Engineering Department

PORT AUTHORITY NY NJ
AIR LAND RAIL SEA

Mechanical Design Guidelines

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DOCUMENT CONTROL

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1.0 Mechanical Discipline

1.1 Overview

These guidelines are provided as an overview of the Port Authority's design standards.

The Guidelines shall not replace professional design analyses nor are the Guidelines intended to limit innovative design where equal or higher performance in value, safety, and maintenance economy can be demonstrated. The design team shall be responsible for producing designs that comply with the Guidelines in addition to all applicable codes, ordinances, statutes, rules, regulations, and laws. Any conflict between the Guidelines and an applicable code, ordinance, statute, rule, regulation, and/or law shall be addressed with the respective functional chief. The use and inclusion of the Guidelines, specifications, or example drawing details as part of the Contract Documents does not alleviate the design professional from their responsibilities or legal liability for any Contract Documents they create. It is also recognized that the Guidelines are not universally applicable to every project. There may be instances where a guideline may not be appropriate. If the design professional believes that a deviation from the Guidelines is warranted, such a deviation shall be submitted in writing for approval to the respective functional chief.

2.0 TECHNICAL AND CODES STANDARDS/REGULATIONS

Comply with all applicable codes, standards, and regulations.

3.0 DESIGN CRITERIA AND SPECIAL REQUIREMENTS

3.1 SPECIAL REQUIREMENTS AND TECHNICAL POLICIES

The Port Authority Tenant Construction Review Manual provides technical criteria to be followed by tenants at Port Authority of New York & New Jersey facilities. While the manual was written for tenants, it provides design criteria that should be used and complied with for all Port Authority contracts.

Refer to the Port Authority Tenant Construction Review Manual.

Refer to the Tenant Construction and Alteration Process (TCAP) for additional criteria for various PA facilities.

3.2 STAGING & SCHEDULING

When designing a complex project or when disrupting existing services within a building, staging is critical. Refer to the following standard notes to be incorporated into the design drawings when staging, sequencing, and scheduling is necessary:

- ❒ Coordination and Shutdown Requirements Notes
- ❒ Temporary HVAC Equipment Notes
- ❒ Cleaning Notes

3.3 HVAC DESIGN

3.3.1 LOAD CALCULATION PROCEDURE

A. If performing manual heating/cooling load calculations, refer to latest ASHRAE Fundamentals book.

B. Use Carrier’s Hourly Analysis program to find cooling and heating loads within a building (use latest version).

C. Recommended temperatures for various spaces:

2. Public Area – Not Open to Outdoors (e.g., Concourse)
   a. Heating Design Temperature: 68°F DB (minimum)
   b. Cooling Design Temperature: 80°F +/- 2°F DB, 50% RH +/- 5%
3. Office Space
   a. Heating Design Temperature 70°F DB (minimum)
   b. Cooling Design Temperature: 75°F +/- 2°F DB, 50% RH +/- 5%
4. Kitchen
   a. Heating Design Temperature 70°F DB (minimum)
   b. Cooling Design Temperature: 80°F +/- 2°F DB, 50% RH +/- 5%
5. Electrical Equipment Room

a. Heating Design Temperature: 55°F DB (minimum)

b. Cooling Design Temperature: maximum 104°F (40°C), or as recommended by equipment manufacturers

6. Elevator Mechanical Equipment Room (MER)

   a. Heating Design Temperature: 55°F DB (minimum)

   b. Cooling Design Temperature: 85°F DB (maximum), or as recommended by equipment manufacturers

7. MER or Storage Area

   a. Heating Design Temperature: 55°F DB (minimum)

   b. Ventilated and tempered air only

D. Normal ventilation levels shall meet (as a minimum):

- ❒ Applicable Building and Mechanical Code requirements.
- ❒ If areas are governed by NFPA (e.g. tunnels, covered roadways, and platforms), comply with applicable NFPA Standards for normal and emergency ventilation.
- ❒ Include Air Flow Measurement Station (AFMS) on all outdoor air systems, as feasible

3.3.2 Pipe Sizing and Distribution

3.3.2.1 Pipe Sizing

A. Hydronic systems: Size piping based on maximum pressure drop of 4 ft/100 ft, a maximum velocity of 10 fps for piping up to 14" diameter, and a maximum velocity of 12.5 fps for piping 16" diameter and larger.

B. All pipe sizes shall be designed in accordance with the latest version of ASHRAE Standard 90.1 entitled "Energy Standard for Buildings Except Low-Rise Residential Buildings" and applicable Building and Mechanical Code requirements.

3.3.2.2 General Requirements

A. PVC piping shall not be permitted within buildings.

3.3.3 Air Distribution Design

3.3.3.1 Ductwork Systems and Duct Accessories

A. Building chases, shafts, tunnels, and mechanical rooms shall not be used as supply or return air plenums. Air shall be ducted within these spaces. This criterion is not meant to prohibit the use of ceiling return air plenums.

B. Where return air ceiling plenums are used:

1. Return air plenums shall not be used where above ceiling construction has spray-on cellulose or mineral fiber fireproofing or exposed fiberglass building insulation.
2. Coordinate fire and smoke rating of all components and insulation above the ceiling to meet plenum rating. Notify other trades of this as well.

3. Collect return air at multiple central locations to avoid severe short circuiting of air from large floor areas with single point return.
4. Provide transfer ducts in walls that extend above ceiling to underside of structure to allow plenum air to transfer freely. Coordinate transfer ducts with architect so openings are shown on general construction drawings and meet space acoustical requirements. Provide smoke and fire dampers in transfer ducts where required by partition rating.

C. Duct systems shall be designed using radius elbows without turning vanes wherever possible. Branch takeoffs shall be designed with conical fittings or 45-degree entry taps.

D. Flexible duct is allowed at connections to supply diffusers and grilles, with long radius duct elbows. Maximum length of flexible duct shall be limited to 5 feet.

E. Manual balance dampers shall be shown at each major branch takeoff and at run outs to diffusers and grilles of supply, return, and exhaust ductwork. Locate balance dampers back from diffusers and grilles as far as possible to reduce damper generated noise. Avoid the use of registers in grilles wherever possible.

F. Locate duct-mounted smoke detectors (sampling tube) at least 6 to 10 duct widths from any bend or obstruction, if possible.

G. Transfer ducts shall be sized for a duct velocity of 300 to 500 fpm.

H. All duct systems shall be sealed and pressure tested in accordance with SMACNA.

I. Design and size ductwork systems using latest SMACNA and ASHRAE criteria for velocities and fitting losses. Do not oversize ductwork unnecessarily to avoid performing sound calculations. Duct layouts should be optimized to perform within acceptable criteria at the lowest reasonable installed cost.

J. Outside air intake louvers and intake hoods shall be installed so that the bottom of the intake is a minimum of 30” above the finished roof level, grade, or bottom of areaway. For buildings adjacent to public roadways, locate intake louvers above the first-floor level, on the roof, and away from the roadways to prevent intentional contamination of the air whenever possible.

K. Arrange intake louvers and associated duct connections to get even air velocities across entire louver area. Design louvers for the following maximum velocities across louvers’ free area:

- 400 fpm for intake louvers on systems with over 75% minimum outside air.
- 500 fpm for intake louvers on constant volume systems with outside air economizer.
- 500 fpm for intake louvers on variable air volume systems with outside air economizer.

3.3.3.2 Insulation

Unless required otherwise internal duct lining shall be specified in the following situations:

- Minimum ten feet immediately downstream of air terminal units.
- Transfer ducts.
- Minimum twenty feet downstream and upstream of air handling unit.

3.3.3.3 References

- ❐ ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Handbook – Fundamentals.
- ❐ SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) HVAC Duct Construction Standards.]
- ❐ SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) HVAC Systems Duct Design.
- ❐ SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) Fire, Smoke, Radiation Damper Installation Guide for HVAC Systems.

3.3.3.4 Noise Criteria

Comply with the sound noise criteria requirements of the latest state and local Building Codes and Guidelines of the latest ASHRAE Handbook – Applications.

Perform an acoustical analysis to demonstrate that the specified space/room noise levels are achieved in all octave bands for all air handling units and other mechanical equipment. The analysis shall consider both air duct borne noise and noise transmission through walls, floors and roofs and shall be completed for all duct systems and all HVAC equipment.

3.3.3.5 Filtration

Provide MERV 8 filters or higher for air handling units having cooling capacity less than 5 tons. Provide MERV 8 prefilters or higher, and MERV 13 final filters or higher for DOAS units, ERVs, and all central station air handling units having cooling capacity greater than 5 tons. Terminal units such as FCUs and fan powered VAV units shall be equipped with MERV 8 filters or higher, where feasible. Where feasible, specify specialty filtration, such as activated carbon, HEPA filtration, etc., for outside air intakes susceptible to introducing noxious fumes and hazardous particulates into occupied spaces.

3.3.3.6 Pressurization

Occupied buildings shall be positively pressurized.

3.3.3.7 Wildfires And When Local Air Quality Index (AQI) Is Greater Than 100

Override existing HVAC units' control sequences to allow only minimum outside air through the units' outside air dampers. For active outside air demand control ventilation, outside air intake may be further reduced if conditioned spaces are not fully occupied. In addition, change any filters that are fully or almost fully loaded, especially carbon filters, to allow for more effective air filtration.

3.3.4 Battery Room Ventilation

A dedicated room shall be provided when battery charging stations are required. An exhaust ventilation system shall run continuously to limit the concentration of hydrogen gas within the room to 1% by volume. To maintain the performance of the batteries, especially during the winter season, a battery room shall be maintained at a temperature range required by a battery equipment manufacturer. A hydrogen sensor shall also be provided to signal an alarm condition in case of ventilation fan failure. Makeup air from adjacent spaces is allowed. The exhaust air from this room shall be ducted to outdoors.

3.3.5 POST-FIRE SMOKE PURGE

When a post-fire smoke or clean agent purge system is required, a purge system shall utilize combination fire and smoke dampers in lieu of fire dampers in penetrations requiring fire dampers only. Such combination fire and smoke dampers shall be remotely operated via a fire command center or fire alarm control unit during purge operation.

3.3.6 EQUIPMENT SELECTION

3.3.6.1 SELECTION CONSIDERATIONS

A. General Requirements

1. HVAC system design shall **avoid the use of fossil fuels** to achieve the Authority's decarbonization goals. When designing a new or replacement HVAC system, low carbon and high energy efficiency HVAC equipment and systems shall be utilized, wherever feasible, such as heat pumps, heat and energy recovery systems (including chiller-heaters), thermal energy storage, and other systems.
2. If fossil fuel must be used as a primary heating source due to a project's budget, schedule, or site limitations, appropriate justification as to why such system is chosen needs to be submitted for review and approval.
3. Condensing Natural Gas Boiler: Category IV condensing appliances with thermal efficiency no less than 92% shall be considered if natural gas fired heating equipment is needed. Reset heating hot water loop temperature lower when outside air temperature rises to increase boiler efficiency.
4. Electric Boilers and Electric Resistance Heaters are not permitted to be used as primary space heating equipment and can only be used as backup space heating equipment.
5. KIAC (Kennedy International Airport Cogeneration) and CHRP (Central Heating and Refrigeration Plant) district heating and cooling shall be utilized at JFK and EWR Airports respectively as applicable and feasible.
6. When heat pump units are specified, provide electrical resistance supplemental heating or electrical boiler(s) when the ambient temperature drops below the units' minimum operating temperature.
7. All fan and pump motors with less than 3 HP shall be NEMA Premium Efficient Electronically Commutated Motors (ECM). All fan and pump motors with greater than 3 HP shall be NEMA Premium Efficient motors furnished with variable frequency drives.
8. Isolation dampers on outside air intake and exhaust air louvers shall have an AMCA Leakage Class of 1 or better.
9. Part-load performance of the equipment shall be considered during selection of mechanical equipment as it is one of critical factors in HVAC equipment sizing. Select equipment that can operate efficiently at a part load.
10. Demand Control Ventilation (DCV) shall be utilized, wherever feasible, to reduce cooling and heating ventilation loads during reduced occupancy periods and decrease building's energy consumption.
11. Ductwork connected to air handling equipment shall be designed to reduce external static pressure of such equipment. Follow SMACNA standards for best practices for ductwork construction.

12. Use variable air volume (VAV) terminal units as applicable and feasible to reduce building's energy consumption.
13. Use air curtains above outside entrance and exit doors at maintenance facilities and high pedestrian traffic public areas as applicable and feasible. Electric heating air curtains should be considered for doors separating conditioned spaces with outdoors.
14. Heat Recovery Chiller: If there are constant year-round building cooling loads and spaces requiring heating in winter, a heat recovery chiller shall be considered to generate both chilled water and hot water simultaneously.
15. Steam Condensate Recovery: If steam is used for space heating, steam condensate shall be collected and returned back to a central steam plant as applicable and feasible.
16. If ground source heat pumps are considered, conduct a feasibility and lifecycle cost study prior to proposing geothermal energy as a cooling and/or heating source.

B. Cooling Plant

17. Peak cooling loads must be met using equally sized chillers.
18. All units must have adequate valving to isolate an offline unit without interruption of service.
19. A Lifecycle Cost Analysis (LCCA) may be performed to determine an appropriate number of chillers and associated chiller plant equipment (pumps, cooling towers) so long as performance requirements are still met.
20. In addition to the minimum energy efficiency requirements of the latest edition of ASHRAE 90.1, air-cooled and water-cooled electric chillers must meet the minimum efficiency requirements equivalent to Federal Energy Management Program (FEMP).
21. New cooling plants shall have control optimization systems.

C. Heating Plant

1. Peak heating loads must be met using equally sized heating hot water equipment.
2. Heating hot water system's turndown ratio shall be optimized and designed to operate in a stable manner. All units must have adequate valving to isolate an offline unit without interruption of service.
3. A Lifecycle Cost Analysis (LCCA) may be performed to determine an appropriate number of boilers and associated heating plant equipment (pumps, etc.) so long as performance requirements are still met.
4. In addition to the minimum energy efficiency requirements of the latest edition of ASHRAE 90.1, heating hot water equipment must meet the minimum FEMP efficiency requirements.
5. New heating plants shall have control optimization systems.

D. Capacity

1. Has a safety factor been factored into load calculations?
2. Is there a possibility of future expansion?
3. Is equipment capable of operating at part loads?
4. Is there a need for a smaller unit to operate at part load?

E. Redundancy

1. Is there a need for equipment redundancy?
2. Is emergency power required?

F. Physical Dimensions

1. All equipment shall fit in its intended space. But for larger equipment, important questions include, "Can it be delivered to its intended location in one piece?" "Has a proper route for delivery been investigated?" and "Does the equipment fit through the path available?"
2. Does the equipment have to be broken down into pieces to fit? Any disassembly of equipment should be discussed with equipment manufacturer to determine both requirements and warranty issues. Equipment requiring disassembly should be identified on Contract Drawings and/or specifications.
3. Weight should also be considered when determining delivery route. Can the load of both the equipment and delivery truck be supported? Ramps, piers, etc., have maximum loading.
4. Is special rigging equipment needed to install? Are street/roadway closures necessary?
5. Roof-mounted intakes, fans and air handling units shall be preferably set on minimum 12" high curbs or structural supports with at least 36" clearance under the bottom of the structure whenever possible.

G. Maintenance

1. Required clearance for equipment maintenance must be shown on drawings.
2. Determine if new equipment can be maintained under the existing maintenance contract or if a new maintenance contract would be required.

3.4 CONTROLS

3.4.1 GENERAL

If possible, Building Management Systems (BMS) shall be used for controlling and monitoring mechanical equipment except for individually controlled equipment that may be delivered with their own packaged controls or field supplied devices. Materials and equipment shall be the catalogued products of the manufacturer regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

3.4.2 BUILDING MANAGEMENT SYSTEM

3.4.2.1 GENERAL REQUIREMENTS

A. Unless impractical or required otherwise, specify direct digital controls (DDC) with remote control and monitoring for all new buildings and renovation projects.

1. Comply with ASHRAE 90.1.
2. DDC system shall be equipped with touch screen displays unless required otherwise. Graphic display at a touch screen or PC workstation shall be a dynamic multi-tier color graphic display including but not limited to the following:
    - A master directory.
    - Floor and equipment location plan.

- BMS overview.
- HVAC system overview.
- Typical building ventilation (HVAC) system view for each operating mode.
- Typical device and equipment status view.
- Trending and history logs, including trending charts and alarm logs for all points.

The operator interface shall allow users to access various system schematics via touch screen.

B. The DDC system must have multiple security access levels (minimum 3 levels) and alarm capability. Alarms and customizable reports should be able to be directed to select remote PCs from the host PC. No print screen option is allowed.

C. The DDC controllers shall perform all HVAC control algorithms, control dampers, temperature settings, economizer operation, and equipment on/off schedules for HVAC plant equipment, air handlers and hydronic systems. Pneumatic controls (for the control logic) shall not be used.

D. Unless required otherwise, electric actuators shall be specified as the motive force for control valves and control dampers. Pneumatic actuators (using DDC to control pneumatic pressure) are acceptable for high temperature and other special applications including a need for a fast response where compressed air is available.

E. Design Basis – Philosophy

1. Use one panel/controller per system/unit.
2. Connect all controls devices for a system/unit on one controller. The reason is when a controlling sensor is connected to a different controller because it is closer to that controller, there may be a communication malfunction and a sensed value may not reach the related system's controller.
3. Expandability – Spare Points
   a. Specify 20% Spare Points: Specify full expansion points Input-Output (I-O) modules (without associated devices) to be installed so that the technicians would only need to connect any future devices and wiring. Stating that the controller is expandable by the "capability to add more modules" in the future is not acceptable.

F. Communication Protocols

There are numerous communications protocols. BACnet (ANSI/ASHRAE 135 - latest edition) by ASHRAE is the one being put forth as the communicator between control panels and PC-based operator workstations, but LONWorks is also used in this manner. For the most part, ethernet cables are used as to connect control panels and PC-based operator workstations. Various protocols used by vendors include BACnet, LONWorks, and RS 485. The preference is to use open-based protocols so that future control equipment can be connected without additional gateways or similar integration devices.

G. Label all devices.

H. Do not install control devices on vibrating surfaces.

I. User Interface - Central

1. Central operator workstation shall be a Windows PC with a 24" LCD display (as a minimum). Coordinate all computer equipment with the Technology Department (TEC).

2. Field interface shall be accomplished through a touchscreen dynamic graphic display on each panel or by connecting a laptop or other suitable mobile device (such as a tablet) to the controller.

J. If a project requires integration of new controls into an existing Building Management System, a sole source or sole brand letter with required detailed quotation is required.

K. Specify control diagrams and sequences of operation for all mechanical equipment/systems on the drawings and/or specifications, including input/output points matrix.

L. Specify one screen display graphic for each system.

M. HVAC control system shall be designed to allow for unoccupied period setback with re-occupancy pick-up and pull-down energy demands within a range of 55°F to 85°F for occupied spaces.

3.4.3 Stage III Required Design Deliverables

- ❒ Custom control specifications.
- ❒ Sequences of Operation: Either as part of the control specifications or on the Control Diagram drawings.
- ❒ Control Diagrams.
- ❒ Floor Plans – Locations of space sensors and control panels.
- ❒ Input-Output point matrix.

3.4.3.1 Specifications

A. Specification Coordination

1. Specify all control components, accessories, and devices necessary for proposed design.
2. VAV Boxes: VAV Box specification shall have a VAV box manufacturer include in their cost the mounting and installation/testing of a VAV controller at the factory, furnished by a control equipment manufacturer.
3. Coordination with other disciplines for control requirements, wiring and conduits.
4. Coordinate project commissioning requirements.

3.4.3.2 Sequence of Operation

Each system shall have a sequence of operation specified. If there are several units that are similar, a typical sequence of operation can be used. List the systems that each sequence applies to.

Sequence of operation shall specify the operational requirements of the system at various conditions. The description should include all equipment and control components involved for the system to work as intended. All possible scenarios that the control system might encounter, including failure conditions, shall be addressed in the sequence of operation to ensure that a complete and functional system is specified. Status or position of equipment under different modes of operation, including offline mode, should be clearly defined in the sequence of operation. (e.g., valve position, pump speed, etc.)

3.4.3.3 Flow/Control Diagram

Develop flow / control diagrams that diagrammatically show control system architecture / interconnection for each mechanical system. This can be combined with an air flow diagram if the system is not very complex. There should be control diagrams for all air handling units, HVAC hot water systems, chilled water systems, steam systems, etc. A system architecture diagram should show an overview of the control panels / controllers and the network communication. Installation details are generally relied upon control contractor to supply. The design specification shall require control devices and instruments to be installed in accordance with the manufacturer's requirements.

System flow diagrams shall be used to show communication requirements and relationships among the equipment, control panels, and field devices involved in the control system. A system flow diagram should depict all equipment, control panels, sensors, connections, etc. required for the control system to work as intended.

Control and power wiring shall be shown and specified on Electrical contract drawings.

3.4.3.4 Location Drawings

Show locations of control panels on HVAC floor plans and coordinate with the Electrical design drawings for location and power requirements. Note that there may be two or more different enclosures; one for the controller and the other for the field interface devices such as relays, current to pressure (I/P) transducers, etc. Space temperature sensor and thermostat locations shall be shown on the HVAC floor plans (comply with ADA requirements). Air and fluid flow sensors/meters shall be located to allow sufficient distances upstream and downstream of sensors/meters to comply with the manufacturer's requirements.

3.4.3.5 Input-Output Points Summary Matrix/List

Develop input-output points summary matrix. This matrix shall identify all physical input and output control points as well as virtual points (that the BMS uses for calculated values and as "flags"). The matrix shall be organized by system and by the type of point for ease of identification.

I/O point matrix shall be created to establish a number and type of analog and digital control points required for control system to meet the design intent.

3.4.4 Hardware

3.4.4.1 Field Devices – Input (Sensors)

For air, fluid and steam measurements refer to latest ASHRAE Handbook - Fundamentals, Chapter: Measurements and Instruments for a complete description of the types of instruments. Ensure that the range of the sensor reading range matches the operating range of the system.

A. Use resistance temperature detectors (RTDs) for general air handling units and hydronic systems. Use thermocouples for high-temperature applications.

B. Freezestat shall be used to shut down the system and indicate an alarm when the air temperature drops down and approaches a freezing temperature. This device shall be installed upstream of the chilled water coils and downstream of the preheat coil. Specify one lineal foot-long capillary tube for every square foot of coil. If an air handling unit has a coil bank of 6 feet wide and 6'-8" high (for a total of 40 sq.ft.) there should be two freezestats (low-temperature switches) wired in series. The capillary tube is to be installed in a horizontal serpentine manner complying with the manufacturer's installation instructions. The set point shall be generally set to 38°F. Specify the freezestat to be manually reset.

C. Pressure, Pressure Differential Transmitters: Ensure that a transmitter does not exceed the operating and expected pressure range. Include a test port so that calibration can be performed with minor interruptions.

D. Room Pressure Differential

Tubing Diameter Schedule: As a minimum, conform to the following schedule for pressure signal tubing diameter based on the length of tubing from the pressure element to the pressure difference transmitter.

Length	Tubing Nominal Diameter
50 feet and less	1/4"
50 feet to 125 feet	3/8"
125 feet to 225 feet	1/2"

E. Relative Humidity – Use an accuracy of ±2% or better for the general operating range.

F. High Limit Humidity Switch – Generally, specify downstream of a humidifier to limit the humidifier in the event the humidity is too high.

G. Flow

1. Air Flow

   a. Pitot Tube Type – Ensure that pressure differential transmitter range matches the operating conditions and is not significantly greater than the expected air velocity pressure. The transmitter accuracy should be ±0.25% of range.

   b. Vortex Type – Maintain velocity above 350 fpm.

   c. Thermal Dispersion Type – Preferred.

H. Field Devices

1. Actuator

   a. Pneumatic – Use a pressure reducing valve to reduce the compressed air pressure from 80-100 psig to 20-25 psig.

2. Automatic Control Valves/Dampers

   a. An automatic hydronic valve (either 2-way or 3-way; 2-way valves to be used when the main chilled water or hot water flow from the chilled water or hot water plant can vary [for energy savings]) is to be located downstream of the coil it serves. This allows the temperature of the fluid to be more moderate in temperature and will have less detrimental effects on the valve. If a steam valve or a high temperature hot water valve is used, ensure that the electric actuator is not directly perpendicular above the valve so that the high heat will not be detrimental to the actuator. It can be rotated up to 45° off the vertical. Steam valves shall be located upstream of coil or equipment. Valves shall be sized for shutoff pressure and operating differential pressure.

   b. Characteristics: Proportional and Linear-Hydronic systems shall be proportional and steam systems to have linear characteristics so that the heat transfer for coil will approach a linear response.

   c. Unless required otherwise, for modulating control use ball valves with configured characteristic, globe valves or butterfly valves (above the 3-inch size).

   d. Preheat hot water control valves shall fail open when a freezestat shows a freezing condition. Chilled water control valves shall fail close. Hot water reheat control valves shall fail close to prevent duct from becoming overheated. Outside air dampers shall fail close to prevent coils from freezing. Smoke dampers shall fail close to prevent smoke from being distributed unless commanded otherwise by fire command center or manual controls.

3.4.4.2 Panel Components

A. Enclosure

1. For dry indoor applications use a NEMA 12 steel enclosure. Use NEMA 3R or NEMA 4 stainless steel for outside applications or where it may get wet. NEMA 4x stainless steel is to be used where there is an anticipated hose down or acidic chemical used.

B. Explosion Proof – Coordinate with Electrical discipline for electrical classification. Rather than specifying sensors explosion-proof, intrinsically safe sensors may be used.

C. Note that any pressure differential switch (i.e., Dwyer Photohelic© gauge) shall be specified at 24V to allow for interlocking with a control panel without needing 120V power.

3.4.4.3 Communication Devices

Note that, if a system is to be part of a fire alarm system, a router should be specified as part of the system for the UL 864 UUK listing. Coordinate with Technology Department (TEC) and other design disciplines.

3.4.4.4 Stand Alone Controls - Unitary Equipment

Unit heaters, door air curtains, and packaged A/C equipment and others.

- ❒ Equipment shall be purchased with controls as part of a package or supplied with a line-voltage thermostat. Include a lockable tamper-proof cover so that unauthorized access cannot alter settings.

3.4.5 Control System Requirements

The following should be considered when specifying a control system:

- ❒ Remote control points
- ❒ Remote monitoring points
- ❒ Connection to existing Building Automation Management System (BAMS)
- ❒ Control system front-end computer
- ❒ Graphics
- ❒ Security features (password, key, different level of access for users, etc.)
- ❒ Input and output points (GPM, FPM, PSI, degree F, etc.)
- ❒ Programmable logic location (central computer or local panels)
- ❒ Commissioning requirements
- ❒ Fail-safe conditions requirements – define positions and actions required for all control devices

3.5 Smoke Management Systems

As part of the mechanical engineering design of various smoke management systems for transit stations, transit tunnels, road tunnels, and partially enclosed bridges and roadways, various modeling shall be performed to validate smoke management system capacity and configuration. Some of the types of modeling may need to be performed:

- ❒ Subway Environment Simulation (SES) Modeling.
- ❒ Computational Fluid Dynamics (CFD).

A smoke management system for transit tunnels and stations is required to be designed in compliance with the latest NFPA 130 Standard entitled "Standard for Fixed Guideway Transit and Passenger Rail Systems." NFPA 130 was adopted by Port Authority Trans-Hudson (PATH) as the governing code for the PATH system. A smoke management system for road tunnels and bridges is required to be designed in compliance with the latest NFPA 502 Standard entitled "Standard for Road Tunnels, Bridges, and Other Limited Highways." NFPA 502 was adopted by the Port Authority and local jurisdictions.

A smoke management system is required to provide a tenable environment. Tenable environment is defined as an environment that permits the self-rescue of occupants for a specific period of time. The goal of the smoke management system is to:

- Protect occupants that are not intimate with the initial fire development and permit a tenable environment needed to evacuate or relocate to a point of safety.
- Maximize the survivability of the occupants' intimate with the initial fire development by provided a clear path of egress to the point of safety.
- Ensure structural integrity of transit stations, transit tunnels, road tunnels, trainways, and other partially enclosed roadways for the time needed to evacuate.
- Provide a tenable environment for first responders to reach the fire/incident source to aide in rescue of individuals who cannot self-rescue, as well as extinguishing the fire/incident.
- Control movement/spread of smoke and fire.

When performing a performance-based design for transit and road tunnels and bridges in accordance with NFPA Standards 130 and 502, engineering analysis results, including SES and CFD modeling, shall be peer reviewed by a third party in accordance with the latest edition of Society of Fire Protection Engineers (SFPE) Handbook of Fire Protection Engineering.

3.5.1 TRANSIT TUNNELS

For transit tunnels, SES modeling shall be performed to validate the capacity and configuration of the emergency ventilation fans. Fan sizing is selected to ensure critical velocity is achieved within the tunnel. Critical velocity is defined as the minimum steady-state velocity of the ventilation airflow moving toward the fire within a tunnel or passageway that is required to prevent backlayering at the fire site. The typical design for the PATH smoke management system consists of a pull/pull concept in which smoke is extracted via NFPA 130 emergency smoke management fans from one end and fresh air supplied via NFPA 130 emergency smoke management fans from the opposite end. Train occupants will egress into the tunnel in the direction of the fresh air supplied by the supply fans and away from the fire. By maintaining critical velocity within the tunnel the smoke layer is maintained at an elevation providing train passengers a tenable environment in the path of egress. Temperature, visibility, and CO criteria for the tenable environment must comply with the requirements of the latest NFPA 130 standard. Non-emergency ventilation shall comply with the requirements of the latest ASHRAE Standard 217 "Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities."

3.5.2 TRANSIT STATIONS

For transit stations, CFD modeling shall be performed to validate the capacity and configuration of the emergency ventilation fans. Fan sizing is selected to ensure a tenable environment is maintained up to an elevation above the platform level as defined in NFPA 130 to permit the unloading of a train assuming crush loading (crush loading = maximum number of passengers in a train) and egress of train passengers from the platform level within four (4) minutes and to a point of safety within six (6) minutes. The point of safety is defined by NFPA 130 as an enclosed fire exit that leads to a public way or safe location outside the station, trainway, or vehicle, or to an at-grade point beyond the vehicle, any enclosing station, trainway, or vehicle or another area that affords adequate protection for passengers.

Temperature, visibility, and CO criteria for the tenable environment must comply with the requirements of the latest NFPA 130 standard. Non-emergency ventilation shall comply with the requirements of the latest ASHRAE Standard 217 ”Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities.”

3.5.3 ROAD TUNNELS AND BRIDGES

For road tunnels and partially enclosed bridges and roadways, CFD modeling shall be performed to determine whether mechanical ventilation is required and validate the capacity and configuration of the emergency ventilation fans. Fan sizing is selected to ensure critical velocity is achieved within the tunnel. Critical velocity is defined as the minimum steady-state velocity of the ventilation airflow moving toward the fire, within a tunnel or passageway, that is required to prevent backlayering at the fire site. Different types of ventilation systems can be utilized in road tunnels including, but not limited to, the following: natural ventilation (which can be induced by air temperature and meteorological conditions and/or by traffic); mechanical ventilation, which can be longitudinal, massive point or point-flow extraction, fully transverse, semi-transverse (and reversible semi-transverse), partial (pseudo) transverse, or combinations of these systems. The existing ventilation systems in the vintage Lincoln and Holland Tunnels are fully transverse, where both a supply and an exhaust air duct uniformly distribute air to and remove air from the tunnel. Air is supplied at low level near the roadway and extracted along the tunnel ceiling. The exhaust and supply fans are installed in the ventilation buildings. During a fire or smoke incident, passengers will egress into the tunnel in the direction of the fresh air supplied by the supply fans and away from the fire. By maintaining critical velocity within a tunnel, the smoke layer is maintained at an elevation providing passengers a tenable environment in the path of egress. For new tunnels, temperature, visibility, and CO criteria for the tenable environment must comply with the requirements of the latest NFPA 502 Standard for` emergency ventilation. For existing tunnels, CFD modeling shall be performed to determine any impact to the existing infrastructure and whether the grandfather status can be maintained. Non-emergency ventilation shall comply with the requirements of the latest ASHRAE Standard 217 ”Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities.”

3.5.4 PARTIALLY ENCLOSED ROADWAY/OPEN GARAGE VENTILATION REQUIREMENTS

Signage, media elements or screening on an exterior opening or façade creates an obstruction to outside air ventilation on a partially enclosed roadway or open garage. An impact of such obstruction on existing or new roadways or garages shall be analyzed using CFD modeling and in accordance with applicable Building, Mechanical and Fire codes and NFPA standards. A comprehensive CFD modeling analysis shall be submitted for review and approval. For the Port Authority Bus Terminal (PABT), comply with the latest Port Authority Bus Terminal Tenant Design Guidelines.

3.6 AVIATION FUELING

3.6.1 AIRPORTS AIRCRAFT FUELING SERVICE

A. Work affecting the existing airport fuel distribution system shall be coordinated with the existing airport fueling system for compatibility, surge pressure safety, and system configuration. Depending on the nature of the modifications, surge pressure calculations may be required.

B. All automatic control valves shall be performance tested in compliance with the airport fuel system operating requirements.

C. Valving at fuel storage tank connections and at truck loading racks, beneath surge suppressors or hydrant valves shall be specified with supplemental fire-rated safety stop valves. These safety stop valves shall be closed by fusible link action upon exposure to fire and shall conform to UL or API Fire-Tested Valve Safety Standards.

D. 100 percent of all belowground and aboveground welds shall be radiographically tested.

E. For protection of building walls around pressure surge suppressors coordinate with Architectural design discipline.

F. For protection of ramp drainage inlets coordinate with the Civil Design Guidelines.

3.6.2 PROTECTION FROM AN AIRPORT RAMPSIDE FUEL SPILL FIRE

Coordinate with Civil design discipline.

3.7 PETROLEUM FUEL STORAGE TANKS & ANCILLARY COMPONENTS/SYSTEMS

3.7.1 GENERAL

Products stored in such storage tanks range from aviation fuel (for air transportation of people and goods) to motor fuels (for ground vehicles, transportation support, and to help maintain operation) to heating fuel (for heating buildings and its occupancy) and product separation (for cleaning facilities).

3.7.2 ABOVEGROUND STORAGE TANKS

A. Field-erected bulk storage facilities – fuel farms design considerations:

1. Tank shell design.
2. Tank level indication.
3. Tank bottom sump design.
4. Tank access stairway, railing, etc.
5. Tanks (such as those found at airport fuel farms) require a lined containment dike to prevent fuel from seeping through the containment walls.
6. Comply with federal, state, and local codes and regulations.

B. Pre-fabricated storage tanks

Comply with the following standards and applicable federal, state, and local codes and regulations:

e. UL-142 – Steel Aboveground Tanks for Flammable and Combustible Liquids.

f. UL-2085 – Protected Aboveground Tanks for Flammable and Combustible Liquids.

3.7.3 UNDERGROUND STORAGE TANKS

A. These tanks must be double-wall construction and are typically horizontal with penetrations and fittings along the longitudinal centerline at the top of the tank. Depending on the size of the tank, penetrations and fittings should include sumps for access into the tank and to piping (supply/return and vent lines), fill tube with overfill protection, and interstitial/annular space leak detection connection.

B. Comply with the following standards and applicable federal, state, and local codes and regulations:

a. UL-58 – Standard for Safety for Steel Underground Tanks for Flammable and Combustible Liquids.

b. UL-1746 – External Corrosion Protection Systems for Steel Underground Storage Tanks.

c. UL-1316 – Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures.

d. STI-P3 standard includes a tri-level corrosion protection system:

1.) Protective coating: A polyurethane heavy-duty dielectric coating that provides the first line of defense against stray current and galvanic corrosion.

2.) Dielectric isolation of the separator from its piping, which prevents the entry of stray currents through plumbing connections.

3.) Cathodic protection: Sacrificial galvanic anodes that provide a protective current flow to any scratches that may have occurred during shipping and handling.

e. ACT-100/U

1.) ACT-100 tank is a UL58 steel tank with 100 mils of FRP coating.

2.) ACT-100-U tank is a UL58 steel tank with 70 mils of a urethane coating.

C. Specify vapor recovery – for gasoline application.

D. Specify overfill protection equipment.

E. Design anchoring requirements – buoyancy calculations and details.

3.7.4 Piping Systems

A. All underground piping shall be designed as double wall where required by federal, state, and local codes and/or regulations. Specify a leak detection system to detect leaks.

B. Piping should be designed to maintain pitch (typically 1/8” per foot) back to the tank. However, it must also be designed to accommodate ground settling.

C. To avoid damage to piping system, pipe routing should be traced with a detectable warning tape.

D. Fuel systems and piping shall not be permitted below bridges and elevated roadways.

3.7.5 Level Monitoring and Leak Detection (Tank & Piping System)

A. Specify petroleum product level monitoring.

B. Specify water detection.

3.7.6 Corrosion Protection

Underground storage tanks must be constructed to resist corrosion. They can be cathodically protected or plastic coated in accordance with the STI-P3 standard.

3.7.7 Filling Stations

Filling station components shall include, as a minimum:

- ❒ Dispensers
- ❒ Fueling hose, breakaway coupling, vents, filters
- ❒ Fire suppression system
- ❒ Emergency stop station

- ❒ Rupture tank
- ❒ Oil water separator
- ❒ Storm water/spill drainage collection system
- ❒ Bollards and pipe guards

3.7.8 TESTING

A. UST:

1. Prior to placing steel tank into excavation, pressure test both piping and secondary tanks at 5 psig for 1 hour. Soap entire tank for pressure test, including fittings. Comply with tank manufacturer's pressure test procedures and precautions for both primary and secondary tanks and monitor for pressure drop and bubbles.
2. Prior to backfilling, perform pressure tests, in the presence of the Engineer, in accordance with tank manufacturer's instructions and other applicable codes. The primary tank shall be hydrostatically tested at 30 psi for 1 hour. The interstice shall be air pressure tested at 10 psi for 1 hour while the primary tank is under pressure. Any leaks or defects detected during testing shall be repaired and the primary tank and interstice shall then be retested. After the hydrostatic test, the interstice shall be evacuated to 20 Hg (min.) vacuum. A vacuum gauge shall be mounted on the 2" interstice monitor pipe to verify that pressure is maintained during shipment and handling.

B. Double Wall Piping:

1. Hydrostatically test a primary piping system to 150% working pressure for two hours in the presence of the Engineer. All piping found leaking shall be repaired or replaced, and the test shall be restarted. After test successfully passes, perform testing on secondary containment piping at 5 psig for 1 hour in the presence of the Engineer.
2. Make repairs as required if pressure loss occurs for either piping system. Perform tests on piping in strict accordance with manufacturer's and National Fire Protection Association (NFPA) requirements.
3. Complete items A through E of Fueling Checklist FPTPI-P8/89 and obtain the Engineer's approval where required. Fueling Checklist FPTPI-P8/89 will be made available post award of contract.

C. Level Monitoring and Leak Alarm Test:

1. Specify a functional test of tank level gauging, leak detection, and alarm system.

3.7.9 GOVERNING STANDARDS

1. American Petroleum Institute (API)
2. American Society of Mechanical Engineers (ASME)
3. American Society for Testing and Materials (ASTM)
4. American Water Works Association (AWWA)
5. International Code Council (ICC)
6. NACE International (Corrosion Engineers)
7. National Fire Protection Association (NFPA)
8. Petroleum Equipment Institute (PEI)

9. Steel Tank Institute (STI)
10. Underwriters Laboratories (UL)
11. American Association of State Highway Transportation Officials (AAHSTO)
12. New Jersey State Department of Environmental Protection (NJSDEP)
13. New Jersey State Department of Transportation (NJDOT)
14. New York State Department of Environmental Conservation (NYSDEC)
15. New York City Department of Transportation (NYCDOT)
16. U.S. Environmental Protection Agency (US EPA)
17. Federal Aviation Administration (FAA)

3.8 Vertical Transportation

3.8.1 Introduction

This section provides general guidelines for the design of vertical transportation (VT) equipment, including traction elevators, hydraulic elevators, escalators, and moving walkways. The purpose of VT equipment is the safe and reliable movement of passengers and goods throughout the facility. Therefore, special design considerations must be undertaken as detailed in the following sections.

Three applications are typically used in PANYNJ facilities:

A. APTA/Transit-Grade – Designed for 24/7 highest-traffic usage in transit applications
   - Longest service life and duty cycle requirements of all escalator models
   - Meets or exceeds APTA guidelines

B. Heavy-Duty – Designed for high-use or high-rise applications
   - Longer service life and higher quality components than commercial model
   - Partially adheres to APTA guidelines

C. Commercial – Designed for low-usage situations, such as retail centers or small airports
   - Does not adhere to APTA guideline.

The PANYNJ operates numerous heavy-use public transportation facilities including airports, bus terminals, and rail stations. All transit elevators, escalators, and moving walks located within these facilities shall be designed based on the latest design guidelines published by the American Public Transit Association (APTA) unless required otherwise.

Where underlying building conditions do not permit APTA/Transit-Grade VT equipment to be installed and/or expected usage does not warrant such equipment ratings, Heavy-Duty VT equipment may be utilized with PANYNJ approval. Commercial-duty VT equipment is not permitted in PANYNJ public transportation facilities.

For PANYNJ facilities that do not serve the public, such as marine facilities or office buildings, Heavy-Duty VT equipment shall be specified. Where underlying building conditions do not permit Heavy-Duty VT equipment to be installed or expected usage is minimal, commercial grade VT equipment may be utilized with PANYNJ approval.

3.8.2 GENERAL REQUIREMENTS

Unless there are spatial constraints or project-specific requirements, comply with the following requirements for public transportation facilities:

A. General

a. All elevators, escalators and moving walkways shall comply with the latest American with Disabilities (ADA) Act.

b. Specify means for remote monitoring of elevators, escalators and moving walkways. All elevators, escalators and moving walkways shall include performance monitoring equipment and related appurtenances required to integrate equipment into the Port Authority's vertical transportation equipment monitoring system. Monitoring equipment and infrastructure shall be as manufactured by Knaq, Inc. c/o Brian Carey; 71 Broadway, Lobby 2B #320; New York, NY 10006; brian@knaq.io (302) 542-8687, no substitutions permitted.

B. Escalators

a. Escalators shall have controller rooms located outside of the trusses.

b. Escalators and moving walkways shall be provided with skirt and pallet lighting.

c. When replacing existing escalator(s), a control room, steps, and pit shall have lighting levels as required by applicable ASME 17.1 standard and building codes.

C. Elevators

a. All passenger elevators shall be capable to carry wheelchairs and be sized for stretchers.

b. Elevator machine rooms and hoistways shall include provisions for emergency power operation, sump pumps and pits, and oil/water separators according to the latest environmental regulations.

c. Passenger cabs shall be clear glass with stainless steel framing in compliance with applicable fire rating requirements.

d. Elevator hoistways exposed to solar loads shall be provided with car-top air conditioning units. Glass hoistways exposed to solar loads shall be mechanically ventilated.

e. Elevator machine rooms shall be air conditioned.

f. When replacing existing elevator(s), a machine room, sills, and pit shall have lighting levels as required by applicable ASME 17.1 standard and building codes.

g. Glass on hoistway doors must be flush with a door frame on a landing side. Glass on cab doors must be flush with a door frame on a cab side.

h. Heat trace hydraulic fluid piping when said piping is exposed to temperatures below 32ºF.

3.8.3 APPLICABLE AMERICAN PUBLIC TRANSPORTATION ASSOCIATION (APTA) GUIDELINES

- ❒ Heavy Duty Elevator Design Guidelines
- ❒ Heavy Duty Escalator Design Guidelines
- ❒ Heavy Duty Machine Room-less Elevator Design Guidelines

- ❒ Heavy Duty Moving Walkways
- ❒ Heavy Duty Traction Elevator

3.9 PLUMBING DESIGN

3.9.1 PLUMBING GENERAL

3.9.1.1 POTABLE WATER CABINETS

A. Potable water cabinets shall be provided at each aircraft position.

B. The water supply to each potable-water cabinet shall be provided with an RPZ type backflow prevention device (BFP).

C. Cabinets shall be provided with lights, heaters and hose rewind motor.

D. Length of a hose shall suit specific application.

3.9.1.2 PLUMBING GENERAL

A. PVC piping shall not be used above ground within buildings.

B. All building expansion joints shall be provided with stainless steel drain pan and piped indirectly to a drainage receptacle.

C. Underground copper piping is to be Type K only.

D. No piping shall be ran below building foundation.

E. Exterior piping insulation shall be 3" thick minimum.

F. Minimum cold water (CW) connection shall be ¾ inch.

G. Mechanical Press fittings are not allowed to be used in PA facilities.

H. Overflow drains shall be connected to vertical stacks only.

I. All restrooms shall be provided with floor drains along with trap primers.

J. Clamps for no-hub piping shall be manufactured by Clamp-all Corp, Husky SD series 4000 or approved equal.

K. All hubless pipes shall be anchored at each side of a hub and at 5-foot intervals.

L. In case of building demolition, unused piping shall not be abandoned in place. Piping shall be removed back to source or point of discharge, and the resulting openings plugged and sealed. Such work shall be shown on the Contract Drawings.

M. All grease producing plumbing fixtures shall be discharged into a grease interceptor prior to discharging into the sanitary system.

N. Oil separator effluents shall be discharged into the sanitary sewer system.

O. Toilet rooms with two or more plumbing fixtures shall be provided with floor drains.

P. Reinforced Fiber Glass Pipe (FRP) may be used for elevated roadway exterior drainage.

Q. Sump pits shall be vented independently to the vent header.

R. Socket welding shall not be permitted.

S. Retro-fit roof drains shall not be permitted.

T. The use of air admittance valves is prohibited.

U. Water Efficient Design

1. Objectives

a. The purpose of this section is to encourage integrated design of high-performance buildings by reducing water consumption, to efficiently utilize an alternate source of potable water, and to provide comprehensive documentation of anticipated reduction in overall city water consumption by Authority's facilities.

2. Requirements

a. On all new, expansion, and renovation projects, building water consumption shall be reduced as follows:

1) Use low-flow United States Environmental Protection Agency (U.S. EPA) Water Sense labeled plumbing fixtures to reduce an overall water consumption by a minimum of 30% where feasible.

2) Electric hot water heating shall be used for generation of domestic hot water as applicable and feasible. Domestic hot water heating can be provided by electric tank water heaters; electric instantaneous water heaters; heat pump water heaters; solar hot water heaters; geothermal hot water heaters, etc. The electrical infrastructure shall be evaluated to determine which type of electric hot water heaters it can support. Tankless domestic hot water heaters shall be used over storage hot water heaters as applicable and feasible.

3.9.2 FIRE PROTECTION GENERAL

A. NFPA 75 and 76 shall be used when designing telecommunication rooms.

B. High and low pressure switches shall be required for dry and pre-action sprinkler systems.

C. A combination of gaseous fire suppression system and pre-action system is an acceptable fire protection approach for telecommunication rooms.

3.9.2.1 SPRINKLER HYDRAULIC CALCULATIONS

Sprinkler systems shall be hydraulically designed. Perform hydraulic calculations for a proposed sprinkler system design.

Submit the following information, as a minimum, along with hydraulic calculations:

A. Water-supply information

1. Static pressure, psi (kPa).
2. Residual pressure, psi (kPa).
3. Flow rate, gpm (L/s).
4. Location and elevation of test.
5. Total supply water flow available.

B. Hazard classification

1. Density and area requirements.
2. Duration of flow requirements.

3. Hose stream allowance.
4. Pressure allowance.

C. Piping material (friction loss)

1. Schedule 40 pipe.

D. Sprinkler heads

1. Obtain sprinkler head “K” factor from technical data sheets.
2. Temperature rating.
3. Special coating requirements.

3.9.2.2 Clean Agent - Special Extinguishing Systems

A. Gaseous Fire-Suppression System

Both Halon 1211 and Halon 1301 were phased out of production in 1994, except for essential uses. The current replacement fire-suppression gases for Halon 1301 are inert gases, such as Novec 1230 systems, and other clean extinguishing agents. All clean agent systems shall be provided with a mechanical purge system, including combination fire/smoke dampers.

3.9.2.3 Pipe Sizing and Distribution

1. Schedule 40 steel piping, as a minimum, shall be used for all sprinkler systems applications.
2. Flex Head sprinkler connections are not allowed to be used in PA facilities, unless approved by PA.
3. Schedule 10, 20 and 30 steel piping is not permitted.

3.9.2.4 Pumps

A. Fire Pumps:

Fire pumps must meet the following requirements:

1. Each pump must be capable of withstanding a hydrostatic pressure of twice the maximum pressure.
2. Pumps must furnish not less than 150% of the rated head at 65% of rated pressure (shut-off not to exceed 120% of the rated pressure).
3. The maximum pump brake horsepower must not exceed the rating of the particular driver.

3.9.2.5 Fire Protection General

Where an automatic sprinkler system is required by code in a building or space, sprinklers must also be provided in the following areas:

A. Electrical equipment rooms, rooms containing electrical equipment, or electrical closets so that sprinkler protection is provided throughout the building.

B. Concealed conveyor spaces inaccessible to firefighting equipment shall be provided with a sprinkler system above the conveyor assembly. Spaces over all types of ceilings are considered inaccessible.

C. In special applications, a hybrid combination clean agent/pre-action systems can be considered for protecting special hazards ex. data center and computer/radio rooms.

D. In dry and pre-actions systems, high/low air pressure trouble alarms shall be provided and indicated on the control panel, send a distinct signal to the base building fire alarm system. Provide sectionalizing valves on sprinkler and fire standpipe system mains.

E. In a dry system, auxiliary (drum drip) drains shall be provided with a drain cabinet similar to Model 5400 by AGF Manufacturing, Inc., as a minimum, or approved equal. A drain cabinet shall be equipped with an electric monitoring system connected to a building wide fire alarm system.

3.10 SUSTAINABILITY AND ENERGY EFFICIENT DESIGN

A. Comply with requirements of Port Authority's Climate Resilience and Sustainable Design Guidelines.

B. Comply with requirements of New York City Energy Conservation Code – latest edition.

C. Comply with requirements of New York State Energy Conservation Code – latest edition.

D. Comply with requirements of New Jersey Energy Code – latest edition.

E. Comply with requirements of ASHRAE Standard 90.1 - latest edition.

F. Comply with requirements of ASHRAE Standard 202 - latest edition.

G. Sustainability Requirements

1. Sustainable design shall follow an integrated, synergistic approach, in which all phases of the facility lifecycle are considered. Following sustainable design principles improves building performance, promotes health and comfort of building occupants, minimizes environmental impacts, and supports natural resource conservation. The result must be an optimal synergy of cost, environmental, societal, and human benefits while meeting a mission and function of the intended facility or infrastructure. The essential principles of sustainable design and development are:

    a. Employ integrated design principles.

    b. Optimize energy performance.

    c. Protect and conserve water and other natural resources.

    d. Enhance indoor environment.

    e. Reduce the environmental impact of materials.

H. Decarbonization Requirements

1. The Port Authority of New York and New Jersey has established CO2 emissions reduction targets with the goal of achieving Net-Zero Carbon emissions by the year 2050. These targets align with both federal goals and New Yok and New Jersey legislation towards reducing carbon emissions by 2050.

   The carbon reduction targets require projects to be designed so that fossil fuel generated energy use is reduced by the following percentages from their 2006 greenhouse gas (GHG) baseline on a source energy basis for prospectus-level new construction and major repairs and alterations:

    a. By 2025: 35% reduction.

    b. By 2030: 50% reduction.

c. By 2050: 100% reduction.

2. Design mechanical systems to reduce/eliminate the use of fossil fuel and reduce overall energy consumption. Where not constrained by existing site conditions and available infrastructure, construction budget, schedule, or other constraints, implement the following:

    a. Replace natural gas or fuel oil space heating equipment with electric (e.g. heat pump) or alternative source (geothermal, solar, etc.) space heating equipment.

    b. Replace traditional air conditioning equipment with energy efficient air-source or water-source heat pump units.

    c. Include mechanical systems commissioning on projects over 20,000 SF or with advanced control systems.

    d. Consider all energy conserving measures (ECMs) such as standby mode, regenerative drives, etc. for vertical transportation equipment.

3.11 Project Life Cycle Cost Analysis

For projects with a total project cost greater than $2.5 million, perform a Life-Cycle Cost Analysis (LCCA) for all design options in accordance with the Port Authority's Life Cycle Cost Analysis Guidelines. Life cycle analyses shall also consider relative carbon footprint impacts of each design option.

3.12 Seismic Restraints for Duct and Pipe – FEMA Guide

Comply with requirements of FEMA's "Installing Seismic Restraints For Duct And Pipe" guidelines.

3.13 Climate Change Resiliency

Climate change forecasts show that the region will more frequently experience severe storms, flooding, and heat waves. Climate change poses significant risks to infrastructure. Various studies on resilience help the understanding of the potential impacts of climate change on infrastructure. For all climate projections, refer to Design Guidelines - Climate Resilience chapter. These impacts include:

- ❒ Sea Level Rise
- ❒ Severe Storms (Increased Intensity and Frequency)
- ❒ Increase in Average Temperature
- ❒ Extreme Heat (Days over 90 degrees Fahrenheit)
- ❒ Increase in Average Precipitation
- ❒ Increase in Rainfall Intensity
- ❒ Increase in Ice Storms
- ❒ Higher Winds
- ❒ Increase in Seismicity

Considering these impacts, the following are criteria to be considered to increase the respective mechanical system category's resiliency to the effects of climate change:

A. HVAC

1. Raise mechanical equipment above a flood level, if warranted, and elevate control equipment above a flood level (see Design Guidelines - Climate Resilience chapter for flood protection levels).
2. Use the latest ASHRAE Handbook of Fundamentals for climatic design data and provide N+1 system redundancy for critical facilities.
3. Supports for mechanical equipment are to be consistent with structural design criteria established for wind loads and seismic design.

B. Aviation Fueling

1. Raise mechanical equipment above a flood level, if warranted, and elevate control equipment above a flood level (see Design Guidelines - Climate Resilience chapter for flood protection levels).
2. Supports for mechanical equipment are to be consistent with structural design criteria established for wind loads and seismic design.

C. Fuel Storage

1. Raise mechanical equipment above a flood level, if warranted, and elevate control equipment above a flood level (see Design Guidelines - Climate Resilience chapter for flood protection levels).
2. Supports for mechanical equipment are to be consistent with structural design criteria established for seismic design.

D. Vertical Transportation

1. Raise mechanical equipment above a flood level, if warranted, and elevate control equipment above a flood level (see Design Guidelines - Climate Resilience chapter for flood protection levels).
2. Supports for mechanical equipment are to be consistent with structural design criteria established or seismic design.

E. Plumbing

1. Specify a submersible type pumping system, if warranted, and provide N+1 system redundancy for critical facilities.
2. Evaluate potential pressure drop of domestic water supply and develop adaptation strategies for the plumbing system design.
3. Adjust the drain sizes and/or the design rainfall rate for the plumbing system design (see Design Guidelines - Climate Resilience chapter for flood protection levels).

F. Fire Protection

1. Raise mechanical equipment above a flood level, if warranted, and elevate control equipment above a flood level (see Design Guidelines - Climate Resilience chapter for flood protection levels).
2. Evaluate potential pressure drop of fire water supply and develop adaptation strategies for the fire protection system design.
3. Supports for fire protection system are to be consistent with structural design criteria established for seismic design.

The criteria shall not replace professional design analyses nor are the criteria intended to limit innovative design where equal or higher performance in value, safety, and maintenance economy can be demonstrated. The design team shall be responsible for producing designs that comply with the criteria in addition to all applicable codes, ordinances, statutes, rules, regulations, and laws. Any conflict between the criteria and an applicable code, ordinance, statute, rule, regulation, and/or law shall be addressed with the respective functional chief. It is also recognized that the criteria are not universally applicable to every project. There may be instances where criteria may not be appropriate. If the design professional believes that a deviation from the criteria is warranted, such a deviation shall be submitted in writing for approval to the respective functional chief.

For future details regarding resiliency design guidelines, refer to Chapter entitled "Design Guidelines - Climate Resilience."

4.0 Standard Abbreviations, Symbols, Notes, Schedules & Specifications

4.1 Abbreviations and Symbols

Refer to CAD Standards.

4.2 Standard Notes

File Name	General Note Description
GN01	Cleaning Notes
GN02	Crane Notes (Aviation Only)
GN03	Ductwork Cleaning Notes
GN04	Ductwork Notes
GN05	Fire Protection Notes
GN06	Fire Protection Notes – Optional
GN07	General Notes
GN08	General Notes – Optional
GN09	Materials Furnished by the Authority
GN10	Mechanical Notes
GN11	Mechanical Notes – Optional
GN12	Net Cost Notes
GN13	Piping Notes
GN14	Plumbing Notes
GN15	Refrigerant Handling Notes
GN16	Removal Notes
GN17	Rigging Notes
GN18	Coordination and Shutdown Requirements Notes
GN19	Temporary Equipment Notes (Chilled Water System)
GN20	Temporary HVAC Equipment Notes
GN21	Welding Notes

4.3 Equipment Schedules

4.3.1 Plumbing Schedules

Detail No.	Description
SCHEDP01	Plumbing Fixture Schedule
SCHEDP02	Gas Fired Water Heater Schedule
SCHEDP03	Electric Water Heater Schedule
SCHEDP04	Plumbing Equipment Schedule

Detail No.	Description
SCHEDP05	Water Hammer Arrestors Schedule
SCHEDP06	Pump Schedule
SCHEDP07	Drainage Fixture Unit Schedule
SCHEDP08	Piping Materials/Insulation Schedule
SCHEDP09	Water Fixture Unit Summary
SCHEDP10	Grease Recovery Unit Schedule

4.4 SPECIFICATIONS

4.4.1 STANDARD SPECIFICATIONS

Standard specifications will be made available post award of contract.

5.0 References

1. [Online] https://panynj.sharepoint.com/sites/EOL365/SitePages/Design-Standard(1).aspx
2. [Online] https://panynj.sharepoint.com/sites/Engineering/Projects/EngineeringManual/_layouts/15/DocIdRedir.aspx?ID=ENGDEPT-1702089146-397
3. [Online] https://www.panynj.gov/content/dam/port-authority/business-opportunities/tcap/tcap-manual.pdf
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6. [Online] https://www.asme.org
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