DESIGN GUIDELINE 230051
WATER CHILLERS

General

Refer to SID-J, University Provided Utilities, for application of steam absorption chillers on Central Campus. Centrifugal chillers are the standard application for other campus areas. On Central Campus, generally capital replacement of absorption chillers shall be with like absorption chillers. Electric water chilling may be used for new loads.

Consult with the U-M Project Coordinator and Utilities and Plant Engineering before making decisions on chiller type. The following are general criteria:

- Air cooled packaged chillers: 100 tons and smaller.
- Water cooled screw chillers: 100 to 200 tons.
- Centrifugal and steam absorption chillers: 200 tons and larger.

Related Sections

U-M Design Guideline Sections:
230050 – Chilled Water Systems
SID 4.6 - University Provided Utilities
Sustainability 3.2 - Energy Conservation

U-M Master Specification Sections:
230930 – Refrigerant Detection and Alarm
232513 – Chemical Water Treatment-Closed Loop
232516 – Chemical Water Treatment-Open Loop
236416 – Centrifugal Water Chillers
236500 – Cooling Towers

General Requirements

Unless directed otherwise, utilize the following U-M specifications as the basis for chiller specifications on projects. The A/E shall edit the specifications to make them project specific. Turn on hidden text and read all spec. editor's notes when editing specifications.

230930 – Refrigerant Monitoring System

232513 – Chemical Water Treatment-Closed Loop

236416 – Centrifugal Water Chillers

The capacity of the machine shall be based on Standard ARI-550-98 fouling factors for the evaporator, absorber and condenser sections, as stated in the U-M Master Specification.

Normally, for centrifugal and absorption machines, marine water boxes shall be specified for condenser and evaporator. Provide accessory davit arms or hinged covers for both evaporator and condenser boxes. Where marine boxes are not feasible, design shall indicate removable spool pieces between isolation valves and chiller heads, which when removed allow tubes to be pulled or cleaned. Design shall include permanent means to hoist and remove heads and spool pieces.

Chiller or chillers shall be sized to operate efficiently over the full range of the system load profile. Special caution shall be exercised to avoid sizing that results in short cycling in low load ranges. Multiple chillers shall be used if the load profile indicates that short cycling (cycling greater than 30 occurrences during a low load day) will occur. Multiple chillers shall be used in any installation of greater than 600 tons.

For small air-cooled chillers, consider providing an indoor chiller with remote condenser or dry-cooler in lieu of roof top chillers. Air cooled chillers operating year-around shall be rated for partial load performance at -10 F°. Chillers exposed to the outside air shall be designed with antifreeze water treatment for operation down to -10°F.

Chillers shall include manufacturer's standard digital control panel. BACnet panels and interfaces shall be provided only when specifically requested by Plant Operations.

Differential pressure switches for chiller proof of water flow shall be specified, not flow switches.

Provide life cycle cost analysis to evaluate chiller options. Contact Utilities and Plant Engineering for maintenance and utilities costs. Determine the system load profile. Evaluate alternative chiller assemblies. Investigate energy-saving opportunities where additional initial investment produces an acceptable payback in accordance with SID-D Energy Conservation. Consider providing variable speed drives (VSDs) for centrifugal chillers where the load profile exhibits an opportunity for acceptable payback. Use of VSDs on chillers must be approved by U-M Design Coordinator. For chillers larger than 200 tons, the specification shall require the manufacturer to provide, as part of their bid, annual energy usage based on a defined load model or ARI standard conditions, as applicable.

Normally chillers above 200 tons should be separately purchased and assigned to the mechanical contractor for installation. This allows the AE and the University to evaluate the chillers bids from a total (life cycle) cost perspective. U-M shall participate with the AE in chiller post bid evaluations, including attendance at post bid meetings.

Consider noise and vibration criteria in mechanical room and adjacent area. Specify machine noise and vibration limits, and specify testing procedures. Evaluate the need for noise and vibration abatement to achieve acceptable noise levels. See UM Master Specification for performance testing required after installation.

Mechanical Refrigeration Chillers

Centrifugal chillers should be specified to use HCFC-123 or HFC-134A (bidder's option). Screw chillers shall use HCFC-22.

Design and specification shall indicate each chiller to be provided with reseating relief valves and rupture discs. Vent the relief to the outside. Each resetting relief valve shall be designed to provide a digital input (contact closure) to the Building Automation System (BAS) on rupture.

For chillers over 300 tons, unless the chillers are installed near a convenient on-grade entrance, provide pump – down refrigerant reclaim tank and piping with capacity equal to 110% of the largest chiller in the installation.

For low pressure chillers, provide hose connections and power outlet for portable "hot pack" unit (to allow chiller to be heated to positively pressurize for service). Coordinate with U-M Project Coordinator as to whether a portable hot pack unit should be furnished with a new chiller installation.

When removing a chiller, specify and coordinate the removal of refrigerants by Plant Operations - Air Conditioning Shop, per EPA standards.

Specify that the chiller manufacturer conduct a full load factory performance acceptance test for each chiller and provide a certified test report for approval. Indicate that the capacity tolerance shall be zero and the allowable tolerance for other performance measurements shall be per ARI 550. Specify that the chiller not be shipped until the report is approved by the owner. Witness of testing by the owner shall be at the discretion of the owner with all travel expenses paid by the owner.

Specify that the chiller be provided with, on the control panel, a separate Hand-Off-Auto (HOA) switch which will allow selection of remote chiller start/stop or local start/stop. Specify that when the HOA is placed in off or hand, remote signaling shall not be able to control the chiller. Keypad activation is not permitted as a substitute for this function.

Provide refrigerant leak detection and ventilation in accordance with current standards and codes, including ASHRAE 15, Safety Code for Mechanical Refrigeration.

Steam Absorption Chillers

Absorption chillers shall be of hermetic design, factory assembled and leak tested, and selected for 5 psi steam at the inlet to the steam control valve. Unit shall be trimmed to 5 psi. Steam shall be controlled by low pressure drop control valve, limited to maximum 1 psig. The control will be a pressure independent control valves system, controlled by the unit control panel, which will permit operation of the unit at varying pressures (5-15 psig) without going into anti-crystallization mode at higher pressures.

If the unit is supplied with an anti-crystallization device such as a positive concentration limiter (PCL) valve, it must be provided with a factory installed manual bypass switch.

The unit shall be charged at the site with lithium bromide solution with chromate inhibitor or York's Advaguard 750. The lithium bromide solution shall be delivered to the site in approved containers and installed by the manufacturer at the site. The inhibitor shall be premixed into the solution before it is charged into the machine.

Tube wall shall be 0.028" for absorber, evaporator and condenser, and 0.035" for generator. The machine shall be supplied with 95/5 cupro-nickel tubes in the absorber, 90/10 cupro-nickel tubes in evaporator and generator, and 100% copper in the condenser section.

Pay particular attention to the manufacturer's requirement for minimum required vertical drop in the condensate piping between the concentrator outlet and steam trap inlet and proper pitch of the entire machine. Condensate lifting at the outlet of the machine is not permitted.

Instruct Contractor to arrange for a representative from the Plant Department through the University Project Coordinator to be present when the machine is initially charged with lithium bromide and water.

When an existing absorption chiller is to be removed, the lithium bromide is to be removed and legally disposed of by the contractor, with associated hazardous waste manifests filed with the U-M Project Coordinator and OSEH.

Specify that the chiller be provided with, on the control panel, a separate Hand-Off-Auto (HOA) switch which will allow selection of remote chiller start/stop or local start/stop. Specify that when the HOA is placed in off or hand, remote signaling shall not be able to control the chiller. Keypad activation is not permitted as a substitute for this function. Final trimming of absorption chillers by chiller manufacturer shall be done in conjunction with U-M Plant Operations and the Test and Balance contractor under full load conditions at the chiller. Since chiller start-up does not typically take place during peak cooling season, contractor must develop, assisted by the commissioner, a plan to fully load the chiller, either by imposing a false load or waiting to complete the contractually required trimming until a natural load can be developed. After the manufacturer trimming has been completed, manufacturer's representative shall perform final performance verification, measuring and document chiller performance under full load, witnessed by the commissioner.