSI/ASTM A153 for irregular shaped articles. Locate opposite each duct entry. Pulling irons shall be designed for a working load of 5,000-lbs. minimum with a safety factor of 2. Provide minimum of eight (8)-pulling irons in the bottom of the manhole and a minimum of four (4) pulling irons in the top half of the manhole.
    4) Cable Rack Inserts: Steel channel insert with minimum load rating of 800 pounds, length to match cable rack channel. Locate 3 feet on centers.
    5) Cable Rack Channel: 1-1/2 by ¾ inch steel channel wall bracket, 48" length, with cable rack arm mounting slots on 1-1/2" centers.
    6) Cable Racks: ANSI/ASTM A569, steel channel, 1-1/2 by ¾ x 14 inches with fiberglass reinforced polyester or porcelain cable supports and fastener to match mounting channel.
    7) Manhole Ladder: Galvanized metal, suitable for manhole shape and construction. Bolt into place. The top of the ladder should extend to two inches below the manhole cover and shall be provided with an extension.
    8) The exterior of the manhole shall be waterproofed with a coating of bitumastic or asphalt material such as Koppers 300M or approved equal.
    9) Ground rods shall be ¾" by 10'-0" long, copperweld. (2 per manhole)
    10) Grade Rings: Pre-cast concrete (4000-psi minimum compressive strength at 28 days) with inside diameter equivalent to manhole opening. The ring shall have circumferential rebar #3 minimum with a trowel finish to provide a true plane with 1/8 inch, as determined with a five-foot straight edge. Waterproof around the ring and C1 frame with roofing element.

11) All manhole interiors shall be painted flat white with two (2) coats of concrete paint.

12) All manholes shall be rated for traffic duty per AASHTO HS-20-44, including manhole and cover.

GROUNDING AND INSTALLATION METHODS

A. General: Provide a complete equipment grounding system in accordance with the minimum code requirements.

1) Service Equipment Enclosure: Bond the enclosure of the main service equipment to the uninsulated equipment ground bus (or bar) with a conductor or bar sized for 50% of the largest service overcurrent device.

2) Ground Bar: Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all switchboards, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc., for grounding the enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and braced bus bar in switchboards or a separately mounted bar adequately braced or bolted at the enclosure of other types of equipment. The ground bar shall be adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to assure good contact. Provide solderless pressure connectors for all conductor terminations. Number and size of pressure connectors on equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.

3) Conduits: Where metallic conduits terminate without mechanical connection to a metallic housing of electrical equipment by means of lock nut and bushings, provide ground bushing connected with a bare copper conductor to the ground bar in the electrical equipment. Metallic conduits containing ground wiring shall be bonded to the ground wire at both conduit entrance and exit. Install grounding conductor in all conduit or duct. Bond the conductor at both ends to the equipment grounding system. Provide new threaded grounding bushing on new and/or existing primary conduits and existing secondary conduits and bond to the grounding conductor.

4) Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated the coating must be removed down to the bare metal. After the coating has been removed, apply a non-corrosive approved compound to cleaned surface and install lugs or clamps. Where galvanizing is removed from metal, it shall be painted or touched up with “Galvanox”, or equal.

5) 1) Grounding at pad-mount switch and pad-mount transformer pads - install a counterpoise grounding system consisting of #4/0 BSD copper conductors and (4) ground rods around all equipment pads. Provide an additional ground rod in the secondary compartment of transformer enclosures and inside the enclosure of switches. Bond counterpoise to switch/transformer frame, the internal ground rod, 15kV cable ground shields, and low voltage secondary grounding conductors.

6) Grounding at manholes – (2) ground rods are required. Bond to all metal components inside the manholes and the grounding conductors that are part of the 15kV circuits.

7) Ground rods shall be ¾” x10’ copperclad type.

8) All grounding connections except those made to ground rods shall be compression type. Ground rod connections shall be exothermic.

9) Splices between new and existing grounding conductors shall be irreversible connections (**split bolt type connectors will not be accepted for grounding connections**).

10) Grounding for surge arresters shall extend from the surge arrester directly to the grounding conductor.

11) Provide a base 4/0 copper ground in bottom of ductbank as specified in the ductbank section.

B. Medium Voltage Cables (15KV)

1) All cable furnished under this contract shall be the product of a single manufacturer and shall be purchased within twelve (12) months of the manufacture date of the cable. Labeling of cable shall be according to NEMA and ICEA requirements and shall contain the name of the manufacturer and the NEC Designation (MV-105). **Cable patches and any other cable repair will not be accepted.**

2) 15KV cable shall operate at 60HZ, three phase on a 7200/12470 volt system.

3) The cable shall be manufactured in accordance with the latest revisions of the applicable specifications of AEIC, ASTM, ICEA, and REA except where they conflict with these specifications in which case this specification shall apply.

4) All cable shall have a forty (40) year warranty from the cable manufacturer. The warranty shall cover full replacement of the entire length of the faulted cable (if installed in a three phase system, all three conductors shall be replaced). Warranty shall cover all material and labor cost to change out cable. The warranty, written on the cable manufacturer's letterhead and signed by a senior representative with signature authority must accompany the submittals for proper evaluation. **No submittals without this warranty will be considered.**

5) Deliver medium-voltage cable on factory reels complying with NEMA WC 26.

6) Store cables on reels on elevated platforms in a dry location.

7) Assure cable in storage is properly end-capped to prevent entry of moisture.

8) Cable Manufacturers: Subject to compliance with requirements, manufacturers are limited to the following: Okonite, Southwire, Pirelli Cable, and BICC General or approval equivalent.

9) Cable shall be type: MV105, Conductor: Annealed uncoated copper compact stranded per ASTM B-496, Conductor Shield: Extruded semiconducting Ethylene-propylene rubber (EPR) per AEIC CS6, and Insulation: EPR complying with AEIC CS6, Voltage ratings: 15 KV, Insulation Thickness: 133 percent insulation level, Insulation Shield: Extruded EPR per AEIC CS6, Shielding: 5 mil copper tape with minimum 12-1/2% overlap, helically applied over semiconducting insulation shield; Jacket: Sunlight-resistant PVC.

10) Provide maximum 15kv-cable slack in all manholes and vaults under switches. 15 kV cable shall be wrapped at least one and one half times around the circumference of all manhole interiors and properly supported.

11) Pull conductors simultaneously where more than one cable is indicated in same raceway. Use NRTL-listed and manufacturer-approved pulling compound or lubricant where necessary. Provide letter from cable manufacturer that the pulling compound is appropriate. Do not exceed manufacturer" recommended maximum pulling tensions and sidewall pressure values.

12) Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceways. Do not use rope hitches for pulling attachment to cable. Puller shall indicate and record actual pulling tension.

13) Install exposed cable parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

14) In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag. All cable supports shall have porcelain insulators.

15) Fireproof cables and splices in manholes: apply one layer of half-lapped fireproofing tape; extend fireproofing one inch into ducts; extend fireproofing one inch into connector bodies and terminations; bind fireproofing tape in place with glass tape; fireproofing shall be 3M® product 77 or equal.

16) Provide a protective cap at each terminal junction, one on each terminal to which no feeder is indicated to be connected.

17) Seal around cables passing through fire rated elements and where cables enter conduits, or equipment.

18) Terminations shall be performed by qualified medium/high voltage electricians. Prior to performing terminations, the qualified electrician shall undergo a suitable training session given by the manufacturer of the termination equipment, or furnish satisfactory documentation or certificate to show that the Contractor has received such training within the last two years.

19) One feeder shall be installed in the A manholes and one feeder shall be installed in the B manholes.

20) It is the intent of these specifications that the Contractor take extreme care and caution when pulling cable in to conduits. In the utility tunnels only, the Contractor may utilize other methods of handling slack cable, other than on a reel. The method of handling slack cable, while making pulls between pullboxes, shall be submitted to the Owner, prior to cable installation for final approval.

21) The cables shall be continuous between terminations. All cables shall be looped and spliced in each manhole.

22) The cables shall be fanned out and marked for phase identification at each termination.

23) The Contractor shall provide equipment to indicate pulling tensions with equipment set to disengage pulling before maximum permissible cable pulling tensions are exceeded. As an option, the Contractor may utilize a “link” between the cable and pulling equipment, set to break at the maximum allowable pulling tension.

24) All work on primary conductors shall be done only when such conductors and equipment are de-energized. The Contractor shall not interrupt any main electrical

utility without a written request for an outage and subsequent approval from the Owner.

25) Phasing of reconnected feeders shall be identical to the existing phasing.

26) Cables of the same circuit shall have the phasing identified with red color tape in manholes, switchgear, and boxes. Phase A shall have one wrap, Phase B shall have two wraps, and Phase C shall have three wraps.

27) Utility Services shall witness pulling and termination of all 15 kv cables. The Contractor shall provide a written two-week advance notice of the schedule.

28) Submit actual cable lengths on all pulls and identify lengths on as-built drawings to Utility Services and FM Engineering.

29) Fault indicators shall be provided in each manhole. Install fault indicators at each manhole, one per phase per manhole. Fault indicators must be approved by Utility Services and FM Engineering prior to installation.

30) Provide one 600-amp non-load break splice connection “T body” in each vault on each new feeder. Make provision for approved racking for the number of feeders represented by the number of conduits entering each vault. Feeders must wrap the circumference of the manhole 1.5 times.

31) Cable splicing and terminating products and accessories are:
    a. Cooper Power Systems, Inc., RTE Components.
    b. Elastimold
    c. G&W Electric Co.
    d. Energy Division, Raychem Corp.
    e. 3M Electrical Products Division

32) Conductor Terminations: Comply with IEEE Standard 48. Insulation class equivalent to that of the cable. Terminations for shielded cables include a shield-grounding strap. Class 1 Termination for Indoor Shielded Cable: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.

33) Separable Insulated Connectors: Modular system complying with IEEE386. Disconnecting, single-pole, cable terminators and matching stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture. Load-break bushing inserts shall be approved by Utility Services and FM Engineering and completely mate with load-break elbows.

    a. Load-Break Cable Terminators: Elbow-type units with 200-ampere load make/break and continuous current rating. Coordinate with insulation diameter and conductor size and material of cable being terminated. Include capacitively coupled test point on terminator body. Load-break bushing inserts shall be approved by Utility Services and FM Engineering and completely mate with load-break elbows.

    b. Dead-Break Cable Terminators: Elbow-type unit with 600 ampere continuous current rating, designed for deenergized disconnecting and connecting. Coordinated with insulation diameter and conductor size and material of cable being terminated. Include capacitively coupled test point on terminator body.

c. Protective Cap: Insulating electrostatic-shielding, water-sealing cap with drain wire shall be installed at all unused inserts.

d. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding 3 phases of feeders, and carrying case.

e. Cable shields shall be grounded at all terminations.

34) Provide 30-mil, flexible elastomer tape that will expand in fire to form an insulating firewall between fire and cable. Manufacturer: 3M “Scotch Brand 77”. All exposed cable in manholes shall be fire wrapped including 6” inside the conduit. Provide glass cloth tape with thermosetting silicone adhesive that performs at NEMA Class H temperatures to bind fireproofing tape in place. Manufacturer: 3M “Scotch Brand 69”.

C. Interior Raceway

1) Conduits containing medium voltage cable (15kV) in the utility tunnels and buildings, shall be installed in rigid steel conduit, threaded, thick wall, zinc coated on the outside and either zinc coated or coated with an approved corrosion resistant coating on the inside or Intermediate Metal Conduit (IMC): Rigid, threaded, lightweight steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion resistant coating on the inside.

2) For conduits containing medium voltage cable (15 kV) in the utility tunnels and building provide threaded connectors and couplings. Compression type threadless fittings for rigid steel conduit or IMC are not permitted. Bushings shall be threaded insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system, for rigid steel conduit and IMC. Provide threaded insulated grounding type bushings at all conduit terminations at all boxes (pull, terminal, etc.) and equipment.

3) Install rigid steel conduits or IMC conduit for all runs in the utility tunnels. Conduit shall be kept at least 6 inches from paralleled runs of hot water or steam pipes, and at least 2 inches at perpendicular crossings (measured from the piping insulation).

4) Install concealed conduits in as direct lines as possible. Install exposed conduits parallel to or at right angles to the lines of the utility tunnels or building.

5) Install conduit systems concealed where possible unless otherwise noted. Conduit systems may be exposed in unfinished utility areas, ceiling cavities and where specifically approved by Utility Services or FM Engineering.

6) In any conduit run, the number of quarter bends or equivalent between terminations at cabinets or boxes shall not exceed three (3) 90 degree bends for 4 inch and 5 inch conduits. Conduit runs between cabinets or boxes shall not exceed 300 feet for straight runs or 200 feet for runs with maximum number of bends.

7) Protect all vertical runs of conduits or conduits terminating in the bottoms of boxes or cabinets, etc., from the entrance of foreign material prior to installation of conductors.

8) Conduit sleeves not used shall be plugged with threaded metal recessed type plugs or caps. Sleeve all conduits passing through walls. Sleeves that are used shall be caulked tight to match the fire rating of the wall and shall utilize Link-Seal if below grade.

9) Install individual pipe hangers for all conduits. Spring steel fasteners with hanger rods may be used where noted on the drawings.

10) Install multiple (trapeze) pipe hangers where two or more horizontal conduits run parallel and at the same elevation. Secure each conduit to the horizontal hanger member by a U-bolt, or other specially designed and approved fastener.

11) Install ½ inch diameter or larger, if required, galvanized steel rods for trapezes, spring steel fasteners, clips or clamps. Wire or perforated strapping shall not be used for the support of any conduit under any circumstance.

12) Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts to brickwork by means of expansion bolts and to hollow masonry by means of toggle bolts. Wooden plugs and shield shall not be used. Power driven fasteners may be used to attach pipe straps and hanger rods to concrete only where approved by Utility Services or FM Engineering.

13) **Do not** use existing supports in the utility tunnels for new conduit runs.

14) Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

15) Elevation of Raceway: Where possible, install horizontal raceway above water and steam piping. Due to existing conditions, raceways may be installed below water and steam in the utility tunnels, where it is not possible to install them above other utilities. Utility Services to approve the location of all conduits runs.

16) Complete installation of electrical raceways before starting installation of conductors within raceways.

D. Medium Voltage Pad Mounted Switches

1) Utility Services shall procure the switch and be reimbursed by the project.

2) The 12.47KV front (and one side) accessible pad mount style gear shall consist of manually-operated, loadbreak, SF6 insulated, 600A line side switches, and electrically-operated 200A load side vacuum fault interrupters with electronic controls. Pad mount style SF6 gear shall be suitable for outdoor operation (NEMA 3R).

3) Securely fasten equipment to the concrete pad per equipment manufacturer’s recommendations. Pad mounted gear shall be anchored to concrete pads utilizing 5/8” diameter anchor bolts, and anchor bracket furnished with pad mounted gear. Anchors shall be provided and installed at each of four- (4) corner of gear in locations per the manufacturer recommendations.

E. Transformers

1) Utility Services shall procure the transformer and be reimbursed by the project.

2) Transformers shall be of the pad mounted design, radial feed type, delta-wye connection and shall have a tap changer. Tap shall be suitable for de-energized operation only. The tap changer shall be set on the 100% tap at the factory and shall be secured to prevent inadvertent change from this position.

3) A two-hole NEMA grounding lug shall be provided on the transformer high voltage and low voltage compartment.

4) Transformer shall be triplex or five-legged core design and connected delta-wye, with secondary neutrals brought out to a neutral bushing in the secondary department. Neutrals shall be bonded to the transformer tank with copper straps.

5) All secondary cable terminations utilizing bolt on connections shall include either transformer manufacturers' termination kits, or shall be made using Bellville washers.

F. Identification

1) UNM Engineering shall provide label terminology (wording). Signs and labels shall generally match existing.

2) Manhole covers shall match existing. Circuit numbers shall be added to existing "label tags" on the cover. Manholes shall be numbered as directed by UNM Engineering.

3) Labels for equipment shall be engraved melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on red face and punched for mechanical fasteners. Provide for boxes, terminal cabinets, SF6 switches, transformers, interior of manholes, etc.

4) Fasteners for Plastic-Laminated nameplates: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

5) Adhesive Marking Labels for Raceway shall be pre-printed, flexible, self-adhesive labels with legend indicating voltage and service.

   a. Raceways 1-inch and smaller: 1-1/8 inches high by 4 inches long.
   b. Raceways larger than 1-inch: 1-1/8 inches high by 8 inches long. Color shall be black legend on red background. Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

6) Labels for cables in distribution manholes shall indicate "to and from".

7) Coordinate names, abbreviations, colors, and other designations used in electrical identification work with existing designations.

8) Identify Pull Boxes and Terminal Cabinets: Code-required caution sign for boxes shall indicate system voltage in white preprinted on red background. Install on outside of box pop-riveted to cover. Also label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

9) Use conductors with factory-applied color the entire length of the conductors or the following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.

   a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

   b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or

splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

10) Power Circuit Identification: Securely fasten identifying tags marker bands to cables, feeders, and power circuits in pull boxes, junction boxes, and switchboard rooms with ¼ inch steel letter and number stamps with legend to correspond with designations of Drawings. If metal tags are provided, attach them with approximately 55-lb test monofilament line or one-piece self-locking nylon cable ties.

11) Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.

12) Where multiple branch circuits are present in the same box or enclosure, label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

13) Match identification markings with designations used in panelboards shop drawings, contract documents, and similar previously established identification schemes for the facility's electrical installations.

14) Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. Except as otherwise indicated, provide single line of text, with ½-inch high lettering in black field. Text shall match terminology and numbering of the contract documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

    a. Pull boxes, terminal cabinets and enclosures
    b. Access doors and panels for concealed electrical items
    c. Electrical switchgear and switchboards

15) Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

16) Install "12470 VOLTS" labels on all 15 kv feeder and/or conduits in the utility tunnels, manholes and buildings at approximately 10' on centers.

G. Field Testing

1) All equipment (switches, transformers, and cable) shall be tested for proper installation and operation by an independent third party approved by Utility Services or FM Engineering. The Contractor shall provide a written seven (7) day notice prior to testing. A representative from Utility Services must be onsite during testing. Equipment shall satisfactorily operate on the existing UNM system.

2) Tests shall conform to manufacturer's recommendations and International Electrical Testing Association (NETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems".

3) Schedule tests and notify Utility Services at least two (2) weeks in advance of schedule for test commencement.

4) The testing organization shall make a written report of observations and tests. Report defective materials and workmanship and retest corrected defective items.

5) Testing organization shall submit written test reports to Utility Services and FM Engineering.

6) Correct deficiencies identified by tests and make ready for retest. Verify that equipment meets the specified requirements.

7) Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paints splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish.

8) Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

9) The Contractor shall provide the source of power as required for the test equipment.

10) In the event of lack of proper insulation, or in the event that any cable fails to meet any of the above tests, the entire faulty cable shall be removed and new cable shall be installed and tested at no additional cost to UNM.

33 72 00 Utility Substations – see 33 70 00
33 73 00 Utility Transformers – see 33 71 00
33 74 00 Extra-High-Voltage (EHV) Switchgear and protection – see 33 70 00
33 75 00 High-Voltage Switchgear and Protection Devices (115 kV – 230 kV) – see 33 70 00
33 77 00 Medium-Voltage Utility Switchgear and Protection Devices (2.4 kV – 69 kV) – see 33 70 00
33 79 00 Site Grounding – see 33 70 00

33 79 93 Site Lightning Protection

1. If system is desired by UNM, based upon importance of the building and/or hazard, it must be shown.
2. If system is provided, then certification is required. Specify whether UL or LPI certification is required.

33 80 00 Communications Utilities – see 33 09 00

Please refer to the UNM IT Design Guidelines and Guide Specifications available at http://it.unm.edu/communications/designguidelines/ for complete specifications pursuant to this section. The items included herein are only intended as a partial summary and shall not be considered to supersede anything in the IT Design Guidelines.

ELECTRICAL CONNECTION CHECKLIST AND APPROVAL

MANHOLES

Item	Notes	By	Date
MV Cable Tested per ANSI/NETA Standard	Testing performed by third party, must supply test results		
All metals parts to be grounded in MH			
T-Bodies shields grounded			
T-Bodies Torqued Connection	UNM must witness torque		
Cable Arms shall have Porcelain Insulators	Inspected by UNM personnel		
Cables properly labeled/identified	Panduit-MP350-C or similar label		
Fire Wrap cable			
Duct Seal conduits			
Clean area of any debris, trash, metal filings, etc.			
Bond Bushings	Per NEC code		
Fault Indicators	As applicable		
Final Inspection by UNM personnel			

MEDIUM VOLTAGE SWITCH

Item	Notes	By	Date
Shell properly aligned to pad	Relay control boxes need to open to 90 degrees		
Switch and Shell properly anchored			
Switch properly grounded			
Shell properly grounded	Shell to Switch		
Bushings Drains/Grounds properly installed			
Cables properly grounded	Non-reversible crimp		
A & B main feeder neutrals/grounds	Non-reversible crimp		
Cables properly labeled/identified	Panduit-MP350-C or similar label		
MV Cables tested per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
Cables properly connected to Switch	T-Bodies and Loadbreak elbows connection and torque witnessed by UNM personnel		
Switch tested per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
Protective relays tested per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
A & B circuits phasing correct	A-A, B-B, C-C must be in phase, UNM to witness, must have calibration certificate with HV meter		
Conduits shall be Duct Sealed			
Clean area of any debris, trash, metal filings, etc.			
Outer Shell sealed with proper outdoor sealant to base of platform			

MEDIUM VOLTAGE SWITCHGEAR

Item	Notes	By	Date
MV Switchgear installed proper and in good condition	Any dents and/or scratches, misaligned		
MV circuit breakers tested and operate properly per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
Switchgear properly grounded			
Cables properly grounded			
A, B, and Tie main feeder neutrals/grounds	Non-reversible crimp		
Cables properly labeled/identified	Panduit-MP350-C or similar label		
Cables tested per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
Cables properly connected to bus	torque witnessed by UNM personnel, must tape connections or other acceptable insulator		
Switchgear tested and functionals verified per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
Protective relays tested and set per coordination study per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
A & B circuits phasing correct	A-A, B-B, C-C must be in phase, UNM to witness, must have calibration certificate with HV meter		
Metering verified for correct connections	Verified for correct Amperage, Voltage, KW, and PF		
Clean area of any debris, trash, metal filings, etc.			

TRANSFORMER

Item	Notes	By	Date
Bushings Drains/Grounds properly installed			
Transformer properly grounded	Primary & Secondary grounds included		
MV Cables properly grounded	Non-reversible crimp		
Cables properly labeled/identified	Panduit-MP350-C or similar label, primary and secondary		
Cables properly connected to Transformer	Loadbreak elbows connection witnessed by UNM personnel, correct hardware used on secondary (Bellville Washers required)		
Secondary connections shall have torque markings			
Primary & Secondary Cables tested per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
Transformer tested per ANSI/NETA Standard	Testing performed by 3rd party, must supply test results		
Conduits must be Duct Sealed			
Clean area of any debris, trash, metal filings, etc.			
Outer Shell shall be sealed with proper outdoor sealant to base of platform			

METERING

Item	Notes	By	Date
All wiring & devices labeled			
Power supply power to be fused			
Voltage circuit shall have fuses, current circuit shall have shorting block			
All wiring shall be stranded AWG			
Current circuits wire to be #12 AWG or larger			
Meter voltage & current phasing correct			

INSPECTION CERTIFICATES

Item	Notes	By	Date
Electrical Contractor inspection Passed	Attach letter from GC confirming, attach green tags		
UNM Inspection Passed	Primary and Secondary		

TESTING UPON ENERGIZATION

Item	Notes	By	Date
Voltage readings	Taken at secondary of Transformer		
Phase Rotation	Taken at secondary of Transformer		
Write voltage and rotation information on secondary door of Transformer	Include date and contractor information		

Voltage Readings & Rotation

A-G:	B-G:	C-G:	Rotation:
A-B:	B-C:	C-A:	

Acceptance of Electrical Installation and Approval to Connect to UNM Utilities:

UNM Utility Services Representative:

Name & Position:_____

Signature & Date:_____

Contractor Representative:

Name & Position:_____

Signature & Date:_____