GENERAL:

Steam and condensate piping and pump systems included in this document are for building systems starting at the pressure reducing station (PRV).

DESIGN GUIDELINES:

A. Design General

1. Definitions:
   1.1 Low pressure steam is 15 psig or less.
   1.2 High pressure steam is above 15 psig.

2. Campus Systems:
   1.1. MU: The steam distribution system operates at 60 psig and 400 F degrees. All equipment using campus steam must be capable of using steam at a temperature of 350F degrees. Confirm this with the Project Manager.
   1.2 Kansas City: Cooling Season: The steam distribution system operates as a single system at a common pressure of 10 to 15 psig. The system is supplied from one 300 hp boiler in Spencer Chemistry.
   Heating Season: The steam distribution system is decoupled at SMH 2. The distribution system east of SMH 2 is operated at 15 psig from one 600 hp boiler in Spencer Chemistry. The line to Flarsheim is supplied from Miller Nichols at 15 psig when ambient temperature is above 40 F and at 50 psig when ambient temperature is below 40 F. The lines west of Miller Nichols are supplied from Miller Nichols at 10 to 15 psig.

3. **ALL** steam used in heating systems will be used at a reduced pressure of 15 psig or less. Designer shall calculate the pressure required as indicated below. A working pressure of 5 to 8 psig is preferred.

4. High pressure steam may be used in a process heating application (autoclaves, cagewashers).

B. Pipe Sizing

1. Pipe sizing for low pressure steam and condensate returns shall be based on table found in the ASHRAE handbook, Fundamentals. Consultant shall size pipe and Pressure reducing valves will not be set higher than the minimum needed to deliver the necessary flow and pressure at the furthest point of use.

2. Pipe steam velocity should not exceed 8000 to 12000 fpm.

3. One pipe steam/condensate piping systems shall not be used. Older systems scheduled for renovation shall be changed to 2 pipe steam/condensate systems.

4. Condensate return piping shall be sized per ASHRAE handbook, Fundamentals for **dry** return.

C. Piping System Design

1. Steam piping shall slope in the direction of steam flow at ¼" in 10 ft. Condensate shall slope ¼" in 10 ft.

2. All steam risers shall be provided with drip legs per detail x.

3. All branch lines shall connect to main piping within 45 degrees to the top of the pipe. See detail x.

4. Exception: Steam main lines may be bottom tapped if the branch is provided with a trap at the tap. See detail x

5. Branch lines less than 10 ft long shall slope back to the main. Branch lines exceeding 10 ft will slope in the direction of flow and be trapped before entering any control device.

6. All sections of steam and condensate lines, which can be isolated with shutoff valves, shall be provided with a vent valve, drain valve and pressure gauge connection.

7. Do NOT use a vacuum condensate return.

8. Piping systems shall be analyzed for thermal expansion. Systems in buildings should be designed with anchor points, which take advantage of the typical pipe routing to achieve a flexible design. DO not use expansion joints, or flexible pipe couplings inside buildings. Solid pipe expansion loops are required.

9. All condensate piping shall be designed to drain by **GRAVITY** to the condensate return pump. Steam condensate after a heat exchanger or coil will not run up hill. Condensate risers which fill with condensate will cause dangerous steam hammer. Where condensate cannot be drained by gravity, and small condensate pump shall be provided. Equipment, such as heat exchangers may need to be elevated to provide proper drainage. Condensate Pumps may be required to be in pits or trenches.

D. Pressure Reducing Valves

1. All pressure reducing valve stations serving an entire building will have 2 pressure reducing valves, sized at 1/3 and 2/3 of the total load. Bypass lines are not required. Follow the Spence Regulator, Designers guide for sizing and layout of PRV stations.

2. Pressure reducing valves shall be selected and specified around a Spence, Type E valve, with pilot positioners. See figure x for approved installation drawings.

3. A vertical PRV station, mounted against the wall, is preferred. Ceiling mount is acceptable only if wall location is not available. Ceiling mounted units should not exceed 8 ft above finished floor.

4. Pressure reducing valves shall not exceed 85db when measured 3 feet from the valve.

5. Pressure Reducing Valves shall be located in Mechanical Rooms. **Do not** locate PRVs in hallways or other rooms not suitable for this service.

E. Steam Traps

1. Provide steam traps per detail _____

2. Primary building heat exchangers will be provided 2 float and thermostatic steam traps on each heat exchanger.

3. All steam pre-heat coils will be provided with 2 F&T traps on each coil.

4. All Drip stations on steam mains shall have a ¾" inverted bucket trap.

5. Where steam condensate cannot be drained by gravity, pumping steam traps shall be provided. Sarco PPT is preferred and drawing details shall be per Sarco instructions.

F. Main Condensate Return Pumps

1. All condensate for a building shall routed to a duplex condensate return pumps. Unless the facility is a major complex of buildings, one duplex pump is preferred.

2. MU Only: Pressure powered pumps, using 60 psi steam as the motive force are required, unless location of the facility requires higher pumping head.

3. When pumps heads higher than 45 psi are expected, design shall be based on a Grunfos _____ duplex pump.

SPECIFICATIONS:

A. General Requirements

1. Welder and weld procedure certificate as required by ASME Boiler Pressure Vessel Code, Section IX shall be submitted by the contractor.
2. Hydrostatic Test Report on Steam and Condensate systems shall be submitted by the contractor.
3. Regulatory Requirements: comply with the provisions of the following:
   a) ASME B 31.1 "Power Piping: for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
   b) ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.
   c) International Mechanical Code.

B. Materials

1. Refer to Piping Section and Pipe Tables at the end of this section.
2. Refer to Valve Tables at the end of this section.
3. Steam Traps
   a) Float and Thermostatic Traps: ASTM A 278, Class 30 cast iron body and bolted cap; renewable, stainless steel float mechanism, with renewable, hardened stainless steel head and seat; balanced pressure thermostatic air vent made of stainless steel or monel bellows with stainless steel head and seat.
   b) Inverted Bucket Trap: ASTM A126, cast iron body with stainless steel inverted bucket and internals. Provide a bi-metal air vent and strainer screen.
4. Pressure Power Pump (MU Only)
   a) The pump shall be pressure powered pump operated by steam, compressed air or other pressurized gas to 125 psig, which does not require any electrical energy, and is safe for use in explosive atmospheres.
   b) Body construction of ductile iron A395 or steel as required, with lift type check (bronze) or stainless steel disc check valves for pumping liquids of specific gravity of 0.65 and above.
   c) The pump shall contain a float operated snap-acting mechanism with no external seals or packing and stainless steel trim, and hardened stainless steel mechanism bearing components.
   d) Pump to be provided with inlet and outlet check valves attached at factory for ease of field installation.
   e) When required, pump shall be equipped with a cycle counter to monitor the volume of liquids being pumped, and sight glass to monitor operation.
   f) Type: Spirax Sarco PPC or PPEC as indicated, or approved equal.

5. Air Vents

    a) Quick Vents: cast iron or brass body, with balanced pressure stainless steel or monel thermostatic bellows, and stainless steel heads and seats.
    b) Float Vents: cast iron or brass body; seamless brass float; balance pressure thermostatic bellows; replaceable stainless steel seat, float, and head.

6. Vacuum Breakers

    a) Brass Body, stainless steel trim, 175 PSIG steam operating pressure.

C. Installation

1. All high pressure steam and condensate piping systems shall conform to the requirements of ANSI B31.1.
2. All low pressure steam systems shall comply with ASME B 31.1.
3. Contractor is responsible for the installation of all specialty items specified herein, pressure gauges, thermometers and other items as shown on the contract drawings.
4. Branch connections shall be made with straight tees, reducing tees, threadolets, or weldolets. Tap size of weldolet or threadolet to be no more than 1/3 of the tapped pipe.
5. Flanges shall be flat face when mating with 125# class cast iron valves.
6. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side down.
7. Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated.
8. Acceptance Testing: Perform hydrostatic tests on the steam and condensate piping in accordance with ANSI B 31.1 and as follows:
    (1) Notify Owners Representative 24 hours before required testing. All tests shall be conducted in the presence of the Owners Representative.
    (2) Flush system with clean water. Clean strainers.
    (3) Minimum test pressure shall be 150 PSIG.
    (4) Test pressure shall be held for 1 hour.
    (5) Test gauges shall be 4" min face, 0-160 PSIG, have a current calibration date within 1 year of the test date.
    (6) Prepare reports for all tests and required corrective action.
9. Clean and flush steam piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing piping system, but before balancing, remove disposable fine mesh strainers.
10. System shall be operated for a minimum of 24 hours to demonstrate to the Owner's Representative that system is complete and operational.

PIPING MATERIAL TABLE

Service: Steam (to 100 psi)

ITEM	SIZE	DESCRIPTION
Pipe	All	Carbon steel, SCH 40, ASTM A53, Gr B. Steam Condensate to be SCH 80.
Fittings	2" and Smaller	Malleable iron, 150 pound Threaded, per ANSI B16.3
Fittings	2 ½" and Larger	Carbon steel, buttweld type, long radius, SCH 40. Steam condensate to be SCH 80, per ANSI B16.9.
Unions	2" and Smaller	Malleable iron, Class 150 hexagonal stock with ball-and socket joints, metal-to-metal bronze seating , ANSI B16.39
Flanges	2 ½" and Larger	Forged steel, Class 150, slip-on, per ANSI 16.5

VALVE TABLE

Service: Steam, up to 100 psi

ITEM	SIZE	DESCRIPTION
Gate	2" and Smaller	Threaded, bronze, 150 lb., non-rising stem, solid wedge.
Gate	2 ½" to 12"	Flanged, cast iron, 125 lb, solid wedge, bolted bonnet, non-rising stem, bronze trim.
Check	2" and Smaller	Threaded, bronze, 150 lb., horizontal swing, Teflon steam disc.
Strainer	2" and Smaller	Threaded, cast iron, 250 lb., 20 mesh stainless steel screen.
Strainer	2 ½" to 12"	Flanged, cast iron 125 lb., .045" perforated S.S. screen.

NOTES

1. Ball valves are not permitted for use on steam systems

REFERENCES