19th Civil Engineer Squadron Mechanical Engineering Design Criteria and Expectations for LRAFB

General:

1. It is not the intent of these standards to inhibit design creativity. The intent is to introduce the designer to LRAFB standard design practices.
2. **It is not the intent of this document to address every facility type that may have tailored design criteria outlined in other specification documents (such as UFGS or others). However, when the design standards outlined herein are found to be *more stringent*, the standards herein shall supersede other outside criteria.**
3. Contractor (or designer) shall, upon each design submittal (35%, 65%, etc.), submit a summary page outlining any aspects of the design that are unclear or irreconcilable (in their view) with this document and cite the reference.
4. Sustainability
    a. Designs shall comply with the latest edition of ASHRAE 90.1, ETL 94-04, AFP 32-1192 and UFC 3-400-01, 3-401-01, 3-410-01, 3-410-02, 3-420-01, 3-430-05, 3-600-01, and 3-600-02. Selected projects will be required to prove compliance with this standard via one of the recognized validation tools (COM-Check, BLAST, etc.). Details of this validation shall be discussed at the design charrette. The design-to building energy budget for renovation and new construction projects is 0.078326 mbtu/sf per annum in accordance with EO 3123.
    b. MILCON projects are expected to meet minimum LEED criteria for sustainable design. Each such project will define a rating expectation (silver platinum, gold, etc.), and decisions will be required on which ones are attainable for the project.
    c. A life-cycle cost analysis is expected if there is no base requirement for a particular technology (ex: VAV vs. dedicated OSA systems, air-cooled package chiller vs. cooling tower). Such analysis is expected to be integral with the energy compliance in item (a) above. Results of that analysis, and resulting recommendations, are expected at the 35% design submittal.
    d. Guidance on energy efficiency requirements for specific equipment (heat pumps, water heaters, etc.) are found at the Federal Energy Management Program website (http://www.eere.energy.gov/femp/technologies/eeproducts.cfm). **Federal law requires the Air Force to purchase equipment meeting these recommendations, as noted on the website.**
    e. All designs shall consider recycled material products. Products that utilize recycled materials shall be highlighted in the design analysis.
5. Security
    a. All designs shall comply with the DOD Anti-Terrorism/Force Protection standards. These standards affect the placement of outside air ducts, emergency shutoff controls, and the location and condition of outdoor equipment.

b. Some Little Rock AFB projects require special security considerations, over and above those for anti-terrorism/force protection. The need for any such security provisions needs to be discussed at the design charrette. The following documents contain detailed guidance for specific items that have affected HVAC systems in past projects. Additional project-specific documents and guidance may also be provided.

i. Director of Central Intelligence Directive (DCID) 6/9 Physical Security Standards for Sensitive Compartmented Information Facilities for all SCIF requirements. The acoustical standards are also employed for all areas that permit secure conversation. This can drive the need for duct silencers or other sound attenuation techniques.

ii. DOD 5200.1-R Information Security Program addresses vaults and secure rooms requiring open/closed storage or containing valuable items. This can require non-passable duct sizes (<96 in^2) or barriers to prevent covert entry.

iii. MIL-HDBK-1013-1/A Design Guidelines for Physical Security of Facilities provides details on ductwork barriers. Commercial products may or may not meet these standards.

6. All designs shall comply with the seismic restraint requirements of US Army Corps of Engineers Technical Instructions 809-4 and 809-5. ETL 00-5 was canceled as of 10 Nov. '05.

7. All underground piping systems shall comply with the cathodic protection standards of UFC 3-570-06. The base puts a strong emphasis on the use of plastic pipe, where permitted by code, to obviate the need for sacrificial anodes or active cathodic protection.

8. All designs shall comply with the reliability and maintainability design checklist (ETL 01-01) and the Little Rock AFB constructability checklist.

Heating, Ventilating and Air Conditioning Systems

1. Load calculations shall use the following outside conditions, as defined for Little Rock AFB in the most recent ASHRAE Fundamentals Handbook.

   a. Cooling: ASHRAE 0.4% dry bulb/mean wet bulb

   b. Dehumidification: ASHRAE 0.4% dewpoint/mean dry bulb

   c. Heating: ASHRAE 99% dry bulb.

   d. Indoor setpoints:

      i. Cooling: 74F at 50% relative humidity

      ii. Heating: 72F

   e. Ambient temperature 105 F (Cooling) & 0 F (Heating)

   The ambient conditions are for outside equipment only.

2. All systems shall fully comply with the latest edition of ASHRAE 62-2001, including all interpretations, addenda and errata (available for free on the ASHRAE website). All VAV system designs shall comply with the multiple-zone equation 6-1. The variable occupancy allowances in 6.1.3.4 can be applied to Little Rock AFB designs, so long as <u>all</u> criteria are met.

3. There is no smoking in Little Rock AFB facilities. Any provisions for smoking rooms or shelters will be addressed as project-specific items.
4. The base cannot accept use of Class I refrigerants. AFI 32-7086 section 4.8.2 requires that the Air Force not procure new facility systems requiring Class II ODS if the system is scheduled to remain in the Air Force inventory after 1 January 2020. Currently the industry can only support the above statement on Chillers 140 tons and larger. Until the industry can support this, chillers 140 tons and smaller may contain Class II ODS refrigerants (R-22). (The previous statement will expire on December 31, 2007). If at any time the industry can support the use of R134a for any size chiller, the Base would require the use of the R134a machine in lieu of an R-22 machine. The base does not accept chillers containing refrigerant blends.
5. The project designer shall develop and provide a complete copy of the HVAC heating, cooling and ventilation loads analysis reports, as well as documentation of input conditions to the model (R-values, room sizes, etc.). The building envelope for new and previously un-conditioned space shall comply with ASHRAE 90.1. The analysis shall include written validation that the design complies with ASHRAE 62 and ASHRAE 55-2004. This information is typically provided with the 35% design submittal.
6. HVAC designs shall comply with all provisions of ETL 04-3, *Design Criteria for Prevention of Mold in Air Force Facilities*, which addresses the prevention of mold. The base has experienced some humidity control problems in both new and old buildings. The usual culprits are either (1) quick sensible conditioning that doesn't "wring out" the water vapor, (2) cycling of the cooling system, such that untreated outside air is sent to rooms, or (3) poor design/construction of the building envelope. It is imperative that rooms susceptible to these conditions be explicitly looked at, such as conference rooms, auditoriums, and large service bays with large doors but relatively low sensible heat loads. It is also imperative that the mechanical engineer works with the project architect in applying ETL 04-3, as many of its requirements apply to wall sections and the envelope. A good source of design instructions for humidity control is the ASHRAE Humidity Control Design Guide (2001).
7. All refrigeration systems shall comply with ASHRAE Standard 15 – Safety Code for Mechanical Refrigeration.
8. Industrial ventilation designs shall comply with the latest edition of "Industrial Ventilation," from the American Conference of Governmental Industrial Hygienists.
9. The following are technology options that the base prefers in projects. There may be instances where a specific project requires something different, but these apply 95% of the time.
    a. Airside
        i. VAV with hot water reheat.
        ii. Given the increasing requirements for outside air and the competing need to reduce energy use, the base is more interested in using dedicated outside air systems (DOAS) to separately treat outside air, rather than just mixing it with the return air. The benefits of using a dedicated DOAS system shall be evaluated for each project. The use of demand control ventilation using VAV dedicated DOAS units with space CO2 sensors shall be considered as well. All DOAS units shall be provided with "Enthalpy" control.

iii. Single-zone systems will only be considered on a limited basis. The Base requires the use of a centralized HVAC systems over multiple, small DX systems. A good use of single zones, that we've seen, is for rooms that have ventilation requirements that are atypical with surrounding spaces. Putting these on dedicated AHUs permits them to be properly ventilated without over-ventilating other areas.

iv. Residential systems shall not be used unless stated or approved otherwise., as most are not designed to continuously condition the required outside air flowrate, even when the inside sensible conditions are met.

b. Waterside: Provide a life cycle cost analysis for all three technologies listed below when the project size is large enough to support such technologies and provide the system that provides the best results.

i. Packaged, air cooled chillers will be equipped with low-ambient feature, unless otherwise stated in the statement of work.

Air cooled chiller system volume shall be sized to the manufacturer's "Maximum" volume allowed by chiller size. Chilled water system piping volume needs to be calculated and documented. Chilled water capacity tank (buffer tank) size shall be calculated as:

CW system volume (piping & coils) – Chiller maximum allowable volume = Capacity Tank Size/Gallons

This will help prevent chiller short cycling in cooler conditions.

Locate capacity tank outside the mechanical room. If the chiller is located in a mechanical yard, locate the tank in the same yard as the chiller.

ii. A separate DX air-side condenser and standalone (off-skid) heat exchanger shall never be used for a chilled water application on base. Chillers shall always have an on-board heat exchanger such that the water chilling and heat rejection process are both contained on-skid.

iii. Chillers shall never be equipped with an on-board pump unless space in the mechanical room does not allow for an off-board (off-skid) CHW system pump. In the event that an on-board pump is the only possible option for the CHW system, the on-board pump MUST be accessible to base maintenance. The contractor shall also provide a spare pump, motor, and pump seals.

iv. Cooling tower systems are NOT allowed on the base unless the project's life cycle cost simple payback is less than 10 years. (Usually, a 100-ton tower or greater when chemical and maintenance costs are considered). For such projects, the Little Rock AFB energy manager will be asked for direction. Any such towers will need consideration of materials, circulation fan exhaust path, basin cleaning, automatic bleed-and-feed system similar to ***Aquatrac part# 2032526*** bleed/feed, timer for biocide feed, LMI Pump Part# 2026095 10 gpd/110 psi and chemical treatment to prevent mold, mildew, Legionnaire's Disease, etc. Tower Tech, Inc. TTGE Series are preferred for 150 ton and above towers due to easy access of fan motors located on bottom of tower and plastic pan. Marley, Primus Towers with polyethylene basins, water distribution system, fan shroud and basin covers are preferred for towers below 150 tons.

v. Ground-source heat pumps: The base has little practical experience with commercial GSHPs, but they are getting a lot attention within the federal government for energy-savings potential. Include GSHPs as candidates in the

aforementioned life-cycle cost analyses, and construct them if they are the best candidate. Before considering analysis on this option, verify if ample site space would be available to support wells. If site space is not available, this technology would not be required to be considered as a HVAC technology for the project.

c. Packaged units are permitted in some conditions – consult with the base before committing to their use. Such units must comply with all of these requirements, including AT/FP provisions for OSA intake location. All exterior ducts shall be externally insulated ASHRAE 90.1 requirements and have metal protective covering. Packaged units shall also have stainless steel heat exchangers to help prevent pre-mature exchanger failure.

d. Ductless mini-splits

    i. Manufacturers, in order of preference, are Mitsubishi, Daikin, and Samsung.

    ii. Units must be BACnet compatible in order to communicate with the facility's EMS system to show alarms.

    iii. Indoor and outdoor units must be easily accessible for maintenance and repair.

    iv. Evaporators (indoor unit) shall not be installed overhead any electrical equipment and condensate pumps (internal or external) shall be easily accessible.

    v. Condensing unit (outside unit) shall be mounted on a housekeeping pad at least 4" above grade. Unit shall also have a dedicated fused disconnect.

e. CRAC Units

    i. Manufacturers, in order of preference, are Liebert and Stulz. All other manufacturers shall have CE approval.

    ii. All CRAC units shall be operational below 90db.

    iii. CRAC units will be BACnet compatible and integrated with the facility's EMS system.

    iv. CRAC units shall have a steam canister style humidifier.

f. Using multiple fan coil units scattered throughout a facility is discouraged, as their maintenance requirements are hard to meet with an ever-shrinking HVAC shop. Consult with the base before committing to their use.

g. Energy recovery wheels are encouraged where funds and conditions permit. Total energy (enthalpy) wheels that are integral to the air handler shall be used in lieu of a plate type air-to-air heat exchanger. Wheel panels shall be individually removable to reduce replacement costs. Run-around loops can be offered as an alternative IF there are reasons not to use wheels, such as contaminated airstreams.

h. Multi-stage gas radiant heaters shall be used in all large, nonconditioned spaces unless directed otherwise. Examples include hangers, vehicle repair areas, and large workshops.

    i. Radiant heaters shall be vacuum-type with sidewall intake and exhaust for large heating spaces.

ii. Radiant heater units shall have Schedule 40 welded steel tubes and cast iron burner combustion chamber.

iii. All radiant burners shall have a local disconnect switch located at the burner for maintenance purposes.

iv. Single pass radiant units are allowed for small spaces pending engineering approval.

v. Single pass radiant units may be used requiring 19 CES approval. However, units must have intake air filtration.

vi. All vacuum pumps will be accessible for maintenance purposes. If not accessible, requires work platforms at pump.

vii. LRAFB approved manufacturers, in order of preference, are Roberts-Gordon Co., Ray-Vac, Detroit Radiant, Re-Verber-Ray, and Advanced Radiant Systems.

10. Specific Airside Requirements

a. In general, air handlers need to reflect the best qualities that manufacturers provide today, such as double walls with insulation, gasketed access panels, vibration-isolated fans, isolation valves on supply and return piping for coils, etc.

b. We do not want air handlers on roofs unless there is no alternative. The base will obviously relent if there is flat out no other choice, but there are almost always other choices.

c. Specs shall require that the contractor provide an extra set of filters and a spare fan belt(s) for each air handler and fan, in addition to whatever filters are consumed during commissioning.

d. All air handlers shall have their cooling coils upstream of the heating coils so that controls for re-heat can be implemented later, if needed. Systems without this arrangement are more expensive to establish humidity control, as extra equipment such as electric strips or wheels are required for the reheat.

e. Coils shall have dedicated isolation valves on supply and return lines, as well as unions (or flanges), to facilitate coil removal. Multiple unions (or flange sets) may be needed upstream and downstream of the coil in order to facilitate piping removal first before coils can be removed. The designer shall ensure that enough space has been provided to remove the full coil width + (6) linear feet. In the event that this space cannot be provided, LRAFB shall be notified for approval.

f. All coils, regardless of service, shall have drain pans in order to facilitate coil cleaning.

g. All coils shall have an ultraviolet light to prevent mold growth in the coil. Ultraviolet lights shall be clearly visible and accessible via the unit's access panel/door. Light shall also have a dedicated manual on/off switch outside the unit with a label.

h. Coil condensate lines shall be made of DWV PVC tubing (min. Schedule 40), with appropriate p-trap and vent. A union shall be installed on the nipple connected to the AHU drain pan so the p-trap can be removed from AHU. Unions shall also be installed on the upstream and downstream sides of the p-trap for ease of removal. The line shall be run to the nearest floor drain (indirect connection). If a drain is unavailable, it can be run outside into an approved French drain or storm drain.

i. Unless otherwise required, all systems shall be equipped with MERV 8 (aka 30%) pleated air filters.

j. Ductwork shall comply with SMACNA ductwork construction standards. Ducts shall be galvanized sheet metal – ideally round but will accept square or rectangular where needed. Seal all supply, return and exhaust duct connections with mastic to meet SMACNA Class A. Flex duct will only be accepted for the purpose of placing diffusers and grilles in a suspended ceiling with a length not to exceed 3 feet with no turns. All supply, return and exhaust ductwork shall be externally insulated to meet ASHRAE 90.1 minimum requirements. The base does not allow internal duct lining. All exterior HVAC ducts shall be painted "Satin Bronzetone" from Sherwin Williams ProMar Bronzetone Enamel Custom Colors, or "SW 7041 "Van Dyke Brown" depending upon location. Coordinate with LRAFB Architect for correct color selection.

k. Merely wrapping the ductwork with insulation does not properly seal and condensate develops at punctures or poorly sealed joints. Rectangular and square ductwork located inside a facility shall be insulated externally with foiled backed Owens Corning Type 703 semi-rigid (or equal) FSK-faced insulation. Board thickness shall be R-8 rated as a minimum standard. Designer shall check manufacturer data to ensure that thickness is adequate to prevent condensation on the outside surface of the FSK. All joints shall be sealed with a vapor retarding sealant accordance with NAIMA and MICA installation protocols. If other similar simi-rigid insulation products are submitted for approval, the contractor shall also attach the installation protocols or standards recommended for the installation for CE review.

l. The use of duct sox shall be permitted in large open areas requiring heating and cooling. Duct sox may not be used with VAV systems unless the terminal dedicated to the duct sox run out maintains a constant flow or enough pressure to maintain the ducts' shape.

m. All HVAC return shall be ducted – the base will not accept plenum or hallway return systems. We will not cry foul if this forces the use of return or relief fans in a design. We've had many problems with air balancing and humidity control with such systems, and some of these arrangements no longer meet building and life safety codes.

n. All supply diffusers shall have insulation to prevent condensation. This shall be explicitly noted in either the specs or drawings.

o. Exhaust, relief and outside air intake openings shall be mounted either above the roof or high on sidewalls to meet AT/FP requirements. Spacing shall comply with the Arkansas Mechanical Code. Exterior surfaces shall be painted to a color selected by the base Contracting Officer – we have a lot of trouble getting this done if it is not explicitly noted in the drawings or specs.

p. Supply ducts shall have manual balancing valves, with extensions as needed to accommodate external insulation. The contractor shall not use diffuser dampers for balancing.

q. Unless specifically told otherwise in the project, all HVAC projects will include replacement of local exhaust fans in the affected areas (bathrooms, janitor's closets, etc.). As most of these fans can influence airside balancing, their controls need to be thought out with the rest of the HVAC system and explicitly documented in the control drawings.

r. Smoke and fire dampers shall be located per IBC requirements. A chart shall be provided on the drawings indicating what IBC paragraphs drive the use of these dampers.

s. Access doors shall be insulated and located at all operable internal ductwork items. Access doors shall be of sufficient size to allow easy manual reset of smoke and fire dampers. Access shall also be provided immediately upstream and downstream of all ductwork sections with turning vanes. Where AT/FP provisions require security bar installation, access doors shall be located where personnel do not have to reach through security bars to access the smoke or fire damper. All access doors shall be large enough to span at least ½ the width of the duct. Example: a 24" wide duct shall have a minimum 12"x12" door for access.

t. Any structural designs for suspended HVAC units, including make-up air units (MAUs), shall not have any structural members blocking unit access doors.

u. Exposed ductwork in a finished area or in the interior of a facility, is unacceptable unless it is in a Mechanical Room.

11. Specific Waterside Requirements

a. <u>All taps</u> (or branches) off the main CHWS/R or HWS/R trunklines shall have isolation valves (ball valves) on the branch.

b. Expansion tanks shall have topside flanged openings (see TACO CA or Bell & Gossett 116078 and 116477 tanks) for ease of bladder removal and replacement. Tanks shall also be pre-charged to the make-up water regulator setpoint pressure in order to ensure that the available acceptance volume is not decreased due to any pressure equalization during install.

c. All expansion tanks shall be installed with a ball valve to isolate the tank from the hydronic system. This main isolation ball valve for the tank shall be "lockable" in the open position. In addition, (1) tee (or tap) with pressure gauge (and gauge isolation valve) shall be located on the *system side* of the expansion tank isolation valve. Another tee shall be located on the *tank side* of the main isolation valve. The *tank side* tee branch shall have another gauge (with gauge isolation) and a ball valve downstream of the gauge to serve as a drain valve. The outlet of this drain valve shall be routed to the nearest floor drain.

d. All HVAC piping shall be covered with appropriate fiberglass, Armaflex, or foamglass insulation (with appropriate sheathing).

Hydronic piping shall be insulated in accordance with NAIMA pipe insulation guidelines (Guide to Insulating Chilled Water Systems, 1ST Edition (or latest); PUB# CI228 6/15).

Exterior, above-grade water pipes shall have aluminum covers.

Underground water piping shall be foamglass wrapped with tar paper and encapsulated with aluminum jacketing. Exterior refrigerant lines shall be secured to C-channel bracing, insulated with Armaflex (rated for refrigerant lines), aluminum jacket over the Armaflex, and finally a metal protective cover to protect the lines from human traffic.

e. Chilled water system with exterior water pipes shall have a 30% propylene glycol mix, whether they are operational in the wintertime or not. Hot water heating systems that require a large amount of outside air (make-up air units, air handling units, and unit heaters in mechanical room) shall have 30% propylene glycol. Draining is an

acceptable alternative for cooling tower systems only if the unit does not need to run in the winter. The base will not accept ethylene glycol. Automatic glycol feeders are not required.

f. Chilled water and hot water HVAC system(s) shall have dedicated make-up water supply, tied into the suction side of each system pump respectively. Make-up water train shall include isolation valve (ball valve), a pressure regulating valve (with bypass and valve), pressure relief valve, and another isolation ball valve. Pressure gauges shall also be installed on both sides of the pressure regulating valve. The train shall also include a mechanical water meter to indicate a leak in the system. Preferred regulator valve is Bell & Gossett.

g. All package chillers shall have quick-connect fittings on supply and return to allow connection of a backup chiller. The connections are typically located outside, above-grade and near the chiller. Temporary Chiller Connections (on the building system side) shall be aluminum cam and groove quick connect fitting. The quick connect fittings shall match the building's system supply/return sizes.

   All temporary chiller connections shall have a fused disconnect near the temporary chiller connections.

h. All air-cooled chillers and cooling towers shall have HVAC air intake filter screens in lieu of hail guards or decorative air intake panels. Filters shall be field installed and equal to Arkansas Filter Inc., "Industrial" filter system with self-tapping stud adapter fastening system. (John Carrell 501-834-5837)

i. Provide 2nd through 5th year extended compressor warranty for all chillers.

j. The base prefers base-mounted, horizontal split-case centrifugal pumps. In-line pumps may only be used if the following criteria are met and CE has approved the plan:

   (1) They are installed at or below (4) feet AFF (for serviceability).

   (2) Are not located behind any equipment that might cause inaccessibility to service and replace.

   (3) The maximum pump weight is 60 lbs.

   (4) The pump and piping are firmly supported (supports on both sides of the pump).

   All base mounted pumps shall be mounted to a base (or skid) with a drip-pan and piping routed to the nearest floor drain. The base will not accept pumps mounted directly to the concrete floor. Pump base (skid) shall be mounted on a concrete housekeeping pad with isolators for vibration attenuation. The pump nameplates and data plates shall be mounted on the skid and clearly visible. All pump connections shall be flanged. Threaded connections on pumps will not be accepted. Chilled water pumps volutes/casings shall not be insulated. Contractor shall terminate chilled water piping insulation at the top of the end suction diffuser and install an additional drip pan underneath (with a drain port). Tie drain port into the pump base drain pan piping. On the discharge side, contractor shall only insulate downstream of the discharge flange. Preferred pump manufacturers, in order of preference, are Bell & Gossett, Flowserve, and Willow.

k. All CHW and HW hydronic system pumps (main loop pumps) shall have 100% redundant spare units. In general, (1) pump (at its maximum RPM) should be sized to 100% of the design flow capacity at the maximum required system head. A redundant pump (with equivalent specs) shall be installed in parallel as a standby unit.

i. Pump motors shall be sized to cover the full range of BHP demand of the next standard size impeller for the pump.

ii. Both pumps shall be equipped with VFDs. VFDs shall have "hand" or "auto" modes (HOA capability). **The designer shall clearly define (in the design drawings) the method of VFD control in automatic mode.**

iii. The plant controller shall be programmed to alternate the primary and standby pumps each month such that equal usage is distributed.

l. All pumps shall be equipped with vibration isolators and a differential pressure (dP) gauge. Prior to commissioning and coupling the pump and motor, all pump housings and drive shafts shall be laser-aligned.

m. All piping connected to base mounted pumps shall be properly supported by pipe hangers. All end suction diffusers shall have supplemental, adjustable height pipe stand support, such that all thermal expansion will be directed away from the pump connection (upward for hot water). For chilled water, the designer shall ensure that any piping contraction will not overload the pump connection after the pipe weight is re-distributed.

n. All coils that are located outside shall be equipped with hail guards.

o. All coils, chillers, and boilers shall be equipped with entering/exiting temperature gauges with English measurement scales, i.e. degrees Fahrenheit, psig, and a dP gauge.

p. All chillers and boilers shall have a mechanical flow switch that prevents their operation if the system pumps are not on.

q. Each hot water and chilled water system shall include a filter feeder equipped with an in-line filter. Filtration Plus Model #8-15-1P-1-150-CS-VS-PB-DP is the standardized filter used for the base's water treatment contract. This allows one standard sock filter Bench Stock. Filter shall be piped into the system such that pumps will circulate through the filter. A 1" gate valve located at the tap point on the main supply/return lines shall be provided for system isolation and a 1" ball valve located at the filter for maintenance. Filter drain port shall be piped to nearest drain. A sight glass shall be included to permit watercolor comparison with manufacturer's color charts.

r. Patterson-Kelley MODU-FIRE and Hurts 4VT Cyclone hot water boilers are preferred, as dictated by design loads.

Units shall have failure isolation package capable of storing at least (6) events and communicating with EMCS.

All boilers shall have intake air filters.

Atmospheric boilers and condensing boilers are <u>not</u> <u>permitted</u>.

The use of "Tankless" heaters as a means of hot water facility heating is not allowed.

s. The Base does not allow the use of butterfly valves for isolation on branches to equipment. Ball valves or gate valves are acceptable.

t. All dielectric unions shall have a gate valve installed to provide isolation. Isolation is necessary to replace a leaking union without draining the entire system.

12. Controls

    a. Unless specifically told otherwise, all new HVAC systems shall be connected to the base's existing Trane Tracer Ensemble, via CE COINE connection, EMCS, and all construction contracts shall include the programming work and support needed to get all EMCS workstations to work with the new equipment. The EMCS must be able to display both graphical and tabular information on all HVAC equipment. This means all HVAC equipment (Boilers, AHU's, DOAS, Package Units, etc.) will be connected to the base EMCS system. If a piece of equipment cannot be directly connected to the EMCS system, it will require BACnet (preferred) protocol device and programing. The EMCS operator must be able to change set points and command equipment from the console. The Little Rock Trane Office can provide details on the nature of this connection. The base will not accept proposals that require alternative workstations for the EMCS operator. The Trane Office also has some standard control and EMCS specifications for Little Rock AFB that permit competition while maintaining this user requirement.

    b. All chillers and boilers shall also be equipped with a BACnet communication card such that the plant controller can retrieve certain "read only" points from the unit controller, such as alarm status, number of active stages, and similar data.

    c. Airside Economizer: ASHRAE 90.1-2001 does not require Little Rock AFB to have ANY economizer. We have lots of complaints when airside economizers kick in on cool, damp days, and we'd prefer not to have them. Our concerns can be addressed by having separate dry-bulb temp and dewpoint sensors, both of which must indicate acceptable conditions.

    d. Water-side economizers should be considered based on life cycle cost simple payback of 10 years or less, anytime the project has a year-round cooling load and a cooling tower is selected for the project.

    e. VAV shall be controlled with a "critical zone" reset strategy, which uses VAV damper position to determine the critical zone and corresponding fan speed. This has been found to save more energy than using a pressure sensor 2/3 the way down the longest duct. If leaving air temperature (LAT) reset is used during unoccupied periods, a dew point sensor must be used to override the reset. Dew point sensors are better than relative humidity sensors for controlling condensation and mold risk.

    f. All VAV terminal unit controls shall be hardwired back to the unit controls and BCU. Preferred VAV controller is a Trane UC210 with a Belimo actuator. This permits both the exchange of data/commands between the central unit and the terminal units, as well as exchange with the EMCS operator.

    g. VAV terminal units shall be equipped with outlet air temperatures sensors and air flow sensors. These are critical for remote, reliable troubleshooting.

    h. AHU supply fan control shall be by VFD. We do <u>not</u> want inlet guide vanes, as they don't save any energy.

    i. All VAV terminals shall have a drip-pan under the reheat coil that extends to the section of hot water lines that are not typically insulated (isolation valves, balancing valve, actuated valve). Drip-pan shall be equipped with a float switch (or some sort of condensate sensing device).

    j. All VAV HVAC systems shall have the following safety sequences programmed into the controllers in order to prevent condensate damage to ceilings under VAV boxes

and also to prevent condensation inside HW boilers if there is a problem with the re-heat operation.

i. All plant controllers serving VAV systems shall be programmed to disable the HW pumps and AHUs:

1. If the HWS temperature falls below 120 degrees while the HW system is enabled (this safety will require some sort of timer delay for startup).

   OR

2. Condensate is sensed in any VAV drip-pan (see Point 12.i above).

This shutdown sequence ensures an increased awareness by the user (and therefore maintenance) that a problem exists, and also protects HW equipment from condensing due to VAV demands for re-heat and/or de-humidification if the heat source is inoperable.

k. Buildings shall be maintained at positive pressure at all times. Pressure control can be attained through the following:

i. The base prefers that a return fan is installed, equipped with VFD control. The preferred (and more reliable) method of control would be a percentage of the supply fan speed. The exact percentage would not be determined until the building "tightness" is somewhat determined during TAB. The percentage setpoint shall be adjustable through the control panel.

ii. The other control method could be a more active scheme, controlled by a differential pressure sensor comparing the occupied space to atmospheric conditions. The return fan's speed would be modulated accordingly to a certain dP setpoint.

l. All HVAC controls and EMCS wiring shall be in metal conduit – it is permitted to reference specific Division 16 requirements for details on sizes, materials, etc. The junction boxes shall be labeled separately from those for other systems. Electrical conduit carrying EMCS signal and voltage wire will be placed in "Orange" conduit and EMCS communication wiring will be ran in purple conduit and fire alarm will be ran in red conduit, this will allow for easy identification while troubleshooting.

m. Control Contractor shall provide the Media Access Control (MAC) information to the Government (19 COMM) for IP address assignment.

n. Control Contractor shall coordinate with 19th Communication Squadron to test communication from the facility controller through the COINv2 server to building 539 19th CES EMCS Shop prior to project completion and the warranty phase of the contract is initiated. This ensures that the EMCS shop can log data and run reports to monitor the HVAC system during warranty period.

o. An electric meter like Trane's E50 series (or equal) shall be installed. Meter shall provide (at minimum) these data outputs: Power (kW), Energy (kWh), Current and Voltage (3-phase average, by phase Line-Line and like neutral). Power points shall be as follows:

i. Power: real, reactive, apparent 3-phase total and per phase

ii. Power factor: 3-phase average and per phase, Frequency

iii. Power demand: most recent peak

iv. Demand configuration: fixed, rolling block, and external sync to real time clock (using BACnet time synchronization).

Meter shall be located in main electrical room and connected to the main incoming power panel. Meter must be connected to the building EMCS controller and programmed for usage and reporting data.

p. A water meter like Badger M2K series meter (or equal) must be connected to the facility's main water supply. Contractor shall ensure that Trane can connect to the meter and provide pulse rates (or separate transmitter if necessary) to read meter. Meter needs to be connected to the building EMCS controller and programmed for reports and usage data.

q. A gas meter like Onicon F-5500 series insertion type (for retrofit projects) or Elster Rotary Gas meter (for new construction) (or equal) shall be connected to the main gas supply. Contractor shall ensure Trane can connect to the meter and provide pulse rates (or separate transmitter if necessary) to read meter. Meter must be connected to the building EMCS.

r. All new Trane Ensemble SC building controllers shall have a large display screen mounted next to the controller.

13. Commissioning

a. For new HVAC systems, the contractor shall be responsible for developing and executing an HVAC commissioning plan per Corps of Engineers standard specifications section 230800.0010. Additional technical guidance on commissioning can be obtained from the Federal Energy Management Program website and ASHRAE Guideline 1. Contractor will notify Construction Management when commissioning is scheduled. Construction Management shall notify R&O and shop personnel in order to verify commissioning.

b. All new or modified air and water-side systems shall be tested, adjusted and balanced, and a full report shall be provided in the O&M manuals. Report shall include copies of certification of the technicians and calibration of equipment.

c. All new ductwork shall be leak-tested per SMACNA, and this shall be explicitly noted in the specs, with the final leak report included in the O&M manuals.

d. All new or modified water-side system piping shall be flushed, cleaned, chemically cleaned, and propylene glycol added if required.

14. There shall be explicit details and/or sequences of operation for all unit heaters and small-scale HVAC systems.

15. Mechanical room ventilation:

a. Projects with existing equipment

i. Mechanical rooms shall include open/close dampers on mechanical louvers unless the louvers are required for boiler/hot water combustion air.

ii. Any outside air supply air vents or louvers (excluding fans blowing into the room) shall have US Mesh #8 screens to prevent

entry of mid/large sized insects. Mechanical rooms shall have positive pressure ventilation (fan blowing into the room) to prevent natural gas exhaust from being sucked out of the flues and into the mechanical space.

b. Projects with new equipment / new construction

i. New hydronic and domestic HW boilers shall be specified as positive pressure ventilating.

ii. Hew hydronic and domestic boilers shall have dedicated combustion air intake piping so that louvers in the external walls of the mechanical room can be minimized or eliminated.

16. Exterior mechanical rooms shall be provided with a sufficient natural gas, electric resistance, or hot water unit heater to prevent freezing of these systems. A cost analysis must be done to decide what heat source makes the most economical sense. This analysis must be presented in the 35% design submittal. The heater shall be controlled by a hard-wired thermostat separate from any supply fan for the room(s).

17. WARRANTY

a. The following equipment and systems will be provided to the Government with a minimum 2 year warrantee.

1. Direct Expansion Systems 10 tons or larger.
2. Package Systems 10 tons or larger.
3. Variable Frequency Drives.
4. Water Chillers.

b. All warranted systems and equipment utilizing refrigerant will be provided with a minimum 1 year refrigerant warrantee.

c. Warrantee period begins at project completion defined as C.E. Closeout. The Contractor is responsible for acquiring components with a long enough warranty period to cover delivery, installation, testing, commissioning, and any work, mechanical or not, to project completion. The Government will receive all warranted items with a full warrantee period.

Natural Gas:

1. All design and construction shall comply with the Arkansas Gas Code.
2. The following materials shall be used;
   a. Below-grade: Plastic, in accordance with code.
   b. Above-grade: Black Steel.
3. The base requires tracing wire and warning tape on all new underground plastic gas lines, and cathodic jumpers where new plastic pipe interrupts an existing metallic gas line.
4. All building service entrances shall be equipped with a gas meter, regardless of gas usage. This is to comply with UFC 3-400-01. Gas meters shall include a KYZ pulse-code output connected to an AMR transmitter. Provide manufacturer's cut sheet on KYZ pulse coder.

The gas meter shall be explicitly specified in the project specs, and its location identified on the drawings. Large gas meters shall be pad-mounted.

5. All exterior gas piping and specialties (regulator, meter, etc.) shall be painted to match adjacent building colors. The base prefers that the meter and regulator be positioned in an inconspicuous area. The regulator shall not be located near an outside air intake or operable window. Meters do not have to be by the roadside, and they do not need a bypass valve.
6. All valves, including below-grade, shall be metal – the shops have had poor results with plastic valves. Metal or plastic fittings, such as tees, are acceptable.
7. Equipment connections shall include stainless steel flex line and a dedicated stop.
8. The designer shall check with the base if it requires an automatic gas-cutoff valve tied to the fire alarm system. This is typically limited to large gas systems, such as in aircraft hangers, but needs to be explicitly determined for each project.

Plumbing:

1. All design and construction for all plumbing services shall comply with the Arkansas Plumbing Code and the Americans with Disabilities Act (ADA).
2. All new water closets whether manual or automatic flushometer shall be a minimum of 1.6 gallons per flush (GPF).
3. All new urinals whether manual or automatic flushometer shall be a minimum of 1.0 gallons per flush (GPF).
4. The following materials shall be used;
    a. Below grade supply: copper or PVC
    b. Above-grade supply: copper and/or PEX
    c. Above grade DWV: PVC (or cast-iron if specifically needed; justification must be provided to engineering)
    d. Below-grade DWV: PVC (or cast-iron if specifically needed; justification must be provided to engineering)
5. PEX Installation and Guidelines
    a. PEX shall be supported a minimum of every 32 inches when running horizontally. If running vertically, it shall be supported every 4 to 6 feet. These supports are critical.
    b. Straps shall be plastic or metal and must be designed to work for plastic pipe. If metal strapping is used, it must not damage the piping during expansion or contraction.
    c. PEX is not meant to be pulled tight; adequate slack or loops for expansion and contraction shall be incorporated into the design and performed during construction. Expansion loop designs and locations shall be clearly called out and details provided to LRAFB during design phase.
    d. Coming out of the wall to fixtures, a PEX to copper stub out, or another type of PEX support (such as drop-ear bend support with a brass nipple) shall be utilized.
    e. PEX A shall be the only PEX piping utilized for plumbing systems.

f. Where allowed, continuous runs are to be used in order to minimize fittings within walls.

g. Where space permits, bend supports shall be used instead of fittings in order to retain pipe continuity and shape as much as possible.

h. If PEX is routed though wooden or metal structure, drilling and nailing protection plate is required.

i. Load bearing structure not to be altered for routing of PEX.

j. PEX to be color coded red for hot water and blue for cold water.

k. PEX main runs that are not dedicated hot or cold water shall not be color coded must be labeled according to service.

l. Plastic or PVC fittings are prohibited.

m. Plastic or PVC valves are prohibited.

n. All valves to be ¼ turn brass utilizing a Uponor (or equivalent spec) type valve.

o. Fittings, valves, and headers within walls without an access panel is prohibited.

p. Under the sink a brass ¼ turn shut-off valve is to be utilized. Then utilize a flex line to the faucet or toilet. If this is a tub or shower, tie directly to the valve with PEX-to-iron pipe adapters.

q. SharkBite fittings are prohibited.

r. All valves and headers are to have an access panel 2” wider and 2” taller than the valve or header for maintenance.

s. All access panels, at a minimum, are required to be large enough to fit tools to make repairs.

t. Fittings or valves withing walls are prohibited unless access panel is provided.

u. All plumbing, regardless of material, routed on an exterior wall, is required be insulated per the State Plumbing Code(s).

v. All PEX piping to be insulated utilizing sleeves.

w. All copper to be insulated utilizing fiberglass.

x. Utilizing PEX underground is prohibited.

y. Exterior fixture (hose bibs, etc.) fittings are required to be a minimum of (2) or more inches from the inside of the wall where connection to the plumbing system piping is made.

z. All plumbing pipe 2” in diameter (or greater) is required to be copper.

aa. All risers (hot and cold) are required to have a valve located on the first floor with easy access to allow for isolation of each riser branch.

bb. Prior to finishing out walls with drywall, all PEX fittings and piping to be checked by contractor and time allowed for the government to fully inspect the plumbing.

cc. Also prior to finishing out walls and ceilings, a hydrostatic test (including operational hot water) shall be performed in order to check all seals at valves, fittings, and any other mechanical joints throughout the system.

dd. The designer shall consider the effect of freezing temperatures upon each mechanical joint and whether permanent deformation of the joint would take place. Any joining material or method that *could* be used in a PEX application but would deform under freezing conditions (and thereby cause leaks upon thawing) shall not be used.

ee. Any codes, industry design guidelines, or other criteria not mentioned in this document shall be explicitly listed in the design phase (in design drawings and submittals).

6. Service Entrance

a. The need for water meters shall be governed by UFC 3-400-01. Selection and design shall comply with Army ETL 1110-3-465, Appendix A. All meters shall measure volume in gallons (not liters). Water meters may be located either in the mechanical room or in a concrete (not plastic) meter box, with the top at grade. The meter shall be equipped with a KYZ pulse-code output connected to an AMR transmitter. Provide manufacturer's cut sheet on KYZ pulse coder.

b. The Base requires a RPZ backflow preventer in the domestic water service entrance. The BFP shall be located in the mechanical room, if at all possible. The BFP shall be located 30" AFF for serviceability. If not, it shall be located above grade in a heated enclosure.

c. The service entrance shall enter the building in a mechanical room, not a janitor's closet or other "user" room.

7. Supply Distribution

a. Makeup water supply to all HVAC systems shall include a RPZ backflow preventer. Each system; chilled water, heating water and when used cooling tower make up shall have independent RPZ's and not be connected off a single unit.. Independent BFP required due to different chemicals utilized in the different systems. Cooling tower water make up will have paralleled RPZ to enable continued system operation during testing or repair actions. The BFP location shall comply with the Arkansas Plumbing Code for height above floor.

b. Each bathroom, kitchen, janitor's closet, etc. shall have an isolation valve on all supply water lines running to it. This is to allow maintenance operations within that area without turning off water to the entire building.

c. The base prefers centralized Rinnai or American Standard tankless hot water heaters with a capacity tank sized for the facility occupant usage and a recirculation loop. 19th CES Utilities Shop will consider "point-of-use" systems for small projects if the conditions or economics warrant.

d. For centralized hot water heaters, the distribution system shall have a return loop and run-around pump w/thermostat control and an on/off switch for maintenance. The base will consider deleting this requirement if the water heater and users are in proximity to each other, or if project costs dictate significant cuts.

e. Urinal shall be hands-free, with a hard-wired power source (no batteries).

f. Water-coolers shall be surface mounted, dual deck water fountains. Semi-recess or recessed fountains are not allowed on LRAFB.

g. Water closets can be either floor or wall mounted. This shall be discussed with the Little Rock AFB architect early in design.

h. Showers shall be equipped with thermostatic mixing valves.

i. Exterior hose bibs shall be freeze-proof and shall include a vacuum breaker. Each project needs to determine if these bibs need to be inside locked boxes, or can instead be the traditional residential type.

j. Provide a hose bib near the outdoor mechanical equipment to support coil cleaning and maintenance.

k. Lawn irrigation systems shall have a separate water meter, with its own EMCS connection. The base prefers that the irrigation water supply branch off of the service entrance prior to the building's water meter.

l. The base may want emergency shower/eyewash stations to be equipped with a flow switch that is connected to a central buzzer/light panel located elsewhere in the facility. This is typically limited to areas where folks may not be able to get immediate assistance, such as aircraft hangers. This needs to be discussed with the user and base fire department early in design. An alternative to the local panel is to attach the switches to the fire alarm system, with dedicated zone ID. Refer to UFC 3-420-01 Appendix D.

m. All temporary connections shall be made via a RPZ backflow preventer.

n. The Base does not allow the use of butterfly valves for isolation purposes and shall not be used. Ball valves or gate valves are acceptable.

8. Drain, Waste and Vent Lines

a. The base wants to minimize the number of floor drains in industrial areas, due to concerns with illegal dumping. This includes drains that are traditionally included with eyewash stations. A project-specific evaluation will be required to determine if the drain is required, or if alternatives exist (ex: test buckets w/socks).

b. The base prefers to minimize cleanout locations in areas subject to high people traffic or high visibility. Cleanout locations shall provide sufficient space for maintenance personnel and equipment.

c. Removable P-traps shall <u>not</u> be used as a substitute for cleanouts.

d. A double cleanout shall be located just outside the building on each sanitary main leaving the building.

e. All external cleanouts shall have a min of a 12"x12"x 4" thick concrete collar (per cleanout) poured around them for protection.

f. Where exposed, ADA lavatory drain lines shall be wrapped in a pre-manufactured insulation product that is either noted in the drawings or identified in the specs. We have had contractors create horrible-looking duct tape and Armaflex pads in the past, and we need specs or drawing notes to stop that.

Fire Suppression:

1. All fire suppression systems shall comply with UFC 3-600-01, the Arkansas State Fire Code, and applicable NFPA standards. There are several additional military standards for specific facilities, including;

a. ETL 98-08: Fire Protection for Existing Aircraft Facilities

b. ETL 02-15: Fire Protection for New Aircraft Facilities

c. ETL 01-18: Fire Protection for Electronic Equipment Installations

2. Fire protections designs shall be accomplished by a registered Fire Protection Engineer as referenced in UFC 3-600-1. All designs shall be a full completed design to include hydraulic calculations and performance design/specification are not allowed by LRAFB.
3. Preferred materials:
    a. Below-grade: AWWA C-900 PVC pipe with iron fittings and building stub-in.
    b. Above-grade: Black steel; grooved 2.5" diameter and larger, and threaded 2" diameter and smaller. Thread-o-lets are often used on base projects for connecting the small lines to the distribution lines.
4. Fire department connections shall be Siamese (2.5"x 2.5"x 4"), and its location shall be coordinated with the base fire department. Ideal locations are close to fire hydrants and roads with multiple entrances/exits. The FDC may on the building wall or at some distance away on a standpipe, depending on project conditions.
5. The base prefers post-mounted indicator valves for service entrances, rather than wall-mounted. NFPA 13 (2007) provides PIV locations in section 8.16.1.3, they are listed in suggested order of preference but LRAFB requires them in the order of preference and if a Contractor cannot meet the requirements, the contractor is required to provide justifications on why they cannot meet the requirements. LRAFB will provide a response to the Contractor's justifications.
6. Outside equipment shall be painted, with color selected by the Contracting Officer. Usually they are painted a dark brown.
7. A double-check backflow preventer that meets the above codes is required at the service entrance including any by-pass lines. The double check backflow preventer shall not be a detector type assembly. "Silver Bullet" type backflow preventers are not acceptable to LRAFB.
8. The base does not require a water meter on the fire suppression service entrance.
9. The base strongly prefers alarm valves to simple flow or pressure switches to trigger the fire alarm system. We've had some sensors tricked by pressure waves in the system, and sometimes the adjustable delay timers don't resolve the false alarm problem.
10. The base prefers mechanical water gongs to those driven by the fire alarm system. The fire department's first responder crew has higher confidence that the event is real if a mechanical device, independent of the smoke/heat/flame detectors, is in alarm.
11. The designer or contractor shall see base input on zoning the fire suppression system. We prefer large buildings to have zoned suppression systems to (1) provide more detailed location data to the fire department when heads are activated, and (2) allow for partial shutdown for maintenance, rather than isolating the entire system. Zones shall be equipped with their own drain lines and tamper switches.
12. Sprinkler heads shall be centered in ceiling tiles – this need to be explicitly noted in the specs and drawings.
13. Flexhead sprinklers are acceptable to LRAFB for use in fire suppression system. They need to be accounted for in the hydraulic calculations.
14. Design drawings need to indicate locations for the following items:
    a. Service entrance and post indicator valve (PIV).

b. Test line locations (Inspectors test station discharge shall be piped to the outside and NOT to a floor drain or sink). Splash blocks are required at discharge point.

c. Drain locations (Main drain shall be piped to the outside and NOT to a floor drain or sink). Splash blocks are required at discharge point.

d. Fire department connection

15. For each project, the designer or contractor shall inquire with the base on the style of head. We have recently started requesting semi-recessed pendants in office space as a good compromise on price and aesthetics. They are either chrome head/escutcheon or a color that matches adjacent surfaces. We will sometimes request concealed heads in areas where there is concern of inadvertent damage to the heads (such as in high-value computer rooms).

16. Heads in mechanical/electrical/comm rooms shall have protective guards.

17. Additions to existing sprinklers systems shall include re-calculation of the hydraulic design.

18. The fire suppression system shall not utilize gate valves.

19. HIGH EXPANSION FOAM SYSTEM FINAL TESTING PLAN

a. All testing will be performed in accordance with the Air Force ETL 02-15, NFPA and 19CES OI 32-10.