SECTION 22 00 00_PLUMBING DESIGN GUIDELINES

I. Purpose

The University of Delaware is a community of diversified organizations that work interactively to accomplish a common set of goals. The plumbing systems are provided as a tool to help the University community meet these goals. The intent of the Plumbing Design Guidelines is to assist the plumbing design consultant to provide design that will within reason accommodate the needs of the various user groups within the University community.

These guidelines shall assist the consulting engineer meet the following University needs:

Occupant Comfort: The University is committed to providing a pleasant working and educational experience on the Newark Campus. These guidelines shall set the minimum requirements for occupant comfort. It is the responsibility of the consulting engineer to apply these guidelines in a way so that the University can provide a pleasant work place and educational experience.

Health and Safety: The University is committed to the health and safety of its entire community. The plumbing systems provide a significant role in insuring the safety of the University's built environment. These guidelines will determine the minimum requirements necessary to insure a safe and healthy campus. It is the responsibility of the consulting engineer to apply these guidelines in a way so that the University can provide a safe and healthy campus.

Environmental Impact: The University of Delaware is committed to minimize its impact on the natural environment. Proper design of the plumbing systems will help the University of Delaware achieve this goal. These guidelines are intended to assist the consulting engineer incorporate sustainability in the plumbing design. It is the responsibility of the consulting engineer to apply these guidelines in a way so that environmental impact is minimized.

Maintenance: In order to meet the University's occupant comfort, health and safety and sustainability goals, and the plumbing systems must be maintained. Often time's maintenance is not considered within the plumbing system design. This often results in plumbing systems that are difficult to impossible to maintain. Plumbing systems will often fall into a state of disrepair. These guidelines will provide the minimum maintenance requirements. It is the responsibility of the consulting engineer to apply these guidelines to insure maintainability of the plumbing systems.

Construction: Plumbing systems that are difficult and expensive to construct compromises the University's comfort, health and safety, sustainability and maintenance goals. Often time's construction is not considered within the plumbing system design. This results in plumbing systems that are difficult and expensive to construct. In addition poorly constructed plumbing systems result in inefficient energy use and compromises health and safety. These guidelines will provide the minimum construction requirements. It is the responsibility of the consulting engineer to apply these guidelines to insure constructability of the plumbing systems.

II. Domestic Heating Source

The University of Delaware operates campus wide heating districts at all three (Central, South and Laird) Newark campuses. The districts provides the majority of the required heating capacity to meet hot water demands.

Central Campus Heating District: Central Campus heating is supplied by a central boiler plant located in the central utility plant. The boiler plant generates 45 psig steam and distributes the steam via underground piping to the various buildings on the district. The steam is reduced to 15psig at the building level and is used by heat exchangers to produce heating hot water for distribution to heating coils. The steam is also used via heat exchangers to produce clean steam that is used for building humidification during the heating season. Steam condensate is recovered at the building level and is returned via steam driven pumps to the central utility plant.

South Campus Heating District: South Campus heating is supplied by a boiler plant located in the central in Worrilow Hall. The boiler plant generates 45 psig steam and distributes the steam via underground piping to Worrilow Hall, Townsend Hall and the Greenhouses. The steam is reduced to 15psig at the building level and is used by heat exchangers to produce heating hot water for distribution to heating coils. The steam is also used via heat exchangers to produce clean steam that is used for building humidification during the heating season. Steam condensate is recovered at the building level and is returned via steam driven pumps to the Worrilow utility plant.

Laird Campus Heating District: Laird Campus heating is supplied by a central boiler plant located in the Pencader complex. The boiler plant generates 200 degrees Fahrenheit heating water and distributes the heating water via underground piping to the various buildings on the district. Heating water is recovered and returned through the district to the Pencader boiler plant.

III. Code Compliance

It is the requirement of the consulting engineer to verify all plumbing systems designed or modified are in compliance with all applicable codes. The consulting engineer will conduct a code analysis to determine all applicable codes and document the impact to the design.

IV. Sustainability and Energy Efficiency

Energy Efficiency: It is the responsibility of the consulting engineer to maximize water conservation and energy efficiency. The consulting engineer shall propose plumbing design options that will minimize water and energy use associated with the plumbing systems. The consulting engineer shall review these options with the University Energy and Engineering Department prior to design. It is the responsibility of the University Energy and Engineering Department to determine the best plumbing system option.

Pay Back Formulas: When calculating payback for energy savings on a project, it is important to include both the savings and costs throughout the life cycle of the building and its assets. The time value of money must also be considered when performing the calculation. Simple Payback is not an acceptable

method to calculate payback on an investment. It is the responsibility of the consulting engineer to design the most efficient plumbing system that conforms to the life cycle cost analysis.

V. Assumptions

Assumptions: Often when plumbing load calculations are started assumptions (room occupancies, fixture types, flow rates…etc.) are made to facilitate the initial calculations. These assumptions may be necessary to provide data necessary for the initial cost estimate or to determine the magnitude of the project. These assumptions must be detailed and communicated to the project team. The assumptions must never be carried into the final calculations. It is the responsibility of the consulting engineer to replace the assumed values with accurate data. The consulting engineer will certify that all data within the model is accurate.

Future Loads: Final calculations may have assumptions for future loads. These assumptions must be detailed and communicated to the project team.

VI. Design Basis

Heating Districts: Domestic hot water heating for all new and renovated buildings shall be supplied by the campus heating districts. In the event that project conditions require that alternative heating sources should be used, the University of Delaware will entertain other options. Alternative heating sources must be approved (in writing) by the University Energy and Engineering Department prior to start of design.

VII. Domestic Potable Water Systems

Heating Water Systems: Domestic hot water shall be supplied by steam to hot water heat exchangers using the steam district as the heating source.

Variable Flow: Consulting engineer shall explore the viability of variable flow domestic water systems. If variable flow is the basis of design, accommodations shall be made to allow for minimum flow through the pumps as per the pump manufacturer's requirements.

Domestic Hot Water Temperatures: The design heating water supply temperature is 120 degrees Fahrenheit.

Domestic Hot Water Temperature Set Back: A setback schedule for the domestic hot water supply temperature will be established at the start of the project. The engineering design firm will incorporate the setback schedule into their design and calculations.

Domestic Water System Head and Effects on Energy Use: Pumping is a significant component of the buildings energy consumption. Often time's energy consumption is not considered when designing and specifying domestic water systems. Domestic water systems shall be designed with energy efficiency in mind. Pipe routes shall be short as possible and have the minimum amount of bends necessary to deliver the medium.

Domestic Water Pipe Sizing: Domestic water piping that is undersized often leads to pumping problems, increased energy use and nuisance noises radiated into occupied space. Pipe must be sized

as to avoid pumping problems, optimize energy use and eliminate noise generated by excess fluid velocity. The maximum allowable pressure drop through hydronic systems is 2.5ft per 100ft of pipe. The maximum allowable fluid velocity in hydronic systems is 5 gallons per second. There may be times where design constraints require pressure drops and fluid velocities greater than these values. In these instances, the consulting engineer shall consult with UD Energy and Engineering department for directions on how to proceed.

Hydraulic Analysis; It is the responsibility of the consulting engineer to perform a hydraulic analysis on all domestic water systems designed or modified. As part of this analysis the total developed system head shall be calculated. All pipe and pump sizing shall be based on the hydraulic analysis. Pump selections shall not be based on assumed or estimated values.

Shut Off Valves: In order to facilitate maintenance of piping systems, shut off valves must be designed into all branch connections. Shut off valves must also be located at all equipment connections. These valves shall be shown on both the system piping diagrams and on the orthographic drawings.

Drain Valves: Drain valves must be located at all low points and at each floor on hydronic piping risers. Drain valves shall be shown on both the system piping diagrams and indicated on the orthographic drawings.

Air Vents: Air vents must be located at all high points in the hydronic piping systems. Air vents shall be shown on both the system piping diagrams and indicated on the orthographic drawings.

Gauges and Thermometers: In order to diagnosis hydronic problems, gages and thermometers must be located on at the following areas:

A. Suction and Discharge of pumps
B. Inlet and Outlet of heat exchangers

Gauges and thermometers must be located on both the system piping diagrams and on the orthographic drawings.

VIII. Natural Gas Systems

Natural gas systems shall be designed per NFPA 54 (The National Fuel Gas Code) and the International Fuel Gas Code. The code that has stricter regulations will take precedent.

VIII. Laboratory and Process Services

End User Requirements: It is the responsibility of the consulting engineer to determine user requirements for laboratory services consumed. The consulting engineer shall base its design on accurate data acquired from the consumer of these services.

Diversity Factors: The consulting engineer and the University of Delaware Energy and Engineering Department shall jointly determine the diversity factor for each laboratory service required. The diversity factor will be a function of end user consumption demands for each project.

Compressed Air Systems: The consulting engineer shall consult with laboratory occupants to determine the quality of the compressed air required. The consulting engineer shall design in all filtration and dehumidification required into the compressed air system. . Compressed air systems shall be designed with energy efficiency in mind. Pipe routes shall be short as possible and have the

minimum amount of bends necessary to deliver the compressed air. Compressed air systems shall be free of dead legs.

Purified Water Systems: The consulting engineer shall consult with laboratory occupants to determine the level of purity required. Piping materials shall be chosen to maintain the required level of purity. Purified water systems shall be designed with energy efficiency in mind. Pipe routes shall be short as possible and have the minimum amount of bends necessary to deliver the purified water. Purified water systems shall be free of dead legs. The purified water system shall be continuous flow. System shall incorporate redundant pumps, a storage tank and UV sterilization. Resistivity shall be monitored in return line to the storage tank. A method for system sanitization shall be provided with sample points as required to test water quality.

Process Steam: Steam is supplied to the buildings at 45psig. If steam pressure requirements are greater or if steam quality requirements are stricter than the steam supplied by the district loop, **process** steam shall be provided via local steam generation. The consulting engineer shall consult with laboratory occupants to determine steam pressure, quality and consumption rates.

Safety Equipment: Domestic potable water to safety equipment (safety showers, eyewashes) shall be supplied at 60 – 100 degrees Fahrenheit.

Specialty Gas Systems: The consulting engineer shall consult with laboratory occupants to determine the quantity of the specialty gases required. Piping materials shall be chosen to be compatible with the laboratory gases conveyed. Specialty gas delivery systems shall be designed with energy efficiency in mind. Pipe routes shall be short as possible and have the minimum amount of bends necessary to deliver the laboratory gases. Specialty gas systems shall be free of dead legs.

Laboratory Vacuum Systems: Laboratory vacuum systems shall be designed based on 1scfm per inlet. For most applications local vacuum pumps will suffice. Consulting engineer shall consult project team if vacuum demand becomes large enough for a house vacuum system.

XIII. Pipe Routing

Pipe Routes: If all possible, route piping through corridors, open areas, and service areas only. Do not use laboratories, process areas, dormitory residence rooms, class rooms, lecture halls or conference rooms as pass throughs for piping. Only route piping into laboratories and process areas if it is required to service equipment or processes in the laboratory/process areas. Do not route piping through electrical rooms, elevator machine rooms, telecommunication rooms, or computer/server rooms.

XIV. Building Automation Systems (BAS)

The Tri-M Group LLC is the term contractor for building automation systems for the University of Delaware's Newark Campus. The HVAC design engineer shall contact The Tri-M Group (1-610-444-1002) at the start of the project. The Tri-M Group shall consult and assist with the development of BAS sequence of operations, point list and BAS specifications.

XV. Maintenance Considerations

A properly designed HVAC system will incorporate maintenance measures into the design. The following are the minimum requirements for system maintainability:

Floor Mounted Equipment: All floor mounted equipment shall be located on a minimum 6" high housekeeping pads:

Ceiling Mounted Equipment: Any equipment mounted above ceilings shall be located so that the bottom and accessible sides shall be clear of any obstructions.

Maintenance Clearances: A 36" minimum maintenance access area must be maintained around all pieces of equipment. Service corridors shall be designed into all mechanical spaces so that equipment can be moved through the space and out of the building. The consulting engineer is required to demonstrate that all equipment is accessible, maintainable and can be moved through the mechanical space and out of the building.

Heat Exchangers: Heat exchangers shall be arranged to provide adequate system head for condensate removal. Clearances around heat exchangers must accommodate removal and replacement of tube bundles.

Sumps: Provide 3'-0" clear access around all sumps. Sumps greater than 3'-0" deep require a built in ladder to access the bottom. Sumps shall have a removable fiberglass cover. Sumps shall be designed so that equipment located in sump can easily be removed.

Valves: Valves must be arranged so that they may be operated in a safe matter. In general valve handles shall be operated without hindrance. The maximum allowable height for any valve handle is 10'-0" from finished floor. Valves shall be located so that they may be replaced without removing any other element in the mechanical room.

Gauges and Thermometers: Gauges and thermometers shall be located so that they can be accessed without a ladder. Nothing shall be located in front of gauges or thermometers.

In Line Instrumentation: Access to inline instrumentation shall be clear of obstructions. If possible, inline instrumentation shall be located no more than 8'-0" off of finished floor.

Exterior Pipes: Avoid routing pipes exterior to buildings. If all possible find routes within the building. Consult with the University Energy Services if pipe routing exterior to the building is determined to be unavoidable. If determined unavoidable routes shall be kept to a minimum. Exterior pipes on historical buildings and on buildings facing the green is not allowed.

Exposed Pipes: Avoid routing exposed pipes in occupied spaces. Exposed pipes in historical buildings is not allowed. Consult with the University Energy and Engineering Department if exposed pipes in occupied spaces is unavoidable.

Lifting Beams: Provide lifting beams where needed to service heavy equipment such as heat exchangers, large pumps, large motors….etc. Lifting beams must be designed by a structural engineer and meet all OSHA and ASME requirements.

XVI. Engineering Surveys

The consulting engineer must not base its design only on documentation provided by the University. The consulting engineer must conduct a thorough engineering survey of the spaces and systems modified prior to the start of the design. All field conditions and modifications affecting the design shall be incorporated into the design. It is the responsibility of the consulting firm to determine what University of Delaware personnel (engineer, shop manager, field mechanic…etc.) will be required during the survey. All personnel support shall be scheduled a minimum two weeks in advance.

XVII. Standards

The consulting engineer is responsibility for incorporating all requirements detailed in the University of Delaware plumbing standards into the design.

XVIII. Room & Equipment Data Sheets

The consulting engineer shall assist architect with room and equipment data sheets. The consulting engineer shall help determine water quality, laboratory gases and waste requirements for spaces and equipment.

XVIX. Schedule of Deliverables

In order to facilitate a holistic approach to University of Delaware design projects, the University requires multiple submissions of documents. The purpose of these submissions is to provide a framework in which the consulting engineer is in regular communication with the University of Delaware project team. This communication may be via a combination of meetings and e-mail submissions with teleconferences. This will be decided by the University of Delaware project team on a project by project basis.

The following is a list of deliverables required by the University of Delaware. The deliverables are listed as to when to present them to the University of Delaware.

Programming Submission1:
Code Requirement Analysis for Plumbing Design – Engineering firm shall document in report form all code requirements that impact the design of the Plumbing systems.
Basis of Design Document

Schematic Design Submission 1:
Plumbing Riser Diagrams –

Schematic Design Submission 2:
Mechanical Space Block Diagrams (Mech Rooms/Elec Rooms & Roof) – All major equipment shown in plan as blocks that represent size and geography of the equipment. Maintenance clearances are dimensioned around the equipment. This diagram will be used to develop mechanical space layout and size.
First Pass Hydraulic Head Calculations – Mechanical Piping Systems
External Wall Penetrations Identified & Located (Provide Detail of Wall Penetrations for Review)

Design Development Submission 1:
Plumbing Equipment Schedules in Spreadsheet Format
Plumbing Equipment Data Sheets and Specifications
Details Mechanical Space Layouts (Mechanical Rooms & Roof)
Single Line Piping Plans

Design Development Submission 2:
Detailed Hydraulic Head Calculations
Pipe Material Schedule including pressure classifications for each piped system
Piping Insulation Material Schedule
Material Specifications for piping, valves, Insulation…etc.
Plumbing Detail Sheets

Design Development Submission 3
Lead Sheet including Legends
Detail Plumbing Plans. Piping sizes greater than 2" diameter shown in double line
Plumbing Elevations and Sections
Plumbing Schedule Sheets
Plumbing General & Construction Specifications
Plumbing Construction Scopes of Work

Construction Documents:
Full Set of Construction Documents – Issued for Bid (This shall include final version of all drawings, diagrams, specifications and scopes of work issued in previous submissions)
Final Version of all Calculations and Reports Issued in Previous Submissions

End of Section