3.5 Mechanical Design

3.5.1 Code Compliance

Design heating, ventilating, air conditioning (HVAC) and plumbing systems to conform to the publications listed in Attachment A. Utilize the most current codes and standards at the time of the design/build contract solicitation.

3.5.2 Existing Systems

The designs include equipment which varies building-to-building. See Section 3.5.8 for design directives for each building.

3.5.3 Functional Requirements

3.5.3.1 Heating, Ventilating, and Air-Conditioning (HVAC)

Attain the following objectives for the HVAC systems: occupant comfort, indoor air quality, acceptable noise levels, energy efficiency, reliable operation, and ease of maintenance. Provide air-conditioning and heating for all occupied spaces except for maintenance bays, hangar bays, and other areas as noted. Provide air-conditioning only for server/communication rooms. Keep areas that require heating for freeze protection above 40 degrees at all times.

3.5.3.2 Energy Sources

The available energy sources are natural gas and electricity provided by Oklahoma Gas & Electric. Meters for each service exist at each building. In accordance with Executive Order EO14057), new gas-fired mechanical systems are not allowed in any the buildings within the scope of this project (201, 202, 214, 216 & 218). The use/continued use of natural gas is limited to the existing gas-fired infrared heaters in Building 201, and all gas-fired systems in Building 202, which will remain in service as-is.

3.5.4 Prescriptive Requirements – New Equipment

3.5.4.1 Life Cycle Cost Analysis

Perform Life Cycle Cost Analysis (LCCA) to determine heating, cooling, and energy-related decisions of major systems in accordance with UFC 1-200-02 Life Cycle Cost Analysis requirements. Per UFC 1-200-02 (current change), achieve at least 30% energy consumption reduction from ASHRAE 90.1 (current version as directed by UFC) baseline, or achieve an energy consumption level at the highest level possible that is life cycle cost effective. Provide mechanical systems based on achieving the lowest life cycle cost of approved alternatives. Include total ownership costs, operation and maintenance costs, and payback. If life-cycle cost effective, implement Energy Efficiency Measures (EEMs) such as variable speed drives and Electronically Commutated Motors (ECM). Implement renewable energy design strategies such as solar hot water heating where life cycle cost effective. Provide life cycle cost analysis and recommendations to the Government for review and acceptance.

3.5.4.2 Design Criteria

3.5.4.2.1 Outside Design Criteria

ASHRAE 2021 0.4%:
Summer: 100F DB, 75.9F WB
Winter: 17.9F DB

ASHRAE 2021 1.0%:
Summer: 96.6F DB, 76.3F WB
Winter: 22.3F DB
HR: 8.9

3.5.4.2.2 Inside Design Criteria

Occupied zones conditioned for comfort cooling and heating

Summer: 78 degrees F and a maximum of 55 degrees F dew point. Design must take into account moisture gain in the space.

Winter: 68 degrees F (occupied), 55 degrees F (unoccupied)

Unoccupied zones conditioned to prevent freezing

Winter: 40 degrees F

Server/Communications Rooms:

72 degrees F

50% RH maximum

3.5.4.3 Calculations

For regularly occupied areas, use the 1 percent dry bulb and corresponding mean coincident wet bulb (MCWB) temperature and the 1 percent humidity ratio and corresponding mean coincident dry bulb (MCDB) temperature for design calculations and equipment sizing.

For server/communication rooms, coordinate with end user for specific temperature and humidity requirements. Separate, dedicated air conditioning systems must provide 24/7 cooling to each room. Utilize the 0.4 percent dry bulb temperature and the corresponding MCWB temperature and the 1 percent humidity ratio and corresponding MCDB for design calculations and equipment sizing.

Perform cooling and heating load calculations, building energy simulation models, and EEMs using Carrier HAP, Trane Trace 700, or other DOE-approved simulation software. Size all cooling equipment based on the calculated peak sensible and total loads for the building/zone. Size terminal units, unit heaters, and communication/server room air conditioning units based on the calculated peak sensible and total loads for the spaces served. Consider site elevation, refrigerant line lengths, and other factors that affect deration of equipment capacity. Consider heat/energy recovery where life cycle cost effective.

Utilize temperature setbacks and resets in occupied spaces during unoccupied times to maximize energy conservation, unless noted otherwise. Do not use setbacks for cooling in storage areas of building 201.

3.5.4.4 Equipment Selection

3.5.4.4.1 Product Procurement

Basis-of-design equipment must be Energy Star or Federal Energy Management Program of the Department of Energy (FEMP) designated products when available. The term “Energy Star product” means a product that is rated for energy efficiency under an Energy Star program. The term “FEMP designated product” means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

3.5.4.4.2 Cooling and Heating Systems

Provide mechanical equipment to maintain space temperature setpoints. The equipment must also include provisions to maintain space humidity levels where specific tolerance requirements are indicated. Possible system types include: split system outdoor heat pumps with indoor fan coils, ground-mounted heat pump packaged rooftop units (RTU), and single-zone minisplit heat pumps with cassette or ducted fan coils. Provide cooling-only, dedicated minisplit systems with low-ambient cooling capability for server/communication rooms. Where required by the UFC or end user for critical server/communication rooms, provide redundant cooling systems. Variable Refrigerant Flow (VRF) systems are prohibited. In accordance with UFC 3-410-01 c9, 3-5.2.5, select condensers/condensing units/heat pumps for service in ambient conditions 5 degrees F above the outdoor dry bulb temperature listed in section 3.5.5.1 above. Select equipment with refrigerants that have ozone depletion potential (ODP) no greater than 0.0. CFC-based refrigerants and refrigerants subject to phaseout must not be utilized.

Where specific humidity control is required for spaces served by an RTU, provide manufacturer’s onboard dehumidification system (i.e.: Carrier Humidimizer). For spaces served by split systems, provide commercial standalone dehumidifiers with automatic draining and/or pump sized to accommodate specified levels.

3.5.4.4.3 Unitary Heating Systems

Provide LCCA-effective electric unit heaters in unoccupied spaces such as mechanical rooms, electrical rooms, etc. Do not specify new gas-fired equipment.

3.5.4.4.4 Exhaust and Ventilation Systems:

Provide exhaust systems in all toilet rooms, janitors closets, etc. Provide ventilation in mechanical rooms, electrical rooms, etc. with inline exhaust fans and interlocked, operable louver or transfer air. Schedule ECM motors for exhaust fans whenever available for the

application. Include fan speed controller mounted nearby in an accessible location for balancing purposes.

3.5.4.5 Variable Frequency Drives (VFD)

Provide VFD's for all motors and fans greater than 10 hp, excluding exhaust fans.

3.5.4.6 Equipment Locations

Locate mechanical equipment to maintain the manufacturer's recommended minimum service clearances, code clearances, and the clearances required for removal of the equipment. Provide access doors for concealed equipment that may require maintenance or repair. Place floor and ground-mounted equipment on concrete housekeeping pads. Do not design roof-mounted intakes, exhaust fans, etc., unless absolutely necessary as buildings 201, 214, 216 and 218 do not have dedicated roof access.

3.5.4.7 Air Quality

Maintain ASHRAE 62.1 (current version as accepted by UFC) ventilation throughout the building to satisfy the minimum occupancy ventilation requirements, maintain building pressurization, and provide necessary make-up air for building exhaust. Outside air for ventilation may be introduced through fan coils or RTUs. Show outside air schedules on drawings and consider the maximum potential occupancy load when calculating outside air requirements in all spaces. For systems with outdoor air exceeding 750 cfm, provide a dedicated outdoor air system (DOAS). Where life-cycle cost effective, use energy recovery to preheat/precool incoming outside air.

3.5.4.8 Emergency Power Off (EPO) and Anti-Terrorism and Force Protection (ATPF)

Locate an EPO switch in the Mechanical Room as well as in the local operating console/fire alarm control panel (LOC / FACP), when available, for all air-moving systems serving occupied spaces and centralized ventilation systems such as Dedicated Outside Air systems (DOAS). Provide ATPF switch where required in accordance with UFC 4-010-01.

3.5.4.9 Ductwork

Construct, brace, reinforce, install, support, and seal insulated and galvanized steel ductwork in accordance with the IMC and SMACNA standards. In addition, ducted returns, dampers, air devices, and filters are required. Louvers are required for exhaust systems in lieu of roof-mounted equipment. Fortification (per Air Force and DOD standards) may be required for ducts with 96 square inch cross-sectional areas and larger passing through secure (SAPF & Secret) area perimeters.

3.5.4.10 Noise Abatement

Select air handling units (fan coils, RTUs, etc.), ductwork and diffusers to minimize noise from the units to the space. The selected fans must generate the lowest possible sound power levels and corresponding sound spectra. If attenuation is required, it must be in accordance with UFC requirements. Secure spaces may require specific Sound Transmission Class (STC) ratings (for example: STC50). Employ sound-attenuation devices such as duct silencers, Z-ducts and similar devices to achieve specified STC ratings.

3.5.5 Building Automation System

Provide a Building Automation System consisting of a building control network, and integrate the building control network into the Base's existing Energy Management Control System (EMCS) as follows:

3.5.5.1 Existing Base-wide EMCS

The Base's existing EMCS includes BACNET-based Siemens controls are already established in each building, and report to the central station located in Building 450. Maintain each building's existing controls infrastructure as much as practicable for reuse including control panel(s), supervisory controller(s), etc., for integration of new equipment.

3.5.5.2 Direct Digital Control (DDC) System

Outfit all new mechanical equipment including split system fan coils, condensing units, heat pumps, RTUs, minisplit systems, etc., with controls compatible with existing controls infrastructure and conforming to Base standards. Coordinate exact requirements with the Base DDC Provider.

3.5.5.3 Base DDC Provider

The Base has an existing service contract with Powers-HVAC based in North Little Rock, AR (877-274-7127). The current point of contact is Mike Fogo (479-275-9733) who is based out the Springdale, AR office.

3.5.6 Testing, Adjusting and Balancing (TAB)

Test and balance all air systems using a firm certified for TAB by the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or the Testing Adjusting, and Balancing Bureau (TABB) in accordance with UFGS 23 05 93. The TAB firm must be an independent subcontractor and not an employee or subcontractor of any other subcontractor on this project. Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are mandatory. Use the provisions of the TAB Standard, including checklists and report forms, as much as practicable to satisfy the contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations. All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, the TAB Specialist must develop TAB procedures. Where new procedures and requirements applicable to the contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are mandatory.

3.5.7 Commissioning

Commission all HVAC systems and equipment, including controls, and all systems requiring commissioning in accordance with ASHRAE, UFC 1-200-02 and Specification section 01 91 00.15. The Commissioning Agent (CA) must be an independent subcontractor and not an employee or subcontractor of any other subcontractor on this project. The CA must not have business connections with any other

party on the project, nor have any other role or responsibilities outside of commissioning activities. The CA must communicate and report directly to the Government in the execution of the commissioning activities.

3.5.8 Building-By-Building Design Directives

Project scope includes existing mechanical systems deemed suitable for reuse due to their age and condition. Remove all gas-fired equipment (split systems with furnaces, boilers, etc.) unless noted otherwise. All gas-fired equipment in building 202 must remain in service as-is. Where directives indicate to remove an existing system, designer of record (DOR) must calculate the capacity of its replacement in accordance with Sections 3.5.4.3 above. Likewise, capacities of new (additional) systems must be calculated by DOR. Not all directives include unit heaters and exhaust systems, which are to be replaced, reused or scheduled as new at the discretion of the DOR.

3.5.8.1 Building 201

a. Remove existing Carrier 5-ton split system (DX & gas, dated 2018) located in south Mechanical room 116, including associated ductwork and air devices. Provide new heat pump split system in its place, and new ductwork and air devices to support “Bulk Spares”.

b. Provide new (additional) heat pump split system in Mechanical 116 and distribution ductwork to support “Spares/Transit Area” & “Semi Bulky Racked Storage”.

c. Demolish existing Carrier 4-ton split system (DX & gas, located in current fire alarm panel room) and associated distribution ductwork in its entirety.

d. Demolish existing Carrier 4-ton split system (DX & gas, located in west Mechanical room 123) and associated distribution ductwork in its entirety. Provide new heat pump split system in its place, and new distribution ductwork and air devices to support “Racked Storage”.

e. Provide new ground-mounted, heat pump, packaged rooftop unit (RTU) on the north side of the building, and mounted on minimum 6” tall concrete housekeeping pad. Provide distribution ductwork to support “Compact Storage” and “Fast Moving Bulk Spares”. Where available, provide manufacturer’s onboard dehumidifier system (e.g., Carrier Humidimizer) in lieu of a standalone dehumidifier.

f. Provide standalone, packaged dehumidifier with onboard automatic drain and/or pump suspended in each of the main storage areas (five total) to maintain relative humidity levels of 50% (or less), or to range specified by end user. Standalone unit not required in space(s) served by an RTU with onboard dehumidification system.

g. Reuse two existing gas-fired infrared (IR) heaters (200 MBH each, date unknown) in “Fast Moving Bulk Spares”, and two (2) existing gas-fired IR heaters (60 MBH each, date unknown) in “Bulk Spares”. DOR to determine if existing IR heater locations will interfere with new racking equipment or other storage methods, and demolish heaters if necessary. The intent is to provide additional heating in these spaces when their overhead doors are open.

h. Provide BACNET DDC controls for each new mechanical system as described in Section 3.5.5.

3.5.8.2 Building 202

a. Existing systems (makeup air units, air compressors, air dryers, water heater, IR heaters, exhaust fans, etc.) located in northwest Mechanical 138 to remain in-service, as-is.

b. Existing systems (IR heaters, exhaust/supply fans, etc.) located in the aircraft bays to remain in service, as-is.

c. Seven (7) existing heat pump split systems serve occupied and unoccupied non-aircraft bay spaces throughout the building. The heat pumps are located in two enclosures on the west side of the building. Corresponding fan coils are located above ceilings throughout the non-hangar areas of the building. The systems must remain in service, as-is, except where ductwork modifications are required to support revised floorplans in the core office areas.

d. Existing systems serving various unoccupied spaces (Electrical, Comm, Fire Riser, Pod, Storage, Vaults, etc.) to remain in service, as-is.

e. Modify one of the existing split system's ductwork and air distribution to support the lactation room.

f. Provide dedicated, cooling-only minisplit system for new Comm room. System must be capable of low-ambient cooling to 0 degrees Fahrenheit.

g. Existing mechanical systems are currently tied to the Base's EMCS in Building 450. Verify this and provide BACNET DDC controls for existing mechanical systems (if none exists) as described in Section 3.5.5.

3.5.8.3 Building 214

a. Demolish existing hydronic heating water system in its entirety including boiler & appurtenances, pump, piping and hydronic unit heaters throughout building.

b. Demolish gas-fired, ground-mounted makeup air unit located outside the northeast corner of the building.

c. Demolish exhaust system including hoods in the northeast corner of the building.

d. Demolish three (3) Carrier split systems on the south side of the building, and one (1) on the north side. Demolish ductwork associated with all four systems.

e. Provide new heat pump split system in Mechanical 008 and distribution ductwork for all spaces on the south side of the building including storage, toilet rooms and AME.

f. Provide new minisplit heat pump system for Parachute 004 including ceiling-mounted cassette fan coil. Locate heat pump on north side of the building.

g. Provide new minisplit heat pump system for the mezzanine JEI-EMMS room including ceiling-mounted cassette fan coil. Locate heat pump on the north side of the building.

h. Provide new minisplit heat pump system for the mezzanine 425FS Trade Learning room including ceiling-mounted cassette fan coil. Locate heat pump on the north side of the building.

i. Provide new minisplit heat pump system for the mezzanine JEIM Engine office including ceiling-mounted cassette fan coil. Locate heat pump on the west side of the building.

j. Provide new minisplit heat pump system for Storage room 006 including ceiling-mounted cassette fan coil. Locate heat pump on the west side of the building.

k. Provide new minisplit cooling-only system for Comm room 005 including wall-mounted fan coil. System must be capable of low-ambient cooling to 0 degrees Fahrenheit. Locate condensing unit on the north or east side of the building.

l. Provide minimum four (4) electric downblast unit heaters for the main Work Bay. Locate and suspend units such that they will not interfere with boom cranes and other equipment located in the Work Bay.

m. Provide one (1) electric unit heater in the Tool Storage area of the single-story north side of the building.

n. Provide new exhaust system(s) for revised toilet rooms and janitor's closet.

o. Provide two wall-mounted airfoil propeller fans on the upper east wall of the Work Bay, each sized to collectively provide 15-20 air changes per hour. Provide two operable louvers on the lower west side of the building, interlocked with the fans and sized for maximum 550 feet per minute airflow. Provide line-voltage thermostat(s) with manual override to operate the systems for cross-ventilation/heat removal in the Work Bay.

p. Provide BACNET DDC controls for each new mechanical system as described in Section 3.5.5.

3.5.8.4 Building 216

a. Demolish two existing Liebert split systems serving the southwest wing of the building in their entirety.

b. Remove existing Carrier 4-ton split system (DX & heating water, dated 2018) located in southwest Mechanical room 17. Remove all associated ductwork and air devices. Provide new heat pump split system, ductwork and air devices to support proposed rooms 106, 111 & 112. Fortify main supply and return ducts leaving/entering Mech 17 per Air Force and DOD standards.

c. Remove existing Carrier 25-ton split system (DX & heating water, dated 2018) located in southwest Mechanical room 17. Remove all associated ductwork and air devices. Provide new heat pump split system, ductwork and air devices to support rooms 107-110. Fortify main supply and return ducts leaving/entering Mech 17 per Air Force and DOD standards.

d. Demolish existing Fujitsu minisplit system located just north of Mech 17 in its entirety. Location of associated fan coil within building is not known.

e. Provide new minisplit cooling-only system for Comm room 00 including wall-mounted fan coil. System must be capable of low-ambient cooling to 0 degrees Fahrenheit. Locate condensing unit on the north or east side of the building.

f. Demolish existing Fujitsu dual minisplit system located just outside Vestibule 30 in its entirety (outdoor and indoor units). Location of associated fan coils within building is not known.

g. Remove existing 250MBH (capacity and 2018 date, both estimated) Lochinvar boiler, distribution pumps, appurtenances and all associated heating water distribution piping in its entirety. Boiler and appurtenances are located in Mech 17. Extent of heating water distribution piping is not known.

h. Remove existing Carrier 30-ton split system serving original portion of the building (dated 2018). Remove fan coil and associated gas-fired duct heater located in Mech 16. Provide

new heat pump split system and revise ductwork and air distribution devices to support proposed room layouts.

i. Provide new minisplit heat pump system for new DV MTG Room/Lounge addition on west side of the building. Provide ceiling-mounted cassette fan coil. Locate heat pump on existing slab north of addition.

j. Provide new precision-cooling split system(s) for Secure Comm, Vault ALIS/ODIN and/or Vault 1 Server rooms. Coordinate exact rooms requiring 24/7 cooling with end user. System(s) must be capable of maintaining room temperature between 60-84 degrees Fahrenheit and relative humidity levels between 40-70%. System must include onboard humidification and be capable of low-ambient cooling to 0 degrees Fahrenheit. Locate condensing unit(s) on the east side of the building. Reference products: Trane S-Mext (indoor unit) and TRUY (outdoor unit).

k. Demolish existing York 30-ton ground-mounted RTU (gas & DX, dated 2018) serving the two northmost additions to the building. Provide new ground-mounted heat pump packaged RTU on existing concrete pad. Revise existing ductwork to support proposed room layouts in the northmost additions. Fortify ducts passing through new secure perimeter in accordance with Air Force and DOD standards, and design ductwork to reduce sound transfer to specified STC levels.

l. Provide dedicated, cooling-only split system for room serving F-16 Unit Training Device (UTD). Data provided for this device (F16SATD) dated August 2015 indicates a heat gain of 52,000 BTUH and a relative humidity range of 30-70% for the space in which it resides. Coordinate exact requirements for this space with end user.

m. Demolish existing Fujitsu dual minisplit system located on the northeast side of the building in its entirety. Associated fan coils are located just inside the adjacent wall.

n. Provide BACNET DDC controls for each new mechanical system as described in Section 3.5.5.

3.5.8.5 Building 218

a. Demolish existing minisplit system that previously served the existing Comm room. System is currently inactive.

b. Provide new minisplit cooling-only system for Comm 119 including wall-mounted fan coil. System must be capable of low-ambient cooling to 0 degrees Fahrenheit. Locate condensing unit on the east side of the building.

c. Remove existing Carrier 3-ton ground-mounted RTU (DX & gas, dated 2018) located near the southwest corner of the original building, and associated ductwork and air devices.

d. Provide new ground-mounted heat pump RTU located near the southwest corner of the original building, and mounted on minimum 6” tall concrete housekeeping pad. Alternatively, provide new heat pump split system in west Mechanical 123 if space allows. Provide distribution ductwork to support new southeast building addition as well as existing adjacent, revised room layouts.

e. Remove existing Carrier 4-ton split system (DX & gas, dated 2018) located in west Mechanical 123. Provide new heat pump split system. Revise distribution ductwork to support proposed room layouts.

f. Demolish existing Luxaire 5-ton split system (DX & gas, dated 2018 or newer) located in northwest Mechanical 113. Provide new heat pump split system. Existing duct distribution system currently serves the west and north exposures of the building. Revise distribution ductwork to support proposed room layouts.

g. Remove existing Carrier 5-ton split system (DX & gas, dated 2018) located in northwest Mechanical 113. Provide new heat pump split system. Existing duct distribution system currently serves the existing central assembly room. Revise distribution ductwork to support proposed room layouts.

h. Remove existing Carrier 5-ton split system (DX & gas, dated 2018) located in northwest Mechanical 113. Provide new heat pump split system. Existing duct distribution system currently serves the existing entry lobby and east exposure of the building. Revise distribution ductwork to support proposed room layouts.

i. Existing mechanical systems are currently tied to the Base's EMCS in Building 450. Provide BACNET DDC controls for each new mechanical system as described in Section 3.5.5