**6. ENGINEERING SYSTEMS REQUIREMENTS**

**D30 HVAC**

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SYSTEMS REQUIREMENTS
HVAC TEMPLATE 09/22

Instructions for using this template: There are template files for each UNIFORMAT Level 2 Group Elements. This template is for Group Element D30-HVAC. Text such as this is hidden text that will not print when the hidden text box in "Print/Options" is un-checked.

The Mechanical Team Member is the person responsible for editing and developing the Mechanical content of this RFP.

The Mechanical Team Member must edit this template for the requirements of the project. The SYSTEMS REQUIREMENTS are intended to define items that are required throughout the facility or on a system wide basis that is common to several rooms. Room-specific requirements are defined in the ROOM REQUIREMENTS section. Coordinate with the lead programmer for ROOM REQUIREMENTS. Editing is required where brackets [ ] appear. Delete all building elements that are not required for the project. If additional elements or sub-elements are required for the project that do not appear in the template, refer to the NIST UNIFORMAT II publication for additional building element numbers and descriptions. The Uniformat II Work Breakdown Structure can be found at** [**www.wbdg.org/ndbm/**](http://www.wbdg.org/ndbm/) **. Coordinate with the PERFORMANCE SPECIFICATION SECTION D30 to ensure that performance requirements are provided for all of the Building Elements listed here and that paragraph numbering matches.

The Mechanical Team Member must coordinate with the Government PM/DM in editing the Design Build RFP Technical Evaluation Factor: Energy Design Reduction of the STANDARD NON-COST/PRICE EVALUATION FACTORS to align with the requirements of the HVAC portion of this RFP Section.
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NOTE: Consider each HVAC component relative to Part 2 UFGS Section 01 33 29, *Sustainability Requirements and Reporting*and UFC 1-200-02, *High Performance and Sustainable Building Requirements*.
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Refer to Part 4 Section D30 for performance requirements of the building elements included in the HVAC system.

**SYSTEM DESCRIPTION**
**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Edit the following for the specific project requirements. Remember to let the design build A/E design the project. Keep the requirements general wherever possible while assuring the RFP is biddable. Check against the real property requirements such as in the DD1391 to capture systems. If there are any discrepancies between the requirements document and this RFP then inform the government PM/DM. Do not repeat technical or performance requirements in the RFP. Check PTS Section D30 for similar requirements and mitigate if found.

 UFC 1-200-02 HIGH PERFORMANCE AND SUSTAINABLE BUILDING REQUIREMENTS paragraph 2-3 OPTIMIZE ENERGY PERFORMANCE selection process for HVAC type(s) must be performed, by the Mechanical Team Member, and approved before RFP release. This includes the evaluation of alternate HVAC systems for a best value determination. Specify the system(s), as determined by best value, in this RFP to be provided by the design build contractor. Include a Government Baseline Building Energy Report in Part 6 of this RFP. It must contain ASHRAE 90.1 baseline model inputs and model outputs. This includes but is not limited to schedules for occupancy, envelope, mechanical, and electrical building systems. An informative guide is included in this DB RFP template under Part six to assist in developing the report. Coordinate with PTS D30 and the Design Build RFP Technical Evaluation Factor: Energy Design Reduction of the STANDARD NON-COST/PRICE EVALUATION FACTORS

Select mechanical system based on base/activity requirements and ensure system is life cycle cost effective relative to other systems studied. RFP editor must partner with the Facilities Engineering Command (FEC) and the Public Works Department (PWD) on life cycle suitability of mechanical systems, along with system Operational, Maintenance, and Support Information (OMSI) requirements. Consider mechanical systems common to the Public Works Department in an effort to reduce associated maintenance costs. Select mechanical systems in accordance with UFC 1-200-02, *High Performance and Sustainable Building Requirements* and UFC 3-401-01, *Mechanical Engineering*and related UFCs. Consider HVAC strategies for the purpose of maximum energy savings (e.g. VFD's. VAV's, Supply Air Temperature Reset, Demand Controlled Ventilation).

This Model RFP has a general requirements paragraph to capture complete and compliant systems, and examples for three system types that supplement the general paragraph for specific instances that are required to support the HVAC LCCA best value selections and the Public Works Department. Modify and or replace these examples for the specific requirements of your project. Modify and/or add technical requirements to Parts 3 and 4 as appropriate. Do not repeat UFC and/or UFGS technical requirements but do provide product and function selections as needed. Delete systems and components in the ESR text that are not used.
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NOTE: Explicitly require DOAS(s) when required by UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*. Do not explicitly exclude DOAS(s) in any case.
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Provide complete and usable heating, ventilating and air conditioning (HVAC) systems that attains the following objectives: Occupant comfort, Indoor air quality, Acceptable noise levels, Energy efficiency, Reliable operation, and Ease of maintenance. Design and install in accordance with UFC 3-401-01, *Mechanical Engineering* and related UFCs. These UFCs incorporate provisions of the International Code Council's International Mechanical Code (IMC) and ASHRAE design guidance with supplemental requirements. Provide BACnet Direct Digital Control for all HVAC system controls. [Refer to Building Requirements, Space Tabulations Section of the Project Program for building occupancy levels.]

[Provide HVAC system for [Building X] with 2-pipe fan coil indoor units, air-cooled chillers, [central steam] [propane] [natural gas] [oil] fired boilers, and dedicated outdoor air system (DOAS) with full exhaust-air heat recovery. Provide automatic and manual changeover capability for chillers and boilers. Provide indoor units in each room with temperature control. Deliver outside air at the required conditions from the DOAS to the inlet of the fan coil units. DOAS must be a factory-packaged unit that delivers the required conditioned air over the full range of load when the heat recovery either is or is not operating.]

[Provide HVAC system for [Building X and Y] with single duct Variable Air Volume (VAV) hot water reheat series fan powered indoor units, continuous cooling primary air handler units, water-cooled chillers, closed circuit cooling towers and [central steam] [propane] [natural gas] [oil] fired boilers. Provide indoor units in each room with temperature control. Primary air handler units must have automatic modulating outdoor air intake control with occupancy sensing in each room.]

[Provide HVAC system for [Building X] with water source heat pumps, [ground-coupled] water loop, closed-circuit cooler, supplemental [central steam] [propane] [natural gas] [oil] fired boilers, and water source dedicated outdoor air system with hot gas reheat and full exhaust-air heat recovery. Deliver the conditioned outside air at a neutral temperature from the DOAS to the occupied spaces. DOAS must be a factory-packaged unit that delivers the required conditioned air over the full range of load when the air heat recovery either is or is not operating.

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NOTE: Revise the following as required to identify system choices that should not be used for this facility. Consider deleting the prohibition on direct expansion VAV systems for applications in the 5,000 to 10,000 square foot (464.5 to 929 square meter) range. Consider deleting the prohibition on thru-the-wall units in BEQ's, and isolated offices. Use of thru-the-wall units (e.g., GE Zoneline) is generally required in Navy Lodges. Economizers are not allowed in humid areas; only provide economizers when recommended by ASHRAE guidelines and standards for the project's weather zones.
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[Economizer cycles are not allowed.]

**GENERAL SYSTEM REQUIREMENTS**
Provide working space around all equipment. Provide all required fittings, connections and accessories required for a complete and usable system. Install all equipment in accordance with the criteria in PTS Section D30 and the manufacturer's recommendations. Where the word "should" is used in manufacturer's instructions, substitute the word "must".

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NOTE: Refer to UFC 3-410-01 for guidance on selection of design conditions, HVAC requirements for specific facility types, and identification of facility types not eligible for air conditioning.
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Provide air conditioning and heating for spaces as indicated and for the following Design conditions:

Outside Conditions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Summer | [ ] | Degrees F dry bulb | Winter | [ ] | Degrees F |
| [ ] | Degrees C dry bulb | [ ] | Degrees C |
| [ ] | Degrees F wet bulb |  |
| [ ] | Degrees C wet bulb |

Inside Conditions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Summer | 78 | Degrees F dry bulb | Winter | 68 | Degrees F |
| 26 | Degrees C dry bulb | 20 | Degrees C |
| 50 | Percent RH |  |

[Special Areas] Inside Conditions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Summer | [ ] | Degrees F dry bulb | Winter | [ ] | Degrees F |
| [ ] | Degrees C dry bulb | [ ] | Degrees C |
| [ ] | Percent RH |  |

Heating & Ventilating Inside Conditions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Summer | [ ] | Degrees F dry bulb | Winter | [ ] | Degrees F |
| [ ] | Degrees C dry bulb | [ ] | Degrees C |
| [ ] | [Air changes per hour] |  |

Provide Ventilation rates and systems in accordance with ASHRAE Standard 62.1, *Ventilation for Acceptable Indoor Air Quality*.

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NOTE: Provide ventilation in accordance with UFC 3 401-01. Consider providing demand controlled ventilation via CO2 sensors where applicable such as Dining Facilities, Multi-purpose rooms, or other areas of highly diverse occupancies.
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[Provide ventilation for [ ].]

[Configure the HVAC system to provide each zone with the choice of heating or cooling year round unless otherwise indicated.] [Provide each zone with its own limited range of control, as allowed by the control system central workstation.]

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NOTE: Where necessary, detail zoning requirements. Coordinate with the project architect for functional requirements of the facility spaces. Clearly indicate which zones are to be heated and ventilated only vs. heated and cooled. Also indicate which spaces can be grouped into zones.
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[Zone the HVAC system as follows:

[ ] must be a separate zone.
[ ] must be a separate zone, heated and ventilated only.
[ ] must be a separate zone, ventilated only.]

Provide minimum 4-inch (100 mm) thick concrete housekeeping pads and vibration isolators under all floor-mounted equipment.

[For sea coast applications, provide factory painted finishes that are designed for 3000 hour duration test for outside equipment and for equipment bringing in outside air.]

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NOTE: Require all HVAC cooling/heating and condenser coils be provided with protective coatings when locations are within 5 miles of the ocean or exposed to corrosive environments.
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[Provide all mechanical equipment HVAC [cooling/heating] [and] [condenser] coils with a manufacturer approved coating system. The heat transfer rating must be as installed.]

For unoccupied mode, provide the following night setback temperatures:

For winter, 10 degrees F (6 degrees C) lower than indoor heating design conditions, but no lower than 55 degrees F (12.8 degrees C).

For summer, 5 degrees F (3 degrees C) higher than indoor cooling design conditions, but no higher than 85 degrees F (29.4 degrees C).

 **D3010 ENERGY SUPPLY**

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NOTE: Edit the following to indicate the required use of a particular energy source (other than electricity) such as natural gas or a central steam or hot water distribution system where dictated for the project. Coordinate with Section G30.
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 **D301001 OIL SUPPLY SYSTEM**

Provide a [complete] oil system to provide [above] [below] ground storage and delivery to the oil fired equipment.

 **D301002 GAS SUPPLY SYSTEM**

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NOTE: Coordinate with and Insert name of utility company.
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[Obtain natural gas pressures from the local natural gas utility provider, [\_\_\_\_\_]. Provide any applications and permits and provide the complete natural gas system from the load side of the utility meter to the heating equipment. Contract with the local natural gas utility provider for installation of piping and appurtenances up to the load side of the meter. Provide gas meter on the building main and tie meter into the Building Automation System (BAS) [and the existing Advanced Metering Infrastructure (AMI) metering system.]

[Provide a complete propane storage and delivery system to the heating equipment.]

 **D301003 STEAM SUPPLY SYSTEM (FROM CENTRAL PLANT)**

Refer to Section G30, *Site Civil/Mechanical Utilities*.

[An existing central steam distribution system is the source of heating for the facility. Provide extension and connection to the existing Base steam system. Provide [[aboveground] [below ground] piping] [concrete trench] system including [manholes] [supports].]

 **D301004 HOT WATER SUPPLY SYSTEM (FROM CENTRAL PLANT)**

Refer to Section G30, *Site Civil/Mechanical Utilities*.

[An existing central hot water distribution system is the source of heating for the facility. Provide extension and connection to the existing Base heating system. Provide [[aboveground] [below ground] piping] [concrete trench] system including [manholes] [supports].]

 **D301005 SOLAR ENERGY SUPPLY SYSTEMS**

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NOTE: Solar Domestic Hot Water Systems (SDHWS) are required by the Energy Independence and Security Act (EISA 07) where Life Cycle cost effective. Evaluate the building and building site for shading, roof orientation, roof area available for solar panels, roof type, and other relevant issues to ensure that the SDHWS is compatible with the project. A Solar Domestic Hot Water Decision Tool is available on the CIME Web Page of the NAVFAC Portal for preliminary assistance in determining the solar economics.
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[Provide a complete solar domestic hot water system including heating panels, roof supports, piping, pumps, hot water storage tanks, heat exchangers and controls. Provide a system designed to furnish a minimum of [30][100][\_\_\_] percent of the annual demand for domestic hot water.

If the solar domestic hot water system is located on the roof, provide a coordinated design of the roof elements in accordance with UFC 3-110-03 Roofing. Organize the roof space necessary to accomplish the functions the roof has to provide, minimize roof penetrations, and plan the roof to facilitate future reroofing of the facility. Select the roof type and detail roof mounted equipment to complement the implementation of the functions that have to take place on the roof and minimize the need for routine maintenance. Accomplish a Pre-Roof Design Conference prior to the design of the roof.]

 **D3020 HEAT GENERATING SYSTEMS**

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NOTE: Check with the Base PWC to see if there has been a previous study or a maintenance preference for boiler configuration.
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Provide a heating system for this facility consisting of [1] [2] boiler[s, each] providing [100] [60] percent of the load.

[Boiler(s) located outside are acceptable.]

[Provide shot type feeder for manual chemical feed for closed loop system.]

[Provide tempered make-up water with automatic chemical treatment for open loop system.]

 **D302001 BOILERS**

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NOTE: Check with the Base PWD to see if there has been a previous study or a maintenance preference for boiler type. Consider packaged gas fired condensing boilers when natural gas or propane is available for the purpose of gaining maximum energy efficiency.
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Provide a [cast iron sectional], [flexible], [steel [] [firebox]], [modified scotch marine], [packaged steel ], [packaged gas fired condensing], [or] [finned tube] [hot water] [steam] boiler[s]. [Provide boiler feed system.] Provide pre-manufactured, multi-wall boiler stack.

[Provide boiler controls with BACnet communication protocol.]

 **D302002 FURNACES**

Provide [gas] [oil]-fired [high efficiency, condensing] furnace[s] [with cooling coil]. Include a [aluminized][stainless] steel heat exchanger as a component of the furnace.

 **D302003 FUEL-FIRED UNIT HEATERS**

Provide [gas-fired unit heaters] [[condensing] [non-condensing], [direct-fired] [indirect-fired] infrared heaters].

 **D302004 AUXILIARY EQUIPMENT**

[Provide steam to hot water converter(s) for this facility, using the Base central steam system to generate hot water for the HVAC system.]

[Provide steam to hot water heat exchanger for the [ ].]

[Provide condensate return unit[s].]

 **D302005 EQUIPMENT THERMAL INSULATION**

Provide insulation for steam system equipment, steam to hot water converters, hot water pumps and other associated heating equipment.

 **D3030 COOLING GENERATING SYSTEMS**

 **D303001 CHILLED WATER SYSTEMS**

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NOTE: The following paragraphs should be used to identify the type of chilled water system. Delete the first paragraph if not expanding an existing system.
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NOTE: Specify the type and number of chillers to be provided. If multiple chillers are provided, require chiller manufacturer to provide a central chiller control panel. Coordinate with the PW department for preference on number of chillers or back-up required.
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Provide [connection to and extension of the existing central] chilled water system for service to the building HVAC equipment. [The existing chilled water system provides chilled water at [45] [\_] degrees F ([7] [\_\_] degrees C). [Chilled water reset is not allowed.] The existing system utilizes [2-way] [3-way] control valves.] [Provide glycol/water mix for protection down to [ ] degrees F.]

Provide [[centrifugal] [rotary screw] water-cooled] [[reciprocating] [rotary screw] [scroll] air-cooled] chiller[s] using a [variable primary] [primary/secondary] [variable speed] pumping system [and [cooling tower] [closed circuit cooler]. [Provide chillers with integral electronic compressor speed control for matching dynamic load conditions.] Provide a cooling system for this facility consisting of [1] [2] chiller[s, each] providing [100] [50] percent of the load.

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NOTE: 40 degrees F is typically standard, 20 degrees F, 0 degrees F, or –20 degrees F (special) are optional. Consult FEC office for guidance.
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[Chiller(s) must operate in temperatures down to [ ] degrees F.

[Provide heat recovery for [reheat] [domestic hot water].

Provide insulation and vapor barrier on all chilled water equipment.

[Provide chiller controls with BACnet communication protocol*.]*

Provide complete start-up and operational testing of chiller equipment.

[Provide factory assembled [galvanized steel with stainless steel basin] [stainless steel] [fiberglass] [cooling tower(s) with automatic chemical treatment system(s)] [closed circuit cooler(s)] to serve the water-cooled chillers. [Provide with basin heater(s).] [The load may be served by a single cooling tower.] [Provide [2] cooling towers, each serving [50][ ] percent of the load.].]

 **D303002 DIRECT EXPANSION SYSTEMS**

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NOTE: This paragraph is intended for light commercial equipment. See paragraph D305006 for requirements for Packaged Terminal Air Conditioners (PTACs) and small split systems and coordinate
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[Provide a dedicated air-cooled direct expansion (DX) ductless split system [cooling only] [heat pump] unit for the NMCI/Telecom space.]

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NOTE: Water source heat pumps are one of the 3 recommended system options. Delete water source heat pumps if not used.
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[Provide vertical [water source] [ground-coupled] heat pump units with ducted air distribution and controls to serve the heating and cooling requirements of the facility. Provide one vertical [water source] [ground-coupled] heat pump unit for each zone and locate within a mechanical closet. The mechanical closet must be lockable and allow adequate space for maintenance. Provide each [water source] [ground-coupled] heat pump with a return filter grille to ease maintenance. If space does not allow for a vertical heat pump unit, provide horizontal heat pump units in the overhead with a means for removal and maintenance of the system through lockable access panels. Install flexible stainless steel piping connections (hose kits) between [water source] [ground-coupled] heat pumps and piping. Install vibration isolators on heat pumps. [Provide heat pumps with supplemental electric heaters.] [Provide heat pumps with desuperheaters and tanks for domestic water.]]

[Provide a [air][water] cooled variable refrigerant flow (VRF) heating, cooling, ventilating and air conditioning system to serve the requirements of the facility. Design the system to provide the facility with simultaneous heating and cooling with heat recovery. Provide a complete and useable system consisting of VRF heat pump units, branch circuit controllers, VRF fan coil units, and associated controls. Incorporate zone thermostats for control of each fan coil.]

 **D3040 DISTRIBUTION SYSTEMS**

 **D304001 AIR DISTRIBUTION, HEATING & COOLING**

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NOTE: Ductwork location should also be addressed in this paragraph if requirements are critical (such as must be concealed, or can be exposed).
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Provide [insulated, galvanized steel] [double wall, preinsulated] ductwork constructed, braced, reinforced, installed, supported, and sealed in accordance with the IMC and Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) standards.

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NOTE: Variable air volume systems are one of the 3 recommended system options. Delete VAV system if not used.
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[Provide a Variable Air Volume (VAV) system using ducted returns [and sound attenuators]. Locate VAV units above ceilings and allow for maintenance and removal of units through lockable access panels.]

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NOTE: Verify that Activity does not have a restriction on the use of Fan-powered VAV boxes due to increase maintenance of the box fans and filters.
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[Direct expansion variable air volume systems are not acceptable.]

[Provide VAV Units.]

[Provide VAV Fan-Powered Units.]

Provide grilles, registers, and diffusers. [Provide filter grilles for return air.] [Provide linear slot diffusers including boot.]

 **D304002 STEAM DISTRIBUTION SYSTEMS**

For Exterior Buried Steam systems, see Section G30, *Site Civil/Mechanical Utilities*.

Provide insulated, steel steam and condensate piping to serve the HVAC equipment throughout the facility. Steam piping and equipment must be in a self-contained dedicated steam equipment room or a wet mechanical room. Piping penetrations from this room into the facility must be tightly sealed to prevent steam from leaving the dedicated steam equipment room in the event of a steam pipe rupture. The dedicated steam equipment room must have double doors to the outside and be designed to contain steam in event of a leak.

 **D304003 HOT WATER DISTRIBUTION SYSTEMS**

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NOTE: Consider providing hydronic floor radiant heating systems in maintenance bays, hangar bays, and child development center infant, toddler, and preschool areas, for climate zones 3 through 8. Recommend insulating under floor slab of hydronic radiant heating system with R-10 insulation for weather zones 3 through 7, and R-15 insulation for climate zone 8.**

**If the variable primary pumping system option is selected, ensure packaged gas-fired condensing boiler option is selected in paragraph D302001 of this ESR.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

For exterior buried Hot Water Distribution Systems see Section G30, *Site Civil/Mechanical Utilities*.

Provide a [variable primary][primary/secondary][variable speed] pumping system to serve the HVAC hot water equipment throughout the facility. Provide insulated [steel][copper] hot water supply and return piping to serve the HVAC equipment throughout the facility.

Provide air control and shot type feeder for manual chemical feed for hot water piping system.

Provide an expansion tank for the hot water piping system.

Provide system flushing and start-up for the hot water piping system.

 **D304005 GLYCOL DISTRIBUTION SYSTEMS**

[Provide as specified for Chilled Water Distribution Systems see D304006.]

 **D304006 CHILLED WATER DISTRIBUTION SYSTEMS**

[For exterior buried chilled water distribution systems, coordinate with Section G30, *Site Civil/Mechanical Utilities*.]

Provide a [variable primary] [primary/secondary] [variable speed] pumping system to serve the HVAC chilled water equipment throughout the facility.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Coordinate with the PW department for preference on type of insulation required.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

Provide [steel][ or ][copper] chilled water supply and return piping to serve the HVAC equipment throughout the facility. Insulate piping with cellular glass insulation.

Provide air control and shot type feeder for manual chemical feed for the chilled water piping system.

Provide an expansion tank for the chilled water piping system.

Provide system flushing and start-up for the chilled water piping system.

 **D304007 EXHAUST SYSTEMS**

Provide ductwork constructed, braced, reinforced, installed, supported, and sealed in accordance with the IMC and SMACNA standards.

Provide ducted exhaust ventilation systems and exhaust fans to serve all ventilated zones of the facility. Provide [in-line] [rooftop] [ceiling] centrifugal exhaust fan[s].

 **D304008 AIR HANDLING UNITS**

Provide [central station] [constant volume] [variable volume] air handlers. Provide with Minimum Efficiency Reporting Value (MERV) [8] [10] [13] [15] filters.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Consideration should be given to the use of ultraviolet (UV) based on the activity's ability to maintain the equipment, since it enhances the equipment life and minimizes coil cleaning. Also this will help avoid indoor air quality (IAQ) problems.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide with ultraviolet disinfection system.]

 **D304090 OTHER DISTRIBUTION SYSTEMS**

Provide [in-line] [base mounted] circulating pumps [with variable frequency drives].

 **D3050 TERMINAL & PACKAGE UNITS**

 **D305002 UNIT HEATERS**

[Provide [cabinet] [unit] heaters to serve the heating requirements of [ ] area of the facility.]

[Provide gas-fired infrared heaters to serve the heating requirements of [ ] area of the facility.]

 **D305003 FAN COIL UNITS**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Fan coil units are one of the 3 recommended system options. Delete fan coil units if not used.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[[Provide 4-pipe vertical type fan coil units and controls to serve the heating and cooling requirements of the facility. Provide one vertical fan coil unit for each zone and locate within a mechanical closet. The mechanical closet must be lockable and allow adequate space for maintenance. Provide each fan coil unit with a return filter grille to ease maintenance requirements. If space does not allow for vertical fan coil units, provide horizontal fan coil units in the overhead with a means for removal and maintenance of the units through lockable access panels. Provide auxiliary drain pans below valves and appurtenances to prevent piping leaks and condensate forming on chilled water piping from damaging ceilings.]

 **[D305004 FIN TUBE RADIATORS] [CONVECTORS]**

[Provide [fin tube radiators] [convectors] for heating [ ] spaces.]

 **D305005 ELECTRIC HEATING**

[Provide electric [unit heaters] [baseboard] [wall] [infrared] heaters for heating [ ] spaces.]

 **D305006 PACKAGE UNITS**

[Provide 100 percent Outside Air Makeup Air Conditioning Units to precondition outside air prior to distributing to [central station air handling] [fan-coil units][terminal units].]

 **D3060 CONTROLS AND INSTRUMENTATION**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Where the Engineering Field Division, Engineering Field Activity, Station, or Command has an Approved Justification and Authorization (J & A) document allowing the use of a single Direct Digital Controls provider; and where all previous J & A bid experiences have indicated that bid pricing remains reasonable and competitive; then use the second bracketed sentence. In other cases, use the first bracketed sentence. For small DX systems, delete this section in its entirety and include a short write-up describing the desired control scenario.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

 **D306001 HVAC CONTROLS**

 **D306001 1.1 DIRECT DIGITAL CONTROLS (DDC)**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: For new standalone DDC systems select the first bracketed option. For new DDC systems intended to integrate into an existing Utility Monitoring and Control System (UMCS) select the second bracketed option.

 In situations where a device requires local control only, even if a DDC system is being provided, identify those specific devices in this Section.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide a complete Direct Digital Control (DDC) system [to comply with UFGS 23 09 00, *Instrumentation and Control for HVAC,* UFGS 23 09 23.02, *BACnet Direct Digital Control for HVAC and Other Building Control Systems,* UFGS 23 09 13, *Instrumentation and Control Devices for HVAC*, and BACnet communication protocol][to comply with \_\_\_\_\_] for the facility.]

[Provide integration of the new Direct Digital Control (DDC) system to the existing [\_\_\_\_\_] Utility Monitoring and Control System (UMCS) in compliance with the UMCS's Risk Management Framework (RMF) Authorization to Operate (ATO) [, \_\_\_\_\_,] and UFGS 25 10 10, *Utility Monitoring and Control System (UMCS) Front End and Integration*.]

[Provide a partial direct digital control (DDC) system [to comply with UFGS 23 09 00, *Instrumentation and Control for HVAC,* UFGS 23 09 23.02 *BACnet Direct Digital Control for HVAC and Other Building Control Systems,* UFGS 23 09 13, *Instrumentation and Control Devices for HVAC*][to comply with \_\_\_\_\_\_\_] for the facility. Provide integration of the new DDC to the existing operator workstation and the existing operator workstation software. The existing DDC system was manufactured by [\_\_\_\_\_\_\_].] [The DDC system must be (make/model).]

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Operator workstation requirements depend on project. Always provide a notebook computer as a minimum with the manufacturer's full application software and license.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide [operator workstation] [and] [notebook] computer[s] and complete application software with all licenses.]

Provide meters, monitored by DDC, on the following incoming utilities of the building: steam and gas. [Tie the gas meter into the existing Advanced Metering Infrastructure (AMI) metering system.] For electrical energy monitoring refer to Section D50, *Electrical*, paragraph entitled, *Service Entrance Equipment*. For potable water meter refer to Section G30, *Site Civil/Mechanical Utilities*, paragraph entitled, *Potable Water Distribution*. [Set up trend reports to record data daily and store values in the operator workstation DDC computer.] [Set up trend reports to record data daily and store values in the ASHRAE Standard 135 building controller for later retrieval by either a notebook computer or an operator workstation DDC computer.]

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* NOTE: Refer to ASHRAE 189.1-2011 Tables 7.3.3.1A and 7.3.3.1B for Energy Source and Subsystem Thresholds.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide meters, monitored by DDC, on the following subsystems for steam, gas and water: HVAC and processes.]

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* NOTE: Refer to ASHRAE 189.1-2011 Tables 6.3.3A and 6.3.3B for Water Supply Source and Subsystem Sub-Metering Thresholds.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide meters, monitored by DDC, on the following subsystems for potable water and reclaimed water: [cooling tower[s] makeup and blowdown] [, evaporative cooler[s]] [, steam boiler[s]] [, hot-water boiler[s]] [, processes].]

[Provide meter, monitored by DDC, on reclaimed water subsystem used for total irrigated landscape area with controller[s].]

[For meter of potable water subsystem used for total irrigated landscape area with controller[s], refer to Section G20, *Site Improvements*, paragraph entitled, *Irrigation Systems*.]

Provide ASHRAE Standard 135 building controller as the main interface for the building control system.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* NOTE: Coordinate with Base Commanding Officer and local CIO.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide patch panel in the mechanical equipment room for ease of connection and disconnection of equipment.]

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* NOTE: Alarm is to notify unauthorized access.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

Provide panels with locks and alarms. The alarms must include [both] [a flashing light] [and] [an audible alarm] inside the mechanical room. The alarms must also be a networked alarm (e.g. switch connected to controller DI) with alarm events recorded remotely for a period not less than one year.

[Provide flow rate meters, monitored by the DDC system, for central and chilled water flow.]

[Provide air handlers and all terminal units, including VAV boxes, with discharge/supply temperature sensors.]

[Provide central air handler unit outside air CFM air flow monitoring stations.]

[Provide a DDC option for automatic operation of building circulating pumps whenever outdoor air temperature is below 35 degrees F or when there is a high potential for freeze damage.]

[Provide control to automatically start back-up pumps (or other HVAC equipment) if the primary device fails.] [Primary and back-up equipment starter circuits must be wired to prevent both pieces of equipment from operating at the same time.] [Rotate primary and back-up HVAC equipment monthly (adjustable) with a lead/lag control routine.]

 **D306001 1.2 ELECTRONIC CONTROLS**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* NOTE: Only utilize electronic controls if extending existing system with electronic controls. All new systems to utilize DDC controls.**

 **Where DDC controls are provided, and there are some items desired with local control, identify those local control items in this paragraph.
 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide electronic controls [with programmable thermostats] for the HVAC systems and equipment.]

 **D3070 SYSTEMS TESTING AND BALANCING**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Where the project is complex, or mission essential, or has life safety issues, or due to local construction conditions, provide additional wording as necessary
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide complete Testing and Balancing (TAB) of all air and water distribution systems and HVAC equipment and performance verification testing (PVT) of all HVAC controls systems.]

 **D307003 HVAC COMMISSIONING**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Extent of Commissioning will depend on the scope and complexity of the project.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

Refer to RFP Part 3 - Project Program, Chapter 2 for Building Commissioning requirements. Mechanical systems to be commissioned, if provided, include HVAC systems and controls, refrigeration systems and controls, renewable energy systems, [\_\_\_\_\_\_\_,] and domestic hot water systems.

 **D3090 OTHER HVAC SYSTEMS AND EQUIPMENT**

 **D309001 GENERAL CONSTRUCTION ITEMS**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Coordinate seismic requirements in Project Program or elsewhere in RFP.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide seismic restraints] [and] Comply with the Force Protection Criteria.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Coordinate with Architect on the mechanical equipment rooms (other than ground floors) to provide with through the wall access doors on building exterior - crane access - with removable hand rails. This requirement may have historical preservation impacts.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

Provide access to all mechanical equipment rooms through the building exterior walls.

[Provide mechanical equipment rooms (other than ground floors) with through the wall access doors on building exterior - crane access - with removable hand rails.]

[Provide mechanical equipment rooms in basements with pit access with floor drains and stairs and through the wall access doors on building exterior - crane access - with removable hand rails.]

 **D309090 OTHER SPECIAL MECHANICAL SYSTEMS**

[Provide industrial ventilation system in accordance with UFC 3-401-01.]

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*
NOTE: Include the following paragraphs if the need for energy recovery devices is required by ASHRAE 90.1, or other project energy goals. Confirm the type of energy recovery to be used with the base Public Works Department.
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

[Provide total energy (enthalpy) type energy recovery wheels (heat wheels) in the air handling system.]

[Provide heat pipe energy recovery in the air handling system.]

-- End of Section --