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District Energy & Cooling

MEP Design Criteria Manual

Applicable Codes and Standards

Applicable Codes and Standards include but are not limited to:

- ASHRAE 90.1-2019 – Energy Standard for Building, Except Low-Rise Residential Buildings.
- ASHRAE 15-2019 – Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants.
- 2021 International Building Code (IBC) with COA Local Amendments
- 2021 International Energy Conservation Code (IECC) with COA Local Amendments
- 2021 Uniform Mechanical Code (UMC) with COA Local Amendments
- 2021 Uniform Plumbing Code (UPC) with COA Local Amendments).
- 2020 National Electric Code (NEC) with COA Local Amendments

Major Design Considerations

Provide a XXXX ton industrial-grade chilled water central utility plant connected to the existing local chilled water distribution system and designed to work in conjunction with the existing plants.

Provide a complete industrial-grade chilled water central utility plant on the subject property. The plant must have adequate clearances for servicing all equipment.

Chillers shall be factory-assembled and tested centrifugal type chillers with the following: refrigerant metering device, lubrication system, prewired control panel with user interface, refrigerant purge system.

Plant must be designed for XX°F leaving chilled water and XX°F entering chilled water temperatures and operate at a voltage mutually agreed upon by AE and design engr.

Cooling towers shall be provided for the heat rejection requirements of the chillers and shall be designed for 79.8°F wet bulb outdoor air conditions. Cooling tower location, sizing, screening, and factory options shall mitigate unwanted effects of cooling tower plume on surrounding buildings and structures and performance of any existing cooling towers on site. Drift eliminators shall be incorporated into the cooling tower. The cooling tower shall have N+1 redundancy. The loss of a single cell shall not prevent the plant from operating at full design capacity.

All pumping systems shall be constructed in an N+1 redundancy configuration with appropriate sequence of operations. The pump configuration must allow continued, uninterrupted service regardless of the loss of a single pump. Chilled water pumps must be configured in a primary-secondary configuration with N+1 redundancy. Condenser water pumps must be configured in an N+1 redundancy configuration. The chilled and condenser water pumps shall be piped in a header for parallel operation. The pumping system must work in conjunction with the existing chilled water distribution system.

Provide fan-coil units with chilled water coils, chemical treatment, refrigerant monitoring system with associated purge and make-up air ventilation systems, and all necessary appurtenances for fully functional systems.

Vibration and Sound Control

New chillers, cooling towers, pumps, in-line fans and heating/cooling units must be designed to minimize vibration and sound. The plant site shall comply with the City of Austin Noise and Amplified Sound Ordinance which requires that noise cannot exceed db as specified by local ordinance at the property line.

Flexible connections shall be provided on all piping and where applicable ductwork connections to new chillers, cooling towers, pumps, in-line fans and heating/cooling units.

Piping and Valve Requirements

The design of all hydronic piping systems shall be the responsibility of the successful bidder, including but not limited to chilled water, condenser water, makeup water, blowdown, sanitary, control wiring and electrical wiring.

All chilled and condenser piping shall consist of black steel. Steel piping shall be seamless, standard weight black steel. Primary chilled water and condenser water piping shall be sized for a maximum velocity of 10 fps. Secondary chilled water piping shall be sized for a maximum velocity of 7 fps. Condenser piping shall be epoxy coated. Insulation and jacketing of condenser water pipe is only required for freeze protection. City water supply lines must be insulated if they are in an unconditioned environment.

All piping shall be labeled with service and direction of flow.

Chilled water and condenser water pipe insulation must be designed to prevent condensation and include appropriate vapor barriers and jacketing. AE prefers one inch thick insulation for indoor piping of one-inch and smaller and two-inch thick insulation for indoor piping larger than one inch.

AE prefers the following insulation for outdoor piping or piping in unconditioned spaces:

- Pipe sizes 1" and smaller: 1" thick insulation
- Pipe sizes larger than 1": 2" thick insulation.
- Piping exposed to exterior conditions should have aluminum jackets; otherwise, piping should have PVC jackets.
- Freeze protection shall be provided for all exterior piping and instrumentation and be sized to prevent freezing down to zero degrees F ambient.

Prior to placing pipe in service, the following activities must occur:

- Hydrostatic testing of all water piping systems.
- Cleaning and flushing of both chilled and condenser water piping systems.
- Passivation of both chilled and condenser water piping systems (chillers and cooling towers)

need not be passivated).

Cooling tower cells shall be individually isolable. Level control shall allow for any combination of cells being isolated at a time. If an equalization line is common to all cells then both inlet and outlet isolation control valves shall be included for each tower cell. Each tower cell shall have a low point drain for emptying the associated cell.

Any piping susceptible to freezing shall be designed with the ability to be drained.

Plant Control System (PCS) Standards

Industrial grade controls shall be provided for the new chilled water & condenser water systems. The new controls shall be tied into the existing Austin Energy PCS at District Cooling Plant 1. The general requirements for the PCS include, at a minimum, the following items:

- Redundant ControlLogix PLCs (two racks with two processors each in a hot backup configuration) with industrial switches. Device level ring (DLR) backbone. This main panel will be installed in the new chilled water plant. Each processor rack shall be powered by a separate, dedicated circuit. Programming of the redundant PLC's will be performed by AE.
- The main PLC shall communicate with each chiller PLC (located at each chiller) and each VFD via Ethernet/IP datalink. If chiller is not controlled by a 1756 PLC, then chiller manufacturer shall provide gateway with their chiller controls that allows high throughput communication with main Plant PLC.
- The HMI shall be included by the plant manufacturer with a runtime license that is installed on a new workstation. The workstation shall be located near (adjacent) the main PLC panel or in a controlled space near the main PLC panel as agreed upon by AE and design engineer.
- HMI graphics and configuration shall be performed by Austin Energy staff. The plant manufacturer shall provide PLC I/O maps to Austin Energy programmers. Equipment equipped with other than Allen Bradley 1756 or 1769 controllers shall provide documentation showing internal controller register addresses including data type, scaling, and contents description for each register.
- For plants that are the sole provider for a distribution loop, the plant manufacturer will provide redundant PLC data servers, and a single historian server and their associated software licenses.
- Network Interface Rack with servers, fiber patch panels and associated appurtenances will be provided by Austin Energy.
- Loop checkout for all plant equipment shall be performed by authorized equipment manufacturer technicians with observation from Austin Energy personnel.
- An industrial grade uninterruptible power supply shall be provided. The minimum run time after loss of power shall be 20 minutes. There shall be a second UPS of identical ratings to provide redundancy.

Plumbing Standards

Domestic cold water must be brought on-site and a new city water meter set by Austin Water Utility. Redundant backflow preventers with a single water meter must be provided for make-up water to the chilled and condenser water systems. Where auxiliary water is used on-site, backflow preventers must be installed immediately downstream of the city water meter per Austin Water Utility standards. Separate chilled water and condenser water make-up water

meters must be provided and monitored by the plant control system. The condenser make-up water meter shall be a type approved by Austin Water Utility for evaporation credit program, such as the Badger Meter M2000 approved by Austin Water.

By City of Austin ordinance, reclaim water must be utilized for commercial developments within 250 feet of an available reclaim water source. It is the contractor's responsibility to confirm all conditions and adhere to the reclaim water requirements based on the actual design produced.

Domestic cold water (potable and non-potable) piping shall be steel or type L hard drawn seamless copper tube with lead-free soldered joints and fittings.

All domestic cold water (potable and non-potable) piping shall be provided with non-fiberglass pipe insulation with all-service jacket, self-sealing lap, and vapor barrier. Piping exposed to exterior conditions shall be provided with aluminum jackets and heat traced as required by city code.

The public sewer must be extended on-site to a point five feet outside the property. Soil and vent piping shall be designed to accommodate the new equipment and architectural layout and the building drain shall convey waste to the building sewer. The building sewer will tie into the public sewer outside the property. All blow-down and backwash piping must be metered and monitored by the plant control system. The blow-down and backwash water meters shall be a type approved by Austin Water Utility for evaporation credit program, such as the Badger Meter M2000. Flow meters shall be installed per manufacturer's recommendation and Austin Water requirements.

Below-grade sanitary sewer piping and above-ground soil and vent piping shall comply with applicable codes.

Fire Protection Standards

Provide service connection from the existing parking garage fire protection sprinkler system. The fire sprinkler system shall be monitored by the existing fire alarm system as well as the plant control system. Provide an automatic wet pipe sprinkler system in accordance with NFPA 13. Piping will be black steel schedule 40 with threaded or mechanical joint couplings. The Design- Build team shall determine the location and arrangement of components such as indicating control valves, system riser components, water flow alarms, etc. Sprinkler systems in electrical rooms shall be pre-action type.

Applicable Codes and Standards

Applicable Codes and Standards include but are not limited to:

- NFPA 70 - National Electric Code (2020) and Local Amendments
- Austin Energy Design Criteria (Most current version)
- NFPA 101 – Life Safety Code (2021) and Local Amendments
- International Building Code (2021) and Local Amendments
- International Energy Conservation Code (IECC) (2021) and Local Amendments
- NFPA 72 - National Fire Alarm and Signaling Code (2022) and Local Amendments
- NFPA 70E, Standard for Electrical Safety in the Workplace
- NFPA 780, Standard for the Installation of Lightning Protection Systems

Major Design Considerations

Perform a preliminary load analysis for the plant. Then consult with Austin Energy Electrical Service Delivery (ESD) to determine the available voltage level, MVA, and redundancy that can be provided to the site and which can satisfy the preliminary load analysis. Make recommendation as to whether to pursue primary or secondary electrical service. Final selection of service voltage and number of service feeds shall prevent a single electrical failure or preventative maintenance activity from curtailing plant production capacity. The successful bidder will be responsible for coordinating with ESD and for providing electrical vaults, equipment pads, manholes, and associated raceways.

Metering

For primary service, the project will include metering enclosures for potential transformers (PTs), current transformers (CTs) and ION Meters separate from the plant MV switchgear. The mains and feeder breakers will each have power metering and be networked to the plant-wide control system. Refer to the latest version of the Austin Energy Design Criteria Manual for details on electrical metering requirements. The mains and feeder breakers shall have capability of remotely initiated opening and closing commands from Balance of Plant PLC (BOPPLC). Breaker status information shall be communicated back to BOPPLC.

Balance of Plant Equipment

The main switchboards will be located in the electrical room. Each switchboard will be of Main-Tie-Main with kirk-key interlocks to transfer the loads to the available source from the dual redundant feeds. The main switchboards will contain feeder circuit breakers. The circuit breakers will feed the following plant loads but are not limited to:

- Chillers w/VFDs
- Cooling tower fans w/VFDs
- Condenser water pumps w/VFDs
- Primary chilled water pumps w/VFDs
- Secondary chilled water pumps w/VFDs
- 480Y/277V Panelboards
- 480-120/208V dry-type transformers
- 208Y/120V Panelboards
- 480V low voltage motor control centers

The plant equipment of similar load types will be equally distributed across the switchboards, panelboards and MCCs for redundancy, availability, increased reliability and minimized downtime during maintenance and repair work.

The switchboards will be provided with motorized power breakers with LSIG and Arc Flash mitigation functions. A Programmable Logic Controller shall be provided for all ATO functions for the Main-Tie-Main schema. The switchboard will be provided with a power metering and monitoring software. Circuit breakers shall have a mechanism to lock out tag out the breaker at the device.

Panelboards will be door-in-door style panelboards for ease of maintenance. Panelboards will have front cover nameplates identifying name, voltage designation, and location where power is derived, and location of connected load. All molded-case circuit breakers shall be bolt-in type.

480V low voltage motor control centers (MCC) will contain equipment starters and circuit breakers. MCCs shall be double ended with feeder circuits from separate services. The MCCs shall contain metering for each cubicle of the MCC and be networked to the plant-wide control system.

Dry-type 480-120/208V transformers and panel boards will be used to serve various balance of plant loads such as general-purpose receptacles, control panels, and other equipment requiring electrical connections. Transformers will consist of copper windings with self-air-cooled ventilation. In areas where dust and dirt may be normally present, use encapsulated-type transformers. Transformers shall have front cover-mounted nameplates identifying name, primary and secondary voltage, kVA, location from where power is derived, and location of connected load. Surge protection will be provided at each level of distribution voltage.

Low-voltage variable frequency drive (VFD) shall be ultra-low harmonic type. VFDs shall be designed for use on 3-phase squirrel cage induction motor and chillers. VFDs shall be provided

with product data and quality assurance data. Design and manufacture according to latest editions of applicable NEMA, UL, NFPA, IEEE, and ANSI standards. Manufacturer shall be ISO 9001 certified and shall have produced similar electrical equipment for minimum period of 5 years. System shall be capable of maintaining rated torque and speed with bus voltage deviations of $\pm 10\%$ and frequency deviations of $\pm 5\%$. Drive efficiency shall be 95% or higher at rated load. Provide output filters, as required, such that motor insulation will not be damaged. If additional equipment is necessary to meet IEEE 519 requirements, it shall be through use of one or more of following: Input isolation transformer, Input line reactor, Input harmonic trap filter with series reactor, Higher pulse rectifier.

All systems will be designed in accordance with the National Electrical Code (NEC). Raceways will consist of conduit and cable tray. All raceways and cable trays will be color coded to identify the installed system. Conduit is primarily rigid metal conduit and liquid-tight flexible metal conduit, except where otherwise required for special classifications or conditions.

Critical loads will be fed from an automatic transfer switch (ATS). The ATS will be fed from two sources, one from each upstream switchboard bus.

Complete electrical studies and drawings are required for permitting as well as record documents for AE. The documents shall include, at a minimum:

- Power system coordination, fault, load flow, and arc flash studies. A preliminary fault study is required prior to purchasing any electrical gear in order to verify the proposed gear has adequate ampere interrupting capacity (AIC) and withstand ratings for its intended installation location.
- Site power and lighting plans
- Plant power and lighting plans
- Plant control system plans
- Electrical plans to all equipment connections
- Panel schedules
- Cable and conduit schedules
- One-line diagrams
- Switchgear, motor control center, switchboard and other major equipment elevations
- Arc fault labels for all equipment

Lighting Systems

Lighting shall be LED type fixtures for interior and exterior applications, except where other source is required for specific applications. Lighting controls shall be a combination of manual and automatic control to provide energy savings. Locations of fixtures and control means shall be coordinated with building features, other trades, and other obstacles.

Surge Protection

Surge protective devices (SPD) shall be incorporated in the design to protect equipment by suppressing transient voltage surge. They help reduce costly downtime and protect sensitive electronic equipment against the damaging effects of transients caused by lightning, utility switching and internal load switching. The SPDs to be specified at each voltage level starting with the service transformer. Metal oxide varistors will be used on each main in the 12470V switchgear, on the MCC bus at the 480V level, and integrated into the lighting panelboard at the 120/208V level. All 480V and 120/208V SPD units will be specified with alarm contacts.

Grounding System

The grounding system will provide equipotential reference and return path for fault currents. The grounding system shall be designed per NEC requirements. The following electrical system components are required to be bonded to the grounding system:

- Electrical service neutral.
- Switchboards and panel boards.
- Separately derived systems such as transformers and UPS system.
- Electrically operated equipment and devices.
- Instrumentation panels and RTU equipment.
- Building steel, domestic water supply metal pipes, all fencing and metal railings.

The grounding system shall be comprised of grounding rings. The ground rings will be installed around each pad mounted transformer. All branch circuits shall include a ground wire connected between its panel board ground bus and the equipment that it serves. Grounding system shall be bonded to the existing grounding electrode system.

Lightning Protection Systems

The lightning protection system shall provide protection from lightning of the entire plant including outdoor structures such as cooling towers and thermal energy storage tanks. It will consist of air terminals and down conductors, Metal parts of the building that have a metal thickness of 3/16 inch or greater shall only require connection to the lightning protection system. The lightning protection system shall be bonded to the existing grounding electrode system.

Telecommunications

The project shall include a dedicated fiber optic connection for PLC communications from the existing chilled water facilities to the new plant, routed through a combination of existing and new conduit. A separate communication connection must be provided for telephone and internet cable.

Fire Alarm Systems

The plant shall have a fire alarm system complying with NFPA 72 and applicable codes. The system shall be monitored by the garage building the DEC designated fire monitoring service and the plant-wide control system.

Access Control Systems

The plant shall have an access control system. The access control system shall monitor and control each access door to the plant. The system will be monitored through the plant control system.