

April 2, 2024

**Statement of Work**  
**1086485 - DB Repair Dorm BOLO B4351**  
**Title 1-B Design and Construction**  
**OPP# 1086485**

Project shall include the furnishing of all design, materials, labor, and equipment necessary to perform Title 1-B Design and Construction to repair BOLO Dorm, building 4351 at Barksdale AFB, Louisiana. Perform design and construction work in accordance with UFC, Statement of Work (SOW), Government Provided 35% Drawings Package that consist of 35% drawings (ACAD & PDF), HVAC Heat Load Analysis, Specifications Table of Contents and Base Standards (see attachments 1-5). Construction notice to proceed shall not be provided or onsite construction commence until 100% IFC stamped drawings are approved by the Government. Title 1-B Drawings and Specifications shall be designed in accordance with Unified Facility Criteria (UFC). The ACAD files will be provided to the contractor upon contract award. Since this a large scale project it will require one person as a full-time sight Superintendent as well as an additional person to be a full-time sight Quality Control Manager.

CLIN 1: Title 1-B Design services (paragraphs A-E) & Construction (paragraphs 1-3)

**CLIN 1:**

**Title 1-B Design services (paragraphs A-E)**

Period of Performance: 121 calendar days from Title 1-B Design Notice to Proceed

GENERAL DESCRIPTION: The Architect-Engineer (A-E) shall perform Title 1-B Design services as identified herein. In general, the work will consist of design and repair of BOLO dorm in accordance with the 35% Design Package, this Statement of Work, and Base Standards (see attachments 1-5).

This includes but is not limited to any Architectural, Civil, Structural, Mechanical, Electrical, Plumbing design and Fire Protection required to meet the specific requirements 1-B design services outlined below.

**B. SPECIFIC REQUIREMENTS:**

**1. TITLE 1-B:**

The purpose of the design is to provide a complete set of construction documents. Title 1-B documents will consist of the following, as a minimum:

- a. DRAWINGS: A complete set of construction drawings shall be prepared showing all construction required. Drawings shall be 24" x 36" with Air Force standard title sheet and title blocks. At each submission drawings will also need to be submitted including electronic media both as .pdf and .dwg formats. Drawings shall be submitted in accordance with paragraph C of this statement of work. Facility drawings shall be completed in AutoCAD while site layouts and utilities shall be accomplished in ArcGIS using English measurements with metric in parenthesis. All text shall be readable when drawings are reduced to half-size. All AutoCad drawings shall have the "Bind" command applied, such that each sheet includes all information without references or attachments. All drawing hard copies shall include set left edge binding.
- b. SPECIFICATIONS: A complete set of construction specifications will be prepared by the A-E identifying all areas of work. Specifications shall be on 8-1/2" x 11" sheets and shall be in Construction Specification Institute (CSI) MasterFormat 2004 (50 division) layout. LDOTD and AASHTO specifications shall be included, as required. Final specs shall also be submitted in electronic format.

**C. SUBMITTALS:** Submittals will be required in accordance with the following:

**1. TITLE 1-B:** Title 1-B shall be submitted in the following stages indicated:

a. Title 1-B 65% design: Submit 45 calendar days (or earlier) after Title 1-B Design Notice to Proceed.

Submit the following documents:

- |                         |                               |
|-------------------------|-------------------------------|
| 1) Preliminary Drawings | 5 copies (two sets half size) |
| 2) Specifications       | 3 copies                      |
| 3) Electronic Documents | 2 DVD containing:             |
- Printable Drawings in PDF Format saved individually by sheet, collectively by discipline **AND** as a single file.
  - Drawings in AutoCAD latest revision Format drawn full scale and containing all text, graphic, and dimensional information found within the construction drawings, to include civil, structural, mechanical, electrical, and plumbing drawings. Drawings should be packaged to preserve any linked external references, blocks, and should include a .CTB file so that drawings can be plotted with their intended line weights.
  - Specifications in Searchable PDF and Microsoft Word format **AND** collectively as a single file.

Above documents must be in sufficient detail to show the design approach for all areas.

b. Title 1-B 95% design: Submit 91 calendar days (or earlier) after Title 1-B Design Notice to Proceed.

Submit the following documents:

- 1) **Responses to all 65% Comments**
- 2) Drawings 5 copies (two sets half size)
- 3) Specifications 3 copies
- 4) Electronic Documents 2 DVD containing:
  - Printable Drawings in PDF Format saved individually by sheet, collectively by discipline **AND** as a single file.
  - Drawings in AutoCAD latest revision Format drawn full scale and containing all text, graphic, and dimensional information found within the construction drawings, to include civil, structural, mechanical, electrical, and plumbing drawings. Drawings should be packaged to preserve any linked external references, blocks, and should include a .CTB file so that drawings can be plotted with their intended line weights.
  - Specifications in Searchable PDF and Microsoft Word format **AND** collectively as a single file.

Above documents should basically be 100% complete documents for final Air Force review.

- c. Title 1-B 100% design, Final Plans: Submit 121 calendar days after Title 1-B Design Notice to Proceed.  
Submit the following documents:

- 1) **Responses to all 95% Comments**
- 2) Drawings 6 copies, paper (two sets half size)
- 3) Specifications 4 copies (8.5" x 11") bound
- 4) Electronic Documents 2 DVD containing:
  - Final Printable Drawings in PDF Format saved individually by sheet, collectively by discipline **AND** as a single file.
  - Drawings in AutoCAD latest revision Format drawn full scale and containing all text, graphic, and dimensional information found within the construction drawings, to include civil, structural, mechanical, electrical, and plumbing drawings. Drawings should be packaged to preserve any linked external references, blocks, and should include a .CTB file so that drawings can be plotted with their intended line weights.
  - Specifications in Searchable PDF and Microsoft Word format **AND** collectively as a single file.

D. GOVERNMENT REVIEWS: The government will normally review each submittal by the contractor per the contract. The government reserves the right to extend review times if A-E designs warrant additional review and /or workloads preclude reviews within specified times. **After government review comments are submitted to the Designer for the 65% and 95% stages of review, the government requires a design review meeting to discuss all comments.**

E. OPTIONAL INSPECTION SERVICES: No optional inspection services will be utilized for this project.

F. PERFORMANCE TIME:

1. Title 1-B 65% shall be submitted within forty five (45) calendar days after receiving the Title 1-B Design Notice to Proceed.
2. The Air Force will take up to sixteen (16) calendar days to review the Title 1-B 65% report and submit to contracting their evaluations and comments. If needed, a design/informative meeting will occur between Contracting, 2CES, the Prime Contractor and any other involved personnel for clarification of the reviews.
3. Title 1-B 95% shall be submitted within ninety one (91) calendar days after receiving the Title 1-B Design Notice to Proceed
4. The Air Force will take up to sixteen (16) calendar days for review of the Title 1-B 95% design package and schedule another meeting if needed.
5. Once the 95% drawings are **approved**, the A-E will have fourteen (14) days to provide to the government a final 100% set of plans consisting of signed original drawings and complete specifications as required by paragraph C.1.c.

**Construction (paragraphs 1-3)**

Period of Performance: 450 Calendar Days from the Construction Notice to Proceed

1. Code Compliance:

Where applicable, all work performed under this contract shall meet all federal and local codes and standards including but not limited to UFC's, Occupational Safety and Health Act of 1970, National Electric Code, International Plumbing Code, International Mechanical Code, National Fire Protection, etc. Where any ambiguity exists between standards, the most stringent shall apply.

2. Requirements:

- A. Repair BOLO Dorm. All work shall comply with contractor's Title 1-B Design 100% IFC stamped construction documents (SOW, Drawings and Specifications).
- B. Contractor shall verify actual existing building, site, utilities, sizes, locations, existing conditions prior to bid. Any discrepancies discovered shall be provided to the Contracting Officer prior to bid.
- C. Contractor shall minimize utility outages conforming to the drawings.
- D. Contractor shall coordinate scheduled utility outages at least 14 days in advance with the contracting office and with the user prior to any interruption of utilities.
- E. All material submittals, as-built drawings, operation and maintenance manuals and other closeout documents shall comply with the drawings.

3. General Requirements:

- A. All equipment, supplies and materials provided / installed shall be new and not refurbished.
- B. Contractor shall obtain a 2 CES Digging Permit (AF Form 103) prior to beginning work, if applicable.
- C. Demolition Materials: All demolition materials under this contract become property of the Contractor and must be removed completely from the Base unless indicated otherwise within.
- D. Acceptance of completed work will be based on its conformance to the contract. Nonconforming work will be rejected. The United States Air Force is not obligated to accept nonconforming work at a reduced price. The contractor shall start correction of rejected work within 10 calendar days after receipt of the rejection notice.
- E. It will be the Contractor's responsibility to visit the site and become familiar with the facility and include all work and equipment required in the bid. Contractor shall maintain a clean site and fully restored site upon completion with minimal evidence of prior construction.
- F. The contractor will be responsible for and incur any and all labor and material costs required to repair any damages to government facilities that occurred during and as result of demolition operations under this contract. This damage will be identified as separate from the condition of the facilities as identified during the initial inspection. The damage will be identified, but not limited, to the following items.
  - a. Government gas, water, waste, communications and electric transmission and distribution systems.
  - b. Adjacent occupant personal property
  - c. Existing trees
  - d. Roadways and Parking Areas
- G. The contractor will begin work not earlier than 7:30 am each workday. Work will not be performed later than 4:30 pm.
- H. Inspections will be conducted by the Contracting Officer and /or Contracting Officer's Representative and the contractor's manager.
- I. All discrepancies, if any, shall be properly annotated and submitted to contracting.

**SOW ADDITIONS**

**LAY-DOWN AREA TEMPORARY FENCING**

1. The Contractor shall furnish all labor, materials, and equipment necessary to provide secure and visually aesthetic temporary fencing for surrounding project equipment and material in lay-down areas.

Work shall include:

- a. Clearing area of all encumbrances to safe erection of fencing.
- b. Provide fence that is: metal tube frame; metal woven wire mesh (minimum 11 gauge); minimum 6 feet in height.
- c. Provide integral to fence visual blocking material, either slat weave or sheet goods.
- d. Erecting fence in such manner as to prevent loss of fencing or blocking due to inclement weather.
- e. At no time shall fence interfere with fire egress paths or fire equipment ingress, to include periods when gates are in operation.

Contractor shall submit cut sheets on all items for installation, prior to procurement, for approval by the C.E. Architect. Complete the design as indicated on drawings in accordance with UFC 1-200-01 General Building Requirements which includes the latest editions of the International Building Code and NFPA Life Safety Code, and Americans with Disabilities Act. All required work shall be accomplished in accordance with the Barksdale AFB Design Compatibility Guidelines (DCG). All colors and materials shall be selected by the Civil Engineer Architect in accordance with the DCG. Construction shall be conducted in a quality workmanlike manner. Contractor shall take any steps necessary to protect government and occupant property from damage caused by weather or other occurrence while work is in progress.

2. Upon notification of completion by the contractor a determination will be made as to the satisfactory completion and acceptance of the contract specification(s). Any segment of the operation that is not acceptable because of an unsightly or unprofessional appearance will be justification for rejection of the treatment. The contractor will incur all costs, both labor and materials, for reaccomplishment of any unacceptable work identified.

## **BACKGROUND CHECKS FOR CONTRACTOR PERSONNEL REQUIRING ENTRY/ACCESS TO BARKSDALE AFB (JAN 2005)**

Security Forces will conduct a National Crime and Information Center (NCIC) background check on all contractor or subcontractor personnel prior to granting access to the installation.

## **CONSTRUCTION AND DEMOLITION DEBRIS REPORTS**

The following requirement is listed in Attachment 2 of the parent MACC, Environmental Requirements for Contractors Working on Barksdale Air Force Base. These reports are required to be submitted on an AF 3000 Material Submittal and should be incorporated into the AF66 Material Submittal Schedule at time of contract award. Final payment will not be released until C&D reports have been submitted and accepted by the Government. "Construction and Demolition (C&D) debris is generated as a result of construction, renovation, or demolition activities. Although C&D debris is usually considered a single waste stream, the composition actually varies with each activity and the type, size, and location of the structures involved. Disposing of C&D debris in landfills consumes enormous amounts of space and is both economically and environmentally costly. In accordance with AFI 32-7042 and BAFB's Integrated Solid Waste Management Plan (ISWMP), ALL WEIGHTS OF C&D MATERIALS RECYCLED AND DISPOSED MUST BE REPORTED TO THE RECYCLE PROGRAM MANAGER."

## **CONTRACT COMPLETION INSPECTIONS**

The contractor will schedule (preferably with 3 working days' notice) a pre-completion inspection to be held approximately 10 calendar days prior to the expiration of the contract. This inspection may result in a "punch list" indicating items to be furnished or work to be completed by the contractor or subcontractors in order to complete the work specified in the contract documents. This list may not be construed to be all inclusive. A copy of the list will be furnished to the contractor within 2 workdays for his use in completing the contractual work. If the pre-completion inspection results in no "punch list" and the work is complete, this inspection may be considered the "final" inspection as determined by the Contracting Officer. If required, the contractor will be responsible for scheduling the contract completion inspection (preferably with 3 working days' notice) to be held no later than the final day of contract performance. Should this inspection result in a "punchlist", the contractor will have 10 calendar days (after receipt of punchlist) to complete all punchlist items and notify the Contracting Officer of this. NO FINAL INVOICE SHALL BE PAID UNTIL ALL PUNCHLIST ITEMS ARE COMPLETED TO THE SATISFACTION OF THE CONTRACTING OFFICER. Should a contractor exceed the time allowed for these corrections, it may result in negative past performance which could affect future contract awards.

## **PERFORMANCE INFORMATION**

NOTICE TO PROCEED will be issued within 15 calendar days after award of contract, unless stated otherwise. Award date shall be established as the date of mailing or otherwise furnishing a properly executed award document to the successful offeror.

## **WORK SCHEDULE**

Working hours for the contractor will normally be between the hours of 7:30 a.m. and 4:30 p.m. excluding Saturdays, Sundays and Federal Holidays (New Year's Day, Birthday of Martin Luther King, Jr., Presidents Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving Day and Christmas Day). If the contractor desires to work during periods other than above, additional government inspection forces may be required. The contractor must notify the contracting officer three days in advance of his/her intention to work during other periods to allow assignment of additional inspection forces when the contracting officer determines they are reasonably available. If such force is reasonably available, the contracting officer may authorize the contractor to perform work during periods other than normal duty hours/days, however, if inspections are required to perform in excess of their normal duty hours/days solely for the benefit of the contractor, the actual cost of inspection at overtime rates will be charged to the contractor. These adjustments to the contract price may be made periodically as directed by the contracting officer.

## **DELIVERY TIME**

The overall period of performance on this project will be 571 calendar days. The Title 1-B Design performance time will be 121 calendar days from the Title 1-B Design Notice to Proceed. The Construction performance time will be 450 calendar days from the Construction Notice to Proceed.

## **SOW Attachments Included:**

1. Attachment 1 – 2 CS Installation Standards
2. Attachment 2 – 230923 N2 DDC Controls Spec\_9-7-23
3. Attachment 3 – Barksdale Electrical Equipment Standards March 2023
4. Attachment 4 – Mechanical\_Typical Comments Base Stds\_3-4-24
5. Attachment 5 – Toilet accessory and interior elevation guidance

# BARKSDALE AFB 2 CS

## Installation Standards

### Inside Plant

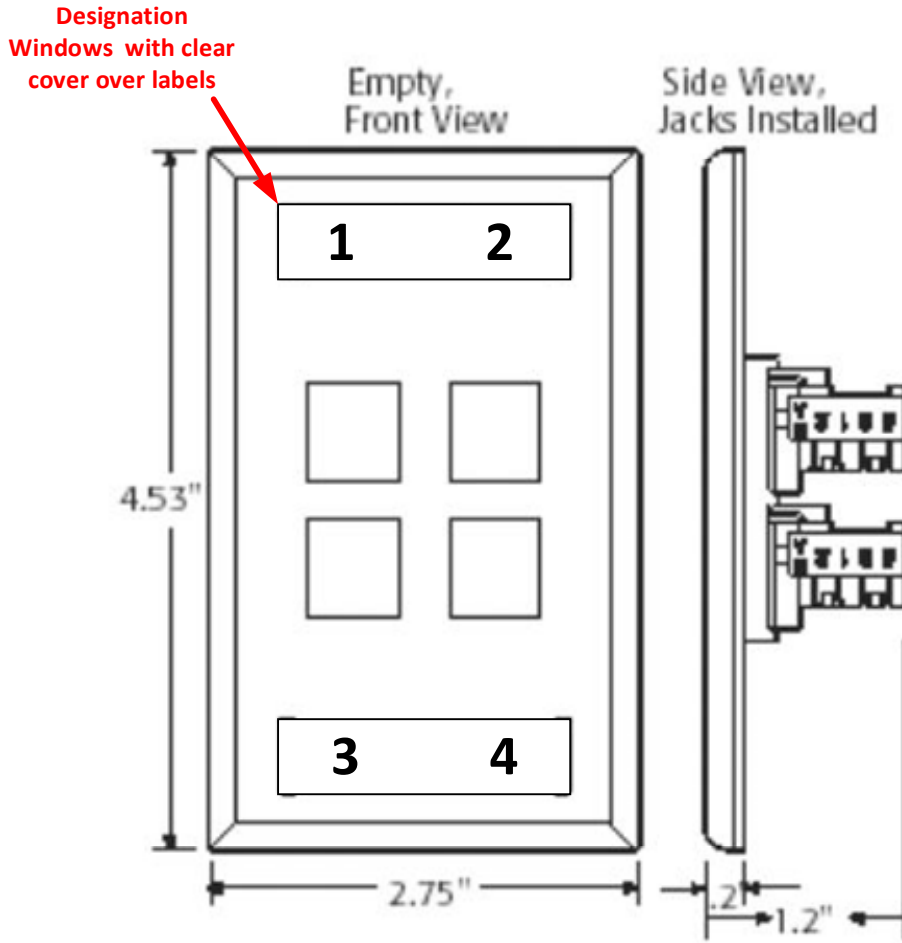
ITEM NO.	SPECIFIC AREA	DETAILS	CHK
1	TR Room Size	Minimum DoD communications TR room shall be 10 feet by 8 feet. UFC 3-580-01 Para 2-4.2.2	
2	Lighting	Provide COMM. Rooms with 2 sets of 4 foot Florescent lights or LED units. Lighting needs to be arranged to provide sufficient light to meet the minimum of 50 foot candles measured 3 foot AFF. Provide switch for light just inside the entrance door. Light fixtures must be installed as to not hinder ability to work on equipment/cabling, (REF; TIA/EIA-569-C, PARA. 6.3.6.1.5, & UFC 3-530-01). Lighting fixtures exact location will need to be determined after above rack conveyance has been laid out.	
3	Ceiling Plan	Ceiling Height for Comm. Room, the height between the finished floor and lowest point of the ceiling shall be a minimum of 3 meters (10 ft.) To accommodate tall frames and overhead pathways. REF: TIA/EIA-569-C, Para. 6.3.6.1.2 Suspended Ceiling. A suspended ceiling shall not be provided within the Communications Equipment Room. REF: UFC 3-580-01 PARA. 2-4.2.3	
4	Door	Door: The door shall be a minimum of 36 inches wide and 80 inches high, without doorsill, hinged to open outward. The door shall be fitted with a lock (112 keyed). REF: TIA/EIA-569-C PARA. 6.3.6.1.6	
5	Mechanical	Provide Communication room with its own independent thermostat for climate control, capable of supporting year round ambient temperature control (24 hours/day, 365 days/year) with a constant temperature not less than 40 degrees (F) or greater than 85 degrees (F). REFERENCE: TIA-569-C PARA. 6.3.6.2.1 & UFC 3-580-01 PARA. 2-4.3.4 NOTE: If COMM. room will be served by a dedicated mini split system. The indoor unit will be mounted above the door of the COMM. room.	
6	Fire Protection	ADD TO FIRE PROTECTION DRAWINGS: Communications room fire protection shall be provided as per applicable code. Sprinklers located within the Comm. Room, the heads shall be provided with wire cages to prevent accidental operation additionally the sprinkler heads shall not be located above the equipment racks, Coordinate Sprinklers head locations with 2 CS., IAW TIA-569-C paragraph 6.3.7	
7	Plywood Backboard	Provide/Install 3/4' Plywood (Grade A/C - with the A side facing out) backboard completely covering all walls starting 24" AFF, paint plywood backboard with 2 coats of white Fire retardant paint. Plywood shall be permanently fastened to the walls by means of wall anchors utilizing galvanized, zinc plated, or stainless steel hardware with a flat head (exact type of hardware / fasteners to be used shall be a submittal item to be approved by 2 CS). Finished installation shall have flush appearance with countersunk screw heads to prevent splitting of the plywood. Drywall screws are not acceptable. REF: TIA/EIA-569-C Para. 6.3.6.1.1 & UFC 3-580-01 PARA. 2-4.4.1	
8	Mechanical Plumbing Fire Protection	ADD TO NOTES PAGES OF MECHANICAL / PLUMBING AND FIRE PROTECTION DRAWINGS: Other Mechanical Fixtures: Mechanical fixtures (e.g. piping, ductwork, pneumatic tubing) not related to the direct support of the Communications room shall not be installed in, pass through, or enter the Comm. room, REF: TIA/EIA-569-C PARA. 6.3.6.3 / NOTE: On a renovation where a Comm. room is being built/craved out of an existing room/area. Any existing items described above must be removed/re-routed out of the Comm. room. If not possible then an alternate location need to be looked at for the Comm. room.	
9	Equipment 2-Post Racks & Vert Wire Management	Equipment racks - shall be 19 inch units, channel depth shall be 6.5 inches or 10.5 inches depending on installation, height of units shall be 7 foot (45 RU) or 8 eight foot (51 RU) the top section of the rack shall be made with curves at each end to form a bridge (for the purpose of running CAT-6 patching jumpers between equipment racks). Equip. racks shall be provided with vertical wire management cage units on both sides, units will be minimum of 6 inches in width by 7 or 8 tall as appropriate and equipped with doors on the front side. The preferred product to be used is: 19"	

		Ortronics Mighty Moe 6, Part# OR-MM6710 (7 FT) or Part# OR-MM6810 (8 FT) with Ortronics Cable Management Cages (P/N OR-MM6VMMD806 for 8 foot rack, P/N OR-MM6VMD706 for 7 foot rack).	
10	Equipment Racks	Equipment Racks – mounting requirements: All equipment racks shall be 19 inch (475mm) floor mounted located at or near the center of the telecommunication spaces. A minimum of 36 inches (900 mm) space both in front and back of the rack, measured from the equipment, and a minimum side clearance of 24 inches (600 mm) on at least one end of the rack or row of adjacent racks is required. Mount racks to floor using ½” drop in anchors with center pin set. Use ½” bolts with lock and flat washers to secure racks to floor. The top of each rack shall be stabilized/supported with unistrut channel or basket tray to one wall, the exact method shall be discussed and approved by 2 CS prior to installation. Coordinate with 2 CS to determine the space requirements for the government provided active equipment. Provide 25% spare capacity within each utilized rack. Provide one spare rack for every four utilized racks with a minimum of one spare rack per telecommunication space. REF: TIA/EIA-569-C PARA. 6.3.9.3 & UFC 3-580-01 PARA. 2-4.4.3	
11	Grounding	For the TGB/TMGB install an 18 inch by 4 inch ground bus bar mounted on standoffs connected to facility ground. Install a horizontal rack ground bar kit in one rack and feed other racks from it, no daisy chaining. Use Cooper B-Line Part# SBHB119K or equivalent. Install a proper AWG insulated (green colored sheath) ground between main ground bar and horizontal rack ground bar. All installed basket/cable tray shall be bonded with UL listed connectors. Install ground warning label on main incoming communications room ground conductor. IAW TIA-607-b, PAR. 7.1.4 (USE TAG P/N 01068 OR CALTAG017). An anti-oxidant electrical joint compound will be applied to all connections. Building grounding systems are covered in UFC 3-520-01 Interior Electrical Systems. All ground connections shall be made with irreversible compression connectors. Placement of horizontal rack ground bar shall be approved by 2CS (Mr. McCallie 318-456-4840). REF: ANSI J-STD 607B & ANSI/TIA 607B,2011 & BICSI TDMM 13 <sup>th</sup> Edition	
12	Power	Provide (1) 110/120 VAC 20 AMP quad outlets, each on a dedicated breaker for each vertical manager and (1) 110/120 VAC 20 AMP duplex outlet on each wall. Coordinate exact placement on site with 2 CS (Mr. McCallie 318-456-4840). Panel board for A/C power receptacles supplying the communication rooms shall be located within each communication room. Ensure panel board location is not on a wall that will limit the number of racks due to the 3 foot clearance required by code. Power outlet placement on the back of a relay rack/cabinet shall not interfere with the placement of hardware within the mounting rail space. IAW UFC 3-580-01 PARA. 2-4.3.2	
13	CAT-6 Outlets	All communications outlets shall consist of CAT-6 cables in various configurations of (2) or (4) as required and determined by 2 CS for the space being served. All CAT-6 cabling shall be terminated using 568A standard. All cable/drops shall be tested to CAT-6 specifications. Terminate cabling at each outlet utilizing ivory 4-Port faceplates loaded with four (4) ivory CAT-6 RJ-45 Jacks (P/N 61110-RI6). (To remain consistent with base installation practices, contractor shall use LEVITON BRAND single gang four port wall plates with designation windows, part# 42080-4IS, labels will be machine printed and placed behind the plastic windows.	
14	CAT-6 Patch Panel	Patch panels shall be Leviton 49255-H48 Quick Port Flat Panel, 48 port. Cable management bars included. Load with CAT-6 RJ-45 Jacks (P/N 61110-RI6) each panel shall be completely loaded even where a complete 48 ports are not utilized for cabling.	
15	CAT-6 Horizontal Wire Mgt	Provide a 2 RU horizontal cable management unit above and below each patch panel. Exact elevation layout shall be coordinated with 2 CS. IAW UFC 3-580-01 PARA. 2-4.4.5 Cable management units shall be HCM-2D Middle Atlantic Front Cable Manager with D-Rings - 2R or a 2 CS approved equivalent.	
16	Floor Boxes	Any area (office / meeting room etc.) utilizing a in floor type box for COMM. drops – the item to be used will be a submittal item 2 CS can see the complete product and approve it / disapprove.	
17	CAT-6 Outlet Box	CAT-6 drops outlet box shall be a double gang & double deep boxes with a reducer plate for a single gang faceplate, recessed boxes with 1 inch EMT conduit stubbed up 6 inches above the ceiling in the accessible ceiling space. All rooms with walls that will not allow for flush mounted communications boxes will have 1 inch EMT installed from a 4”x 4” box with a single faceplate adapter mounted to the wall surface and run to above the ceiling (6 inches minimum). 1” push fit bushing shall be installed on conduit above ceiling. The so forth shall be used for configuration of (6), (8), (12). 8” box with a 1 ¼” EMT or 1 ½”.	
18	Maint Loops	CAT-6 cables shall have a 1 meter maintenance loop at the Outlet end above the ceiling and a 3 meter loop provided at the equipment rack end. The method for installation/racking of the 3 meter maintenance loop shall be approved by 2 CS (Mr. McCallie 318-456-4840).	

19	Labels	Install machine generated labels within 4 inches of each end of all horizontal cables, both CAT-6 and fiber optic cables (both ends) No permanent markers shall be used for any labeling (IAW TIA/EIA-606-A, Para. 5.1.2 page 14 & Para. A4 page 31).
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## **CAT-6 FACEPLATE INFO**

**Labeling for Cat-6 cables and faceplates will start with 1 and go sequentially to whatever the last cable ends up being.**



**Example Single Gang 4-Port Faceplate**

McCallie / 10 Jul 2010

20	Containment	All cable containment provided will use either J-Hooks (J-Hook spacing shall not exceed 36 inches), wire basket tray and or conduits. Metal cable trays must be bonded to ground and electrically continuous per NEC Article 392.7. All field cutting of wire basket tray will be free of sharp edges and burrs. TIA/EIA-569-B, PARA. 8.6.1 & UFC 3-580-01 PARA. 2-5.3.1. Cable containment will not exceed the 25% fill rate allowing for 50% spare capacity. Once the 19" equipment racks are installed, install wire basket tray to provide adequate support for 3 meter maintenance loop of the CAT-6 cabling so that can be rerouted if loop is needed. Proposed method shall be discussed with 2 CS. Wire basket tray shall be installed thru walls with a cased opening with a (1 inch minimum) opening maintained around the basket tray. Once all cables have been installed the opening area will be fire stopped with a removable material, sock, brick and or pillow. CAT-6
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		<p>cables shall be secured/bundled with VELCRO STRAPPING (3/4 inch wide) centered between J-Hook supports (use of plastic cable ties/ties wraps or electrical tape is not authorized). Installation of fiber optic cable/s within buildings IE the COMM. room or Core Node facility - if the cable is to be installed not using plastic inner duct it shall be secured to the basket or cable tray with ¾ inch wide Velcro with a minimum of 1 and ½ full wraps. The Fiber optic cable shall be fastened with the Velcro every 3 feet minimum. The use of plastic tie wraps or vinyl electrical tape is PROHIBITED not even for temporary use.</p> <p>NOTE: Within Telecommunications rooms - Basket cable tray shall have a minimum of 12 inches of clearance between the ceiling and the top rail of the cable tray. Basket tray shall have enough clearance on one side to access top of tray to work.</p>	
21	Systems Furniture	Communication outlet CAT-6 or fiber cabling shall be run to permanent wall outlet locations, architectural columns, approved in floor boxes or approved utility columns. Running premise cabling to or within Systems Furniture is strictly PROHIBITED. IAW UFC 3-580-01 PARA. 2-5.2.1.1.	
22	EMCS & Wall Phone	Provide a CAT-6 drop for Building Heat/Air conditioning system & a wall drop for wall mounted telephone. IAW UFC 3-580-01 PARA. 2-7.4.4	
23	Wall Phone	Wall – Mounted Telephone Faceplate (WP) shall consist of a stainless steel Single-Port Faceplate designed for the purpose of hanging a Wall Mounted Telephone. The unit shall have two metal buttons that hold the telephone in place, with a CAT-6 cable terminated with a RJ-45 connector. WP Outlet locations shall be located 56” above finished floor (AFF) unless otherwise indicated. IAW REF: UFC 3-580-01 2-7.2.2. Outside mounted wall phone will use P/N <b>GB92V144H</b> Manufacturer Allen Tel.	
24	Plenum	Plenum spaces require plenum rated cabling IAW (In accordance with) UFC 3-600-01, NFPA101, NFPA-262 and NFPA90A.	
25	Testing	All installed cable (fiber and copper) will be tested and baseline test records provided to 2 CS in printed and digital format. All CAT-6 cabling will be tested and certified. Fiber cabling shall be tested as follows: Single-mode Test at 1310 & 1550nm in both directions. Multimode Test at 850 & 1300nm in both directions. Power budgets will be determined using BICSI and or TIA/EIA manuals.	
26	Copper House Cable	If Applicable: Provide/Install a 50 pair house cable from the backboard location, terminate on split fifty style 66 blocks (NOTE: terminate cable on left side of block only) mounted on SB89 standoff brackets, at the equipment rack terminate on a 48 port patch panel, 1 pair per port (WH/BL) except the 24th and the 48th ports where 2 pairs will be terminated (WH/BL & WH/OR). NOTE: SIZE OF HOUSE CABLE IS DEPENDENT UPON APPLICATION, AS IS PATCH PANEL NUMBER AND SIZE.	
27	D-Rings	If Applicable: Install metal D-rings (small Half rings) between all 66 type terminal blocks both protected terminals and the split fifty style terminal blocks. One D-ring for each terminal block installed. Additionally install large D-rings across the bottom or top (TBD on site with 2CS representative / (Mr.McCallie 318-456-4840).	
28	D-Rings	If Applicable: Install metal D-rings (Distribution Rings - P/N GB10 size small) between all 66 type terminal blocks both protected terminals and the split fifty style terminal blocks. One D-ring for each terminal block installed. Across the bottom install the Medium size D-rings (note exact spacing and arrangement to be coordinated / approved on site with 2CS).	
29	Fiber Termination	All fiber optic cables shall be terminated in applicable connector or splice housings. SM fiber cables in the communications rooms shall be terminated using 12-strand LC shuttered splice cassettes. No Unicam, HotMelts or like connectors shall be used. MM fiber cables in the communications rooms shall be terminated using SC pigtails fusion spliced. The method of terminating fiber cables at wall outlets shall be determined on a case by case basis.	
30	CAT-6 Patch Cables	Provide sufficient CAT-6 Copper patch cords/cables, of various appropriate lengths, to terminate all copper patch panel appearances, IAW UFC-3-580-01 paragraph 2-6.2.1.4 Coordinate appropriate lengths with 2 CS (Mr. McCallie 318-456-4840).	
31	Fiber Patch Cables	Provide sufficient fiber optic patch cords/cables, of various appropriate lengths, to terminate all fiber optic patch panel appearances plus 25% spare, IAW UFC-3-580-01 paragraph 2-6.2.2.3 Coordinate appropriate lengths with 2CS (Mr. McCallie 318-456-4840).	
32	Separate Containment	Fiber optic cables for SIPRNET and CAT-6 copper cables for NIPRNET shall be supported and contained within <b>its own</b> pathway system. At no point shall one share the other. Pathway system will consist of, but not limited to J-Hooks, basket type tray or conduits.	
33	SIPRNET Cabling	Each SIPRNET location is a DUPLEX DROP consisting of (4 EACH STRANDS OF 62.5 MULTI-MODE FIBER OPTIC CABLE) to each location in RED COLORED OUTER JACKET,	



		(SHEATH). SIPRNET outlet shall be terminated with SC TYPE CONNECTORS ON BOTH ENDS OF CABLING.	
34	Conduits between Closets	A minimum of (2) 4” conduits shall be installed between communication rooms on different floors.	
35	Sleeves, Penetrations	<b>Non-fire-rated barriers/partitions:</b> Provide sleeves for all locations where cable must pass-through building barriers such as walls. All sleeves shall be Electrical Metallic Tubing (EMT) w/bushings unless otherwise shown on drawings or approved by 2 CS. All EMT sleeves will protrude enough on each side of wall to show material make up. All sleeves in non-fire-rated walls will be sealed with non-shrinking material in the envelope area between wall and sleeve on both sides. Tool exposed surfaces smooth. All areas where basket tray passes through walls will be trimmed out around tray and annular space filled with mineral wool through penetration. Expanding filler foam is not accepted.	
36	FOC Bulkheads	Fiber optic patch panel bulk heads will be labeled as follows: the 1 <sup>st</sup> and last fiber on each unit will be labeled on the front side, (coordinate exact specifications with 2 CS prior to execution).	
37	Vindicator	Vindicator Alarm systems - Provide a single CAT-6 cable terminated on a RJ-45 outlet (utilize a 1 port surface mount box, Allen TELE product P/N AT33S-09) locate within the control panel with the other end terminating in the Comm. room at the patch panel, (Coordinate with Mr. McCallie 318-456-4840).	
38	Redundant Cabling	Remove completely all redundant Comm. cabling between floors and basement, IAW <u>NEC 800.25</u> . Contractor is responsible to properly dispose of redundant copper cabling. Remove completely all redundant Comm. infrastructure (Tele/Data wiring – CAT3/CAT5 cabling), shall be removed back to source of origin (patch panel or 66 style terminal block) IAW <u>NEC 800.154 800.3(c)</u> . Contractor is responsible to properly dispose of redundant copper cabling. <b>All penetrations shall be patched or sealed after removal of cabling if not shared with other building utilities.</b>	
39	As-built drawings	The Contractor shall submit drawings showing the as-built configuration in format specified by 2 CS/SCX project manager. 2CS shall be provided with a building drawing of installed cabling with cable pathways and its assigned numbering of CAT 6 outlets.	

## Outside Plant

40	Underground Utilities Markings	The Contractor shall coordinate with base agencies to ensure markings are placed over existing base infrastructure prior to digging or directional drilling and will take precautions to protect existing infrastructure. Contractor shall be responsible for costs associated with repair of any damages caused during installation when the infrastructure is clearly marked.	
41	Service Outages	The Contractor shall be responsible for preventing any unscheduled (i.e. cutting or disabling any in-service cables or equipment.), Contractor-caused, interruptions of communications capabilities that are properly identified. The Contractor shall coordinate planned outages with the site POC at least 10 calendar days in advance of the outage if the implementation necessitates disruption of service, (e.g., communications, electrical, or other utilities).	
42	Hand Holes	Hand holes installed under this Task Order shall have an American Association of State Highway and Transportation Officials (AASHTO) rating of H-20 or equivalent. Hand holes installed in grassy areas shall have a concrete band 24”Width x 12” Depth installed around the hole. Unless otherwise stated, HHs shall have a minimum interior dimension of 4’W x 4’L x 4’H (width, length, height). HHs shall be furnished with cable racks (2 each shall be installed on each of the 4 walls), (2) appropriate length steps per rack, and a grounding system. Racks will be anchored top and bottom to HH walls. Steps shall be secured using locking clips. Splice support racks will be used to support splice cases. HHs shall meet the requirements of TIA -758A, paragraph 4.2.2. Prefabricated HHs are preferred. HH covers shall be labeled with 1/8” raised letters stating “COMMUNICATIONS”. Additional two (2) 4” knock-outs shall be provided on each HH’s wall (all four walls) at a minimum of 12 inches from the hand hole floor. Hand holes will be concrete precast with concrete bottoms. All trash will be removed after installation of cables in new or reused hand holes.	
43	Conduits/ducts	Installation of underground conduits/ducts shall be IAW RUS Bulletin 1751F-643 and RUS Bulletin 1753F-151. Ducts across roads, sidewalks, parking areas, drainage ditch, or areas to be paved, etc. shall be installed by boring at a minimum of 36" below grade. In maintenance holes with knockouts, ducts shall start at the bottom knockout, allowing for upward expansion in the maintenance holes. All ducts not installed a cross roads, sidewalks, parking areas, or areas to be paved, etc. shall have a minimum of 36 inches ground cover, where possible and no less than 24” where areas of 36” depth cannot be achieved. The Contractor shall provide other protective	

		measures, concrete cap, etc., in those areas where the minimum ground cover cannot be achieved. Grading of ducts shall be accomplished IAW RUS Bulletin 1751F-643.	
44	Conduits/ducts	Any new 4 inch conduits runs provided between manholes that are spare shall have compression plugs installed, Oatey P/N 270-245 or approved equivalent. Spray foam will not be used to cap any spare conduit. Cored man hole/hand hole shall have terminators installed on conduit and installed flush with interior wall. Conduits will be sealed properly inside and outside of man hole/hand hole through cores with hydraulic cement/grout or mastic sealant. Conduit shall be inserted in terminator with no more than 1/2" gap from being fully seated. When installing new 4 inch conduits between manholes or hand holes if the new conduit is vacant at this time install a nylon mule tape with a tensile strength of 1250 pounds minimum, for future cable installation. The mule tapes shall extend into the manhole or Hand Hole and be secured to the cable rack or pulling iron. Plug the end of each conduit with a rubber plug assembly (coordinate part number with 2 CS). The ducts shall be corrosion resistant and 4-inch inside diameter (I.D.) round or metric equivalent. The ducts shall be made of EPC-40 Polyvinyl Chloride (PVC) (Schedule 40) IAW NEMA TC-2; or EPC-80-PVC (Schedule 80) IAW NEMA TC-2; or high density polyethylene (HDPE) SIDR 11.5. Schedule 80 PVC shall be limited to risers. The ducts shall be appropriately labeled indicating the composition material. Ducts shall have a sleeve or bell end type coupling and shall be watertight when assembled.	
45	Bends and Sealing	All bends between maintenance holes shall be a minimum 20-foot radius with the sum of bends in all directions not exceeding a total of 180 degrees. Where a bend or sweep is placed in PVC nonmetallic duct bank between maintenance holes, the duct bank must be encased in concrete with a minimum compressive strength of 17,225 kilopascal (kPa) [2500 pounds per square inch (psi)]. Ducts shall enter a maintenance hole perpendicular to the surface of the wall through which it is entering. All ducts/inner ducts entering maintenance holes must be sealed. Universal duct plugs or removable putty sealants may be used. Upon completion of conduit sections, a test mandrel 1/4" (6.4mm) smaller than the inside diameter of the conduit shall be pulled through two diagonally opposite ducts to ensure proper alignment. In addition, all ducts shall be cleared of loose materials such as concrete, mud, dirt, stones, etc.	
46	Entrance Conduits	When new entrance conduits/ducts or sleeves are required, the Contractor shall core and install the necessary holes and install the ducts or sleeves, if knockout doesn't exist. Penetration shall not be in such a location through the wall as to block use of existing ducts in the maintenance hole. New ducts will be a minimum of 18 inches from either the maintenance hole floor or ceiling, if practical. The minimum bending radius for entry conduit/ducts shall be no less than 10 times the inside diameter of the conduit. Ducts and openings around ducts shall be sealed both on the outside and inside of man hole or hand hole to prevent moisture from entering the maintenance holes	
47	Inner duct / Maxcell	All locations where 1 inch smooth wall plastic Inner duct is being used, whether installed by this project or previously installed, shall be trimmed to 6 inches (smooth and neat) protruding out of the conduit prior to fiber installation. NOTE: For newly installed 1 inch smooth wall plastic inner duct trimming of length shall be accomplished after / once it has had a chance to relax within the conduit. Maxcell shall have 3 foot extending from conduit entrance. Pull strings shall be secured to the cable rack or pulling irons. Pull strings will have 4 foot of slack from end of Maxcell sleeve. Tracer wire will be anchored and routed to neck of manhole lid or within 6 inches of hand hole lid, and labeled to what manhole/hand hole it goes too. A gel filled wire nut will be installed on each tracer or twisted together and a gel filled wire nut installed on all.	
48	Pull Rope	All vacant installed plastic inner ducts shall be provided with nylon mule tape with a tensile strength of 1250 pounds minimum, for future cable installation. The mule tapes shall extend into the manhole or hand hole and be secured to the cable rack or pulling iron, etc. A minimum of 24" slack on mule tape.	
49	OSP Cabling	Use the following for securing cable and inner duct within manholes and for racking of maintenance loops etc. DELTEC Cable Support System with DELTEC double locking heads shall be used to secure cabling/inner duct to steps or ladder rack. Cables should not move. No plastic Ty-wraps will be used to secure cabling/inner duct to steps or ladder rack. Ty-wraps are allowed on sides of maintenance loops for grouping of 3' loops. Ty-wraps tabs will be cut flush to prevent sharp ends. Thomas & Betts (at tnb.com) is one source for these parts. Cat number for the locking heads is TYD-LH (package of 25). Cat number for the DELTEC strapping is TYD-50R (50' reel)	
50	Maint. Loops	The Contractor shall install maintenance loops in hand holes/manholes at locations indicated on Attachments as provided. Hand hole or Manhole will each get 50 feet. The maintenance loop shall be formed in a 3' radius and properly secured using ladder rack and steps.	
51	Labels	All cable tags shall be permanently labeled, easily visible and corrosion resistant, information shall be machine printed (permanent markers shall not be used) with information placed behind / underneath protected clear film of tag. Install cable tags in all maintenance holes/hand holes, pull	

		boxes, building entrance, and fiber optic distribution panel (FODP) locations. When cables pass through a maintenance hole, put a tag on the cable, approximately 18” from each duct entrance. Information on the cable tag shall identify cable by size, type, cable number( fiber will have bldg-bldg) and count (Tag info will be provided by 2 CS). Cable tags shall be flagged not wrapped. The same information shall appear on the Contractor’s completed as-built-drawings. Install (1) additional tag at all HH’s/MH’s with maintenance loops on the maintenance loop. NOTE: Plastic ty-wraps used to fasten cable tags shall be cut off flush leaving no sharp edges. FODPs shall be labeled with black on white p-touch tape with 1/2” letters/numbers. Each splice (if fusion splice method is used) tray/cassette shall be marked to identify the fiber count contained in the splice tray. The FODP marking shall be as follows: IE example - FO 3447-3433, 1-24 This item will be discussed further with contractor during site visit.	
52	Excavation/ Building Penetrations	All wall penetrations, including inside buildings, shall be restored to meet the required base fire ratings. All new building entrances will be done with diagonal coring or 24” x 24” x 8” NEMA 3R lockable enclosures secured to building construction. Use of LBs is prohibited.	
53	Site Restoration/ Debris Removal	The Contractor shall restore all disturbed grounds to the “as found” condition or better after installation. Base grounds restoration requirements shall be complied with. Common use areas shall be restored with sod.	
54	As-built drawings	The Contractor shall submit drawings showing the as-built configuration in format specified by 2 CS/SCX project manager. 2 CS will provide MH butterflies for the contractor to update.	
55	Butterfly Drawings	MH/HH butterfly drawings shall show MH/HH orientation, cable path and building penetration information for all new installations in an electronic format such as PDF format.	

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## SECTION 230923 - N2 DDC CONTROLS - BARKSDALE AFB

## PART 1 - GENERAL

## 1.1 SUMMARY

Provide and install a complete Direct Digital Control (DDC) system in accordance with Barksdale Air Force Base standards, suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as indicated and shown.

The existing Basewide Energy Management Control System (EMCS) is Johnson Controls Metasys with an existing ADX Server. Entire campus system is based only on N2 protocol at field level and BACnet IP at supervisory level. This Building is to receive a new Direct Digital Controls System (DDC) complete and ready for operation that is N2 protocol at field level and BACnet IP at supervisory level and completely compatible with the existing Johnson Controls Metasys System and ADX Server without the purchase or use of integrators, converters, or special software for use as a building operations terminal. JACE of any framework are not allowed. Barksdale AFB Central EMCS monitoring office shall have graphical monitor and control capability of all points on the existing front end.

Provide and install N2 DDC Controllers, actuators, and sensors for all equipment associated with, but not limited to air handlers, terminal units, pumps, boilers, and chillers. Install sensors needed for a complete control system to meet the sequence of operations. Controls Contractor shall be responsible for programming and integration with existing EMCS. When installing controllers and sensors in air-handling units, the cabinet shall be sealed to maintain air-handling unit manufacturer's published air leakage rates.

When equipped with dedicated split systems, communication rooms, server rooms, computer room units, split system fan coil units, unit-heaters, and exhaust fans shall operate on local control and also include any other devices necessary to provide specified points to be monitored/alarmed to the existing Johnson Controls BMS via N2 protocol such as a space temperature and humidity sensor, condensate float switch alarm, fan status and discharge air temperature, etc., unless noted otherwise on plans.

Provide and install full project BAS Graphics of the system and equipment. Contractor shall be responsible for coordination with Barksdale AFB's EMCS staff to ensure that the BMS will be displayed in a Graphical Format at the existing Metasys ADX Server Workstation.

Provide trending and graphical display of formulated Total Chiller Capacity (MBH), EWT, LWT and GPM of each chilled water system.

Provide and install meters and metering capability including three years consumption trending for each installed meter. Provide monitor and alarms for all metering on the campus EMCS. Coordinate with Division 22 and Division 26 for water, natural gas, and electric meters.

Provide a PVT Plan, PVT Report and PVT Demonstration as described in Section 3.4 Performance Verification Test

Provide Controls Training as described in Section 3.3 Training.

## 1.2 RELATED DOCUMENTS

- A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections specifications for details.

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- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.3 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.
- C. Building Management System (BMS): A total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials. The BMS shall be provided by this Division BMS Contractor and shall be interfaced to the associated work of other related trades.
- D. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.
- E. Control Sequence: A BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control (DDC): The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BMS network.
- I. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.
- J. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BMS Contractor's cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.

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- L. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.
- M. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- N. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.
- O. Software: The term "software" and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.
- P. Energy Management Control System (EMCS): A supervisory monitoring and supervisory control (front-end) of base-wide building control systems and utility control systems using N2. Barksdale AFB EMCS is N2.
- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- S. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	Analog to Digital Converter
AI	Analog Input
AN	Application Node
ANSI	American National Standards Institute
AO	Analog Output
ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
AWG	American Wire Gauge
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DAC	Digital to Analog Converter
DDC	Direct Digital Control
DI	Digital Input
DO	Digital Output
EEPROM	Electrically Erasable Programmable Read Only Memory
EMI	Electroftic Interference
FAS	Fire Alarm Detection and Annunciation System
GUI	Graphical User Interface
HOA	Hand-Off-Auto
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCC	Motor Control Center
NC	Normally Closed
NIC	Not In Contract

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NO	Normally Open
OWS	Operator Workstation
OAT	Outdoor Air Temperature
PC	Personal Computer
RAM	Random Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference
RH	Relative Humidity
ROM	Read Only Memory
RTD	Resistance Temperature Device
SPD	Single Pole Double Throw
SPS	Single Pole Single Throw
XVG	Extended Video Graphics Adapter
TBA	To Be Advised
TCP/IP	Transmission Control Protocol/Internet Protocol
TTD	Thermistor Temperature Device
UPS	Uninterruptible PowerSupply
VAC	Volts, Alternating Current
VAV	Variable Air Volume
VDC	Volts, Direct Current
WAN	Wide Area Network

1.4 BMS DESCRIPTION

- A. The Building Management System (BMS) shall be a complete system designed for use at the existing Barksdale AFB Server Front End. Barksdale AFB uses a JCI Metasys N2 Front End. Contractor to verify requirements with Barksdale AFB EMCS Shop. This functionality shall extend into the equipment rooms.
- B. Devices residing on the BMS network located in equipment rooms and similar shall be fully compatible devices that mount and communicate directly on the EMCS Post Wide Area Network. Contractor shall be responsible for coordination with Barksdale AFB's EMCS staff to ensure that the BMS will be displayed in a Graphical Format at the existing Metasys ADX Server Workstation without disruption to any of the other activities taking place on Barksdale AFB's EMCS Network.
- C. The BMS shall include DDC Controllers for each major piece of equipment such as Meters, Air Handling Units, Chilled and Hot Water Systems and other HVAC terminal/unitary equipment.
- D. All DDC points shall not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. Software shall not live solely in a controller. Software shall be provided to the Government at no additional cost. The primary point of interface shall be the HMI Display Terminal in each building at the post-wide EMCS.
- E. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
- F. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.



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- G. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- H. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- I. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
  - 1. Operator information, alarm management and control functions.
  - 2. Enterprise-level information and control access.
  - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
  - 4. Diagnostic monitoring and reporting of BMS functions.
  - 5. Offsite monitoring and management access.
  - 6. Energy management
  - 7. Standard applications for terminal HVAC systems.
  - 8. Indoor Air Quality monitoring and control

1.5 QUALITY ASSURANCE

A. GENERAL

- 1. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.
- 2. The BMS Contractor shall have a branch facility within a 20-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
- 3. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
- 4. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.

B. WORKPLACE SAFETY AND HAZARDOUS MATERIALS

- 1. Provide a safety program in compliance with the Contract Documents.
- 2. The BMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
- 3. The Contractor and its employees and sub-trades shall comply with federal, state and local safety regulations.
- 4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
- 5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
- 6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

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7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

1.6 REFERENCES

- A. All work shall conform to the following Codes and Standards, as applicable:
  1. National Fire Protection Association (NFPA) Standards.
  2. National Electric Code (NEC) and applicable local Electric Code.
  3. Underwriters Laboratories (UL) listing and labels.
  4. UL 864 UUKL Smoke Control
  5. UL 268 Smoke Detectors.
  6. UL 916 Energy Management
  7. NFPA 70 - National Electrical Code.
  8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
  9. NFPA 92A and 92B Smoke Purge/Control Equipment.
  10. Factory Mutual (FM).
  11. American National Standards Institute (ANSI).
  12. National Electric Manufacturer's Association (NEMA).
  13. American Society of Mechanical Engineers (ASME).
  14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
  15. Air Movement and Control Association (AMCA).
  16. Institute of Electrical and Electronic Engineers (IEEE).
  17. American Standard Code for Information Interchange (ASCII).
  18. Electronics Industries Association (EIA).
  19. Occupational Safety and Health Administration (OSHA).
  20. American Society for Testing and Materials (ASTM).
  21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
  22. Americans Disability Act (ADA)
  23. ANSI/ASHRAE Standard 195
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Project Engineer and Contracting Officer at the project site.

1.7 SUBMITTALS

- A. SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
  1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
  2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the COR for Contract compliance.

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3. Allow 15 working days for the review of each package by the COR in the scheduling of the total BMS work.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:
  - a. BMS network architecture diagrams including all nodes and interconnections.
  - b. Systems schematics, sequences and flow diagrams.
  - c. Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
  - d. Samples of Graphic Display screen types and associated menus.
  - e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
  - f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
  - g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
  - h. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
  - i. Details of all BMS interfaces and connections to the work of other trades.
  - j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.
8. Performance Verification Plan (PVT Plan) and actual PVT once complete.

## 1.8 RECORD DOCUMENTATION

### A. OPERATION AND MAINTENANCE MANUALS

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall include the following for the BMS provided:
  - a. Table of contents.
  - b. As-built system record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal. Include as-built control drawings, schedules and sequence of operations.
  - c. Manufacturer's product data sheets or catalog pages for all products including software.
  - d. System & Equipment Operator's manuals.
  - e. Archive copy of all site-specific databases and sequences.
  - f. BMS network diagrams.
  - g. Interfaces to all third-party products and work by other trades.
  - h. Alignment and calibration procedures for components
  - i. Preventive maintenance requirements and a maintenance checklist
  - j. Spare parts list data, including required tool kits and suggested method of repairs such as field repair, factory repair, or item replacement
  - k. Controller configuration and parameter setting procedures

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- I. Step-by-step procedures required for each HVAC control systems startup, operation, shutdown, recovery, and fault diagnosis

## 1.9 WARRANTY

### A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the BMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted by the BMS Contractor at the cost of the BMS Contractor.
3. Maintain an adequate supply of materials within 30 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours.

## PART 2 - PRODUCTS

### 2.1 GENERAL DESCRIPTION

- A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
- B. The Building Management System shall consist of the following:
  1. Standalone Network Automation Engine(s)
  2. Field Equipment Controller(s)
  3. Input/Output Module(s)
  4. Local Display Device(s)
  5. Portable Operator's Terminal(s)
  6. Distributed User Interface(s)
  7. Network processing, data storage and communications equipment
  8. Other components required for a complete and working BMS
- C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
  1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
  2. The System shall maintain all settings and overrides through a system reboot.
- E. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

### 2.2 BMS ARCHITECTURE

#### A. Automation Network

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1. The automation network shall be based on an industry standard of Ethernet TCP/IP. LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
2. All BMS devices on the automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
3. Network Automation Engines (SNE) shall reside on the automation network.
4. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

### B. Control Network

1. Network Automation Engines (SNE) shall provide supervisory control over the control network and shall support the following communication protocols:  
N2
2. Control networks shall provide either "Peer-to- Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.

## 2.3 USER INTERFACE

### A. Human Machine Interface (HMI)

1. BMS Contractor shall provide and install an HMI Display Terminal for command entry, information management, network alarm management, and database management including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability. The HMI shall be comprised of a workstation meeting Barksdale AFB IT requirements and located in the manager's office. Primary control is to occur from this workstation with central EMCS initially configured for monitoring capability, to including historian capability of meter data.
2. Dedicated User Interface Architecture - The architecture of the HMI shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers.
  - a. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries

## 2.4 NETWORK AUTOMATION ENGINE (SNE)

### A. Network Automation Engine (SNE)

1. The Network Automation Engine (SNE) shall be a fully user-programmable, supervisory controller. The SNE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer- to-peer basis with other Network Automation Engines.
2. Automation network - The SNE shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface - Each SNE shall have the ability to deliver a web based User Interface. All computers connected physically or virtually to the automation network shall have access to the web based UI.
  - a. The web based UI software shall be imbedded in the SNE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
  - b. The SNE shall support up a minimum of four (4) concurrent users.
  - c. The web based user shall have the capability to access all system data through one SNE.

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- d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one SNE.
  - e. Systems that require the user to address more than one SNE to access all system information are not acceptable.
  - f. The SNE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the SNE.
  - g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
  - h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
    - Configuration Commissioning
    - Data Archiving Monitoring
    - Commanding System Diagnostics
  - i. Systems that require workstation software or modified web browsers are not acceptable.
  - j. The SNE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
4. Processor - The SNE shall be microprocessor-based with a minimum word size of 32 bits. The SNE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. SNE size and capability shall be sufficient to fully meet the requirements of this Specification.
  5. Memory - Each SNE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
  6. Hardware Real Time Clock - The SNE shall include an integrated, hardware-based, real-time clock.
  7. The SNE shall include troubleshooting LED indicators to identify the following conditions:
    - a. Power - On/Off
    - b. Ethernet Traffic - Ethernet Traffic/No Ethernet Traffic
    - c. Ethernet Connection Speed - 10 Mbps/100 Mbps
    - d. FC Bus A - Normal Communications/No Field Communications
    - e. FC Bus B - Normal Communications/No Field Communications
    - f. Peer Communication - Data Traffic between SNE Devices
    - g. Run - SNE Running/SNE in Startup/SNE Shutting Down/Software Not Running
    - h. Bat Fault - Battery Defective, Data Protection Battery Not Installed
    - i. 24 VAC - 24 VAC Present/Loss Of 24VAC
    - j. Fault - General Fault
    - k. Modem RX - SNE Modem Receiving Data
    - l. Modem TX - SNE Modem Transmitting Data
  8. Communications Ports - The SNE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry- standard computers, modems, and portable operator's terminals.
    - a. Two (2) USB port
    - b. Two (2) URS-232 serial data communication port
    - c. Two (2) RS-485 port
    - d. One (1) Ethernet port
  9. Diagnostics - The SNE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
  10. Power Failure - In the event of the loss of normal power, The SNE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

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- a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
- b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft- start sequence.
11. Certification - The SNE shall be listed by Underwriters Laboratories (UL). The Conformance Statement shall be submitted 10 days prior to bidding.
12. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences.
13. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
14. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately.
15. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
16. The FEC shall include a removable base to allow pre-wiring without the controller.
17. The FEC shall include troubleshooting LED indicators to identify the following conditions:
  - a. Power On
  - b. Power Off
  - c. Download or Startup in progress, not ready for normal operation
  - d. No Faults
  - e. Device Fault
  - f. Field Controller Bus - Normal Data Transmission
  - g. Field Controller Bus - No Data Transmission
  - h. Field Controller Bus - No Communication
  - i. Sensor-Actuator Bus - Normal Data Transmission
  - j. Sensor-Actuator Bus - No Data Transmission
  - k. Sensor-Actuator Bus - No Communication
18. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
19. The FEC shall support the following types of inputs and outputs:
  - a. Universal Inputs - shall be configured to monitor any of the following:
    - Analog Input, Voltage
    - Mode Analog Input,
    - Current Mode Analog
    - Input, Resistive Mode
    - Binary Input, Dry Contact Maintained Mode
    - Binary Input, Pulse Counter Mode
  - b. Binary Inputs - shall be configured to monitor either of the following:
    - Dry Contact Maintained
    - Mode Pulse Counter
    - Mode
  - c. Analog Outputs - shall be configured to output either of the following:
    - Analog Output, Voltage Mode
    - Analog Output, current ModeBinary Outputs - shall output the following:
    - 24 VAC
  - d. Configurable Outputs - shall be capable of the following:
    - Analog Output, Voltage Mode
    - Binary Output Mode
20. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
  - a. The FC Bus shall be a Master-Slave/Token- Passing (MS/TP) Bus supporting N2 Standard protocol.
  - b. The FC Bus shall support communications between the FECs and the SNE.



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- c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the SNE.
- d. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.
- e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.
- 21. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
  - a. The SA Bus shall be a Master-Slave/Token- Passing (MS/TP) Bus supporting N2 Standard Protocol.
  - b. The SA Bus shall support a minimum of 10 devices per trunk.
  - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.
- 22. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
- 23. The FEC shall support, but not be limited to, the following:
  - a. Chilled water/central plant automation applications including but not limited to the selection and sequencing of up to 8 chillers of different sizes (constant or variable speed capacity control), 8 primary and secondary chilled water pumps, as well as selection and sequencing of cooling towers and bypass valve. Sequencing of the devices shall consider user- defined efficiency ratings, runtime equalization and number-of-starts/number-of - stops.
  - b. Heating central plant applications
  - c. Built-up air handling units for special applications
  - c. Terminal units
  - d. Special programs as required for systems control
- 24. The FEC shall support a Local Controller Display (DIS1710) either as an integral part of the FEC or as a remote device communicating over the SA Bus.
  - a. The Display shall use an N2 Standard Master-Slave/Token-Passing protocol.
  - b. The Display shall allow the user to view monitored points without logging into the system.
  - c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
  - d. The Display shall provide password protection with user adjustable password timeout.
  - e. The Display shall be menu driven with separate paths for:
    - Input/Output
    - Parameter/Setpoint Overrides
  - f. The Display shall use easy-to-read English text messages.
  - g. The Display shall allow the user to select the points to be shown and in what order.
  - h. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
  - i. The display shall be a minimum of 4 lines and a minimum of 20 characters per line
  - j. The Display shall have a keypad with no more than 6 keys.
  - k. The Display shall be panel mountable.

## 2.5 SYSTEM TOOLS

### A. System Configuration Tool (SCT)

- 1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Automation Engine (SNE) or a Network Integration Engine (NIE).
- 2. The configuration tool shall provide an archive database for the configuration and application data.

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3. The configuration tool shall have the same look- and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
  4. The configuration tool shall include the following features:
    - a. Basic system navigation tree for connected networks
    - b. Integration of Metasys N2 enabled devices
    - c. Customized user navigation trees
    - d. Point naming operating parameter setting
    - e. Graphic diagram configuration
    - f. Alarm and event message routing
    - g. Graphical logic connector tool for custom programming
    - h. Downloading, uploading, and archiving databases
  5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
    - a. N2 Bus devices
    - b. Metasys N1 networks
  6. The configuration tool shall be capable of programming the Field Equipment Controllers.
    - a. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
    - b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
    - c. The configuration tool shall contain a library of standard applications to be used for configuration.
  7. The configuration tool shall be capable of programming the field devices.
    - a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
    - b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
    - c. The configuration tool shall contain a library of standard applications to be used for configuration
  8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
    - a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
    - b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
    - c. The wireless connection shall use the Bluetooth Wireless Technology.
- B. Wireless MS/TP Converter (BTCVT)
- a. The converter shall provide a temporary wireless connection between the SA or FC Bus and a wireless enabled portable PC.
  - b. The converter shall support downloading and troubleshooting FEC and field devices from the PC over the wireless connection.
  - c. The converter shall employ Bluetooth Wireless Technology.
  - d. The converter shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
  - e. The converter shall operate over a minimum of thirty three (33) feet within a building.
  - f. The converter shall have LED indicators to provide information regarding the following conditions:
    - Power - On/Off
    - Fault - Fault/No Fault
    - SA/FC Bus - Bus Activity/ No Bus Activity
    - Blue - Bluetooth Communication Established/ Bluetooth Communication Not Established
  - g. The SWCVT shall comply with FCC Part 15.247 regulations for low-power unlicensed transmitters.

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2.6 INPUT DEVICES

A. GENERAL REQUIREMENTS

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. TEMPERATURE SENSORS

1. General Requirements:
  - a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
  - b. The temperature sensor shall be of the resistance type, and shall be two-wire 1000 ohm nickel RTD.
  - c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	+ .5 Degrees F.
Room Temperature	+ .5 Degrees F.
Duct Temperature	+ .5 Degrees F.
All Others	+ .75 Degrees F.

2. Room Temperature Sensors with Integral Display:
  - a. Room sensors shall be constructed for either surface or wall box mounting.
  - b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
    - Display room and outside air temperatures.
    - Display and adjust room comfort setpoint.
    - Display and adjust fan operation status.
    - Timed override request push button with LED status for activation of after-hours operation.
    - Display controller mode.
    - Password selectable adjustment of setpoint and override modes.
3. Thermo wells:
  - a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
  - b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
  - c. Thermo wells and sensors shall be mounted in a thread-o-let or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
  - d. Thermo wells shall be constructed of Series 300 stainless steel.
4. Outside Air Sensors:
  - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
  - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
  - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
5. Duct Mount Sensors:
  - a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.

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- b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
  - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
6. Averaging Sensors:
- a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
  - b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
  - c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

C. HUMIDITY SENSORS

- 1. Relative humidity, from 0 to 100 percent for high/low limit applications; from 20 to 80 percent min for space applications.
- 2. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
- 3. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
- 4. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
- 5. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealite® fittings and stainless steel bushings.
- 6. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
- 7. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
- 8. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac.

D. DIFFERENTIAL PRESSURE TRANSMITTERS

- 1. General Air and Water Pressure Transmitter Requirements:
  - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
  - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
  - c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
  - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
- 2. Low Differential Water Pressure Applications (0" - 20" w.c.)
  - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
  - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

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- .01-20" w.c. input differential pressure range. 4-20 mA output.  
Maintain accuracy up to 20 to 1 ratio turndown.  
Reference Accuracy: +0.2% of full span.
3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
    - a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:  
Differential pressure range 10" w.c. to 300 PSI.  
Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).
    - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
  4. Building Differential Air Pressure Applications (- 1" to +1" w.c.)
    - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
    - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:  
-1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)  
4-20 mA output.  
Maintain accuracy up to 20 to 1 ratio turndown.  
Reference Accuracy: +0.2% of full span.
  5. Low Differential Air Pressure Applications (0" to 5" w.c.)
    - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
    - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:  
(0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)  
4-20 mA output.  
Maintain accuracy up to 20 to 1 ratio turndown.  
Reference Accuracy: +0.2% of full span.
  6. Medium Differential Air Pressure Applications (5" to 21" w.c.)
    - a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:  
Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.  
Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG. Thermal Effects: <+.033 F.S./Deg. F. over 40 F. to 100 F. (calibrated at 70 F.).
    - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

E. FLOW MONITORING

1. Air Flow Monitoring (when not integral to AHUs)
  - a. Duct Air Flow Measuring Stations:  
Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the

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ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.

Unless integral to a specific equipment with independent controls, Air Flow Measuring Station shall be in the ductwork with the proper straight length duct. Airflow measuring stations shall be of a thermal dispersion type, Ebtron Hybrid Series or prior approved equal. Pitot tube and other type Air Flow Measuring Stations when used as control sequence dependent are not allowed.

The main take-off point from both the total pressure and the static pressure manifolds must be symmetrical.

Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.

b. Static Pressure Traverse Probe:

Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.

c. Shielded Static Air Probe:

A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

2. Water Flow Monitoring:

Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.

F. POWER MONITORING DEVICES

1. Current Measurement (Amps)

a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.

b. Current Transformer - A split core current transformer shall be provided to monitor motor amps.

Operating frequency - 50 - 400 Hz.

Insulation - 0.6 Kv class 10Kv BIL.

UL recognized.

Five amp secondary.

Select current ration as appropriate for application.

c. Current Transducer - A current to voltage or current to mA transducer shall be provided. The current transducer shall include:

6X input over amp rating for AC inrushes of up to 120 amps.

Manufactured to UL 1244.

Accuracy: +.5%, Ripple +1%.

Minimum load resistance

30kOhm. Input 0-20 Amps.

Output 4-20 mA.

Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).

G. STATUS AND SAFETY SWITCHES

1. General Requirements

a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing

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- circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
- b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
  - c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
- 3. Air Filter Status Switches
    - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
    - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
    - c. Provide appropriate scale range and differential adjustment for intended service.
  - 4. Air Flow Switches
    - a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
  - 5. Air Pressure Safety Switches
    - a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
    - b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
  - 6. Water Flow Switches
    - a. Water flow switches shall be equal to the Johnson Controls P74.
  - 7. Low Temperature Limit Switches
    - a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
    - b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
    - c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
    - d. The low temperature limit switch shall be equal to Johnson Controls A70.

## 2.7 OUTPUT DEVICES

### A. ACTUATORS

- 1. General Requirements
  - a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
- 2. Electronic Damper Actuators
  - a. Electronic damper actuators shall be direct shaft mount.
  - b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
  - c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The



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feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

- d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
3. Electronic Valve Actuators
- a. Electronic valve actuators shall be manufactured by the valve manufacturer.
  - b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
  - c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations.  
The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
  - d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
  - e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

B. CONTROL DAMPERS

1. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
2. All dampers used for variable airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil- impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.

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5. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls D-1600, Ruskin CD36, and Vent Products 5800.
6. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. CONTROL RELAYS

1. Control Pilot Relays
  - a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
  - b. Mounting Bases shall be snap-mount.
  - c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
  - d. Contacts shall be rated for 10 amps at 120VAC.
  - e. Relays shall have an integral indicator light and check button.
  - f. Acceptable manufacturers: Johnson Controls, Lectro

D. CONTROL VALVES

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule in specifications Division 23 "Hydronic Piping".
2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
6. VAV modulating hot water valves shall have stainless steel trim and stem.
7. Any control valves mounted outside exposed to ambient conditions shall be installed with an accessible water proof protective cover of sufficient size.

2.8 MISCELLANEOUS DEVICES

A. LOCAL CONTROL PANELS

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1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices-such as relays, transducers, and so forth-that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All low voltage wiring inside panels shall be in flame retardant PVC wire duct raceway.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. POWER SUPPLIES

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply. 2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

2.9 SPARE PARTS

- A. Contractor shall provide Spare Parts equal to 10% of the total DDC Equipment for the following:
1. Controllers
  2. Valve and Damper Actuators
  3. Thermostats & Humidistats
  4. Sensors
  5. Switches
  6. Relays

PART 3 - EXECUTION

3.1 BMS SPECIFIC REQUIREMENTS

A. GRAPHIC DISPLAYS

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. ACTUATION / CONTROL TYPE

1. Primary Equipment
  - a. Controls shall be provided by equipment manufacturer as specified herein.
  - b. All damper and valve actuation shall be electric.
2. Air Handling Equipment

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- a. All air handlers shall be controlled with a HVAC-DDC Controller
- b. All damper and valve actuation shall be electric.
3. Terminal Equipment:
  - a. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.
  - b. All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 INSTALLATION PRACTICES

A. BMS WIRING

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
  - a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified. Color of conduit shall be blue.
  - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BMS LINE VOLTAGE POWER SOURCE

1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BMS RACEWAY

1. All low voltage wiring non-accessible/concealed or exposed shall be installed in a conduit raceway min 1/2", standardized blue in color for controls (EMT for inside and Rigid for exterior). All other low voltage wiring shall be neatly installed with J-hooks or bridal rings spaced at 5' max with hangers specific to this system (do not use other trades hangers or structures).
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) shall be used as approved by the Project Engineer.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

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4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment.
  5. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
- D. Penetrations
1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
  2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
  3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
  4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
- E. BMS IDENTIFICATION STANDARDS
1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
  2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.
- F. BMS Panel Installation
1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
  2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.
- G. INPUT DEVICES
1. All Input devices shall be installed per the manufacturer recommendation.
  2. Locate components of the BMS in accessible local control panels wherever possible.
- H. HVAC INPUT DEVICES - GENERAL
1. All Input devices shall be installed per the manufacturer recommendation
  2. Locate components of the BMS in accessible local control panels wherever possible.
  3. The mechanical contractor shall install all in- line devices such as temperature wells, pressure taps, airflow stations, etc.
  4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
  5. Outside Air Sensors
    - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
    - b. Sensors shall be installed with a rain proof, perforated cover.
  6. Water Differential Pressure Sensors
    - a. Differential pressure transmitters used for flow measurement shall be sized to the flow- sensing device.
    - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
    - c. The transmitters shall be installed in an accessible location wherever possible.
  7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
    - a. Air bleed units, bypass valves and compression fittings shall be provided.
  8. Building Differential Air Pressure Applications (- 1" to +1" w.c.):

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- a. Transmitter's exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
- b. The interior tip shall be inconspicuous and located as shown on the drawings.
9. Air Flow Measuring Stations:
  - a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
  - b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
10. Duct Temperature Sensors:
  - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
  - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
  - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
  - d. The sensor shall be mounted to suitable supports using factory approved element holders.
11. Space Sensors:
  - a. Shall be mounted per ADA requirements.
  - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
12. Low Temperature Limit Switches:
  - a. Install on the discharge side of the first water or steam coil in the air stream.
  - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
  - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
13. Air Differential Pressure Status Switches:
  - a. Install with static pressure tips, tubing, fittings, and air filter.
14. Water Differential Pressure Status Switches:
  - a. Install with shut off valves for isolation.

I. HVAC OUTPUT DEVICES

1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI.

3.3 TRAINING

- A. The BMS contractor shall provide the following training services:

1. Provide (2) 8 hour days, total of 16 hours of on-site training by a system specialist who is fully knowledgeable of the specific installation details of the project. This training shall, at a minimum, consist of a review of the project Graphics, As-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

3.4 PERFORMANCE VERIFICATION TEST (PVT)

- A. PVT Plan

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Prior to the scheduling of the PVT, submit a PVT Plan for approval. The PVT Plan shall include the following, as a minimum:

1. Installed system one-line block diagram, indicating servers, workstations, peripherals, network equipment, controllers, and instrumentation.
2. Installed system hardware description.
3. Installed system software description, including any software revisions made since the factory test.
4. Listing of control and status points installed in the system; plus a table with the following information:
  - a. Input and output variables.
  - b. SNVTs for each variable.
  - c. Expected engineering units for each variable.
  - d. Node ID.
  - e. Domain & subnet addressing.
5. Layout full plan to show what will be tested by the PVT
6. List of test equipment.

### B. PVT Test

- Provide qualified on-site controls system specialist to perform the PVT.
- Contractor shall notify the Project Engineer and Inspector to observe testing minimum of 7 days prior to testing.
- Conduct the PVT to demonstrate that the control system maintains setpoints and that the control loops are tuned for the correct sequence of operation.
- Conduct the PVT during one week of continuous HVAC and control systems operation, after the TAB and before final acceptance of work.
- Specifically, the PVT shall demonstrate that the HVAC system operates properly through the complete sequence of operation (e.g., seasonal, occupied and unoccupied, warm up, etc.), for specified control sequences.
  - Provide a minimum of (4) days of trends in graphic format measured with the BAS while equipment is in full automatic mode to ensure that all system are working properly under all conditions. Include the project points, data in same time increments and clearly identify all trend data.
- Demonstrate that hardware interlocks and safety devices work as designed and alarm as specified.
- Demonstrate all equipment flow stations, dampers, sensors, end devices operate and alarm as specified. Record all data per design, actual and final. Record any notes for each component, as required.
- Demonstrate the Controls Graphics depict actual building / space / equipment layout, functioning properly, descriptions are user friendly & accurate, ECMS shop controls manager has reviewed graphics, monitor / alarms are set up and schedules are set up. Provide hard copies of the Controls Graphics with the PVT.
- If, during PVT testing, the system fails a portion of a test, the Government will inform the Contractor if the entire test or only the portion that failed shall be re-performed. Give the Government a written report of those items which failed, what the problem was, and what was done to correct it.



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- Other items to include in PVT:
  1. Test identification number(s)
  2. Test title
  3. Initial environmental conditions (if applicable)
  4. Test equipment (if required)

C. PVT Report

Submit a final, complete PVT test report, after completing the test, consisting of the following, as a minimum:

1. Section one of the submittal shall be a short summary of the performance verification test.
2. Section three shall be the executed test procedure and shall be divided using tabs. Each tab section shall include all pertinent information pertaining to the executed and approved test, showing date and Government representative who witnessed/approved the test.

D. PVT Demonstration

Perform a PVT Demonstration. Explain the DDC System, review the PVT Report, demonstrate 10% of the tested components and make a punchlist of any deficiencies to be corrected. Contractor correct deficiencies and retest any items necessary based on the demonstration. Once all punchlist deficiencies are complete and resubmitted, the Government shall approve the PVT Test.

END OF SECTION 230923

**Barksdale Standards for electrical installation****CONDUCTORS:**

All conductors will be copper.

Secondary will be THHN insulation. #12 and larger will be stranded.

3 Phase Medium Voltage cable will be 3 each - 15 KV EPR Jacketed Concentric Neutral w/ 133% insulation and have a 1/3 Stranded Neutral.

Note: laterals will be #2 to 4/0 and main trunks will be anywhere from 4/0 to 750kcmils

1 Phase Medium Voltage cable will be 2 ea #2 AWG 15 KV EPR Jacketed Concentric Neutral w/ 133% insulation and have a full Stranded Neutral.

**SPLICING:** underground direct buried splices will be compression type only, NO mechanical splices will be allowed.

High potential insulation resistance test is required for all cable installations in accordance with IEEE standard 141-1976, chapter 10, page 354.

Meg or insulation resistance testing for low voltage cable under 600 volts is also required per NEC.

**DUCT BANK:**

Schedule 40 PVC supported every 5' with conduit supports; for the three phase and all stub outs install Parallel 5", and for the single phase install parallel 4".

All new road crossings or bends greater than 45 degrees will be RGS.

Encapsulate ducts with a minimum of 3" of concrete sprinkled with red dye. Top of concrete will a minimum of 36" below grade.

Back fill with clean dirt to 1' below grade and install a 6" DANGER ELECTRICAL marking tape then fill trench. Trench should be compacted to prevent dirt settling.

**DUCT BANK SECONDARY:**

Schedule 40 PVC. All road crossings or bends greater than 45 degrees will be RGS.

Trench will be 24" in depth.

Back fill with 1' of sand, install 6" electrical marking tape then complete back fill with clean dirt.

**MANHOLE:**

Install a new 8'x8'x8' manhole with a minimum 36" diameter steel cover lid placed every 500 feet of duct bank and change of direction and within 100' of electrical equipment.

Manholes shall be constructed of reinforced concrete which may be monolithically constructed pre-cast concrete. duct lines shall enter manholes through preordered factory installed knock outs as necessary to meet the project requirements. Required conduit be installed flush with bell ends and sealed around openings. Manhole covers shall be installed no more than 3" above finished grade and traffic rated. A cast metal grille-type sump frame and cover shall be installed over the manhole sump hole. Drill

a hole in the manhole corner and drive a 5/8" x 8' copper clad ground rod into the earth so that approximately 4" of the ground rod will extend above the manhole floor then seal around ground rod in the man hole floor. A #4 bare stranded ground wire shall be cad welded to the ground rod and encircle the manhole 4' above the floor anchored to the wall. A cable pulling iron shall be installed in the wall opposite each duct line entrance and in center of the floor such that it doesn't present a tripping hazard. Cables shall be securely supported from walls by the hot dip galvanized cable racks with stand offs fitted with porcelain insulators. Install eight cable racks with two spare standoffs on each cable rack two cable racks per wall per manhole (five total stand offs per rack and rack each separate). Fireproof cables and label with metal tags. Splice cables, ground splices, rack and fireproof cable individually in manhole. All splices will be supported between the racks.

### **PAD MOUNT SWITCH ( PMS ) 422**

S121 is S&C's spec number for Barksdale brown 20117 (Ral#)

S&C dead front type vista with enclosure

12 to 18" skirt.

Penta head bolt.

Danger High Voltage Signs.

6" labels identifying the switch.

2" phenolic placards with 1" letters for each cubical identifying what each cubical feeds.

### **TRANSFORMER:**

#### Single phase pad mounted transformer specifications

Single Phase Pad Mounted Transformer

60 Hertz, 65 degree C rise, class OA

Insulation Fluid Non-PCB mineral oil

Primary Voltage: 12,470 Delta – 95 kV BIL

Primary Bushings: (4) Bushing Wells with 200 amp bushings and (2) Parking Bushings and (2) insulated dead end caps

Taps: (2) 2.5% Above & Below Normal, Non -Load Break Tap Changer

Fusing: Bay-O-Net fuses

Switches: (1) 2-position, On/Off, Single Phase Gang-operated Oil Immersed Load-break rated 300 amps

Impedance: Manufacturer's Standard per ANSI and NEMA

Paint Color Brown-Federal Spec 20117

Other features:

- a. Stainless Steel Ground Pad in HV and LV Compartments
- b. 20 inch Deep Cabinet
- c. High Security Cabinet per ANSI C57.12.28 with Pentahead Bolt
- d. Anodized Aluminum Nameplate with Non-PCB on Nameplate
- e. 1.0" Fill Plug
- f. 1.0" Drain Plug in HV Compartment

- g. Removable Neutral Ground Straps
- h. Provisions for Pressure/Vacuum Gauge
- i. Pressure Relief Valve
- j. Liquid Level Gauge
- k. Dial Type Thermometer
- l. 1.0" Drain Valve with Sampler Device in LV Compartment
- m. "Danger High Voltage" Warning Decals
- n. Surge Protection, (3) 9/10kV Heavy Duty Distribution Class Dead front Arresters
- o. Feed Through design
  - p. Anodized aluminum plate with specs and wiring diagram
  - q. Copper windings

**PAINT:** Brown-Federal Spec 20117 (Ral#)

**TERMINATIONS: (poles & live front)**

Outdoor type- 3M cold shrink type termination w/ skirts and stem connector.  
Indoor type- 3M cold shrink type without skirts.  
Stem connectors or heavy long barrel 2 hole lugs to fit the different application.

**LOAD BREAK ELBOWS:**

200 amp load break with test points and cold shrink cable accessory sealing kits designed to seal the jacket end of power cables where elbows or other cable accessories are installed. Both the sealing tube and mastic must be compatible with commonly used power cable jacketing and semi conductive materials.

**LIGHTNING ARRESTORS: (poles & live front)**

9/10 KV elbow type

**CONCRETE PADS:**

PADS--3000 PSI 6 inches thick with a 1' footer. A 3/4 " chamfer on all edges. 1 foot clearance on all sides of the equipment that is going to be placed on the pad. No more than 3" above grade.

4"X 5' RGS bollards filled with concrete placed 2' in the ground and painted **Barksdale specs. Brown-Federal Spec 20117.** One in each corner **and all at equal height.** These bollards will not be installed in the concrete pad.

Windows.—will be blocked out. After curing blocks removed and windows filled with gravel to 1" of the top and capped with mortar. Calk around all entrances and around mortar to prevent ants from coming in.

All cable entrances will be protected by Schedule 40 PVC or coated RGS.  
4" thick housekeeping pads will be necessary for floor mounted switchgear, dry type transformers and electrical equipment mounted on channel strut in the grass.

**COUNTERPOISE:**

4/0 bare copper conductor.  
30”deep  
30” from pad  
4 ea. 3/4“ x 10’ copper clad steel ground rods one in each corner.  
Cad weld conductor at each ground rod  
Provide 2 paths into the transformer compartments one from each side and 4 for pad mounted switches.

**TRANSFORMER:**

Three Phase Pad Mounted Transformer

60 Hertz, 65 degree C rise, class OA

Insulation Fluid Non-PCB mineral oil

Primary Voltage: 12,470 Delta – 95 kV BIL

Primary Bushings: (6) Bushing Wells with 200 amp bushings and (3) Parking Bushings and (3) insulated dead end caps

Taps: (2) 2.5% Above & Below Normal, Non -Load Break Tap Changer

Fusing: Bay-O-Net fuses

Switches: (1) 4-position, On/Off/loop feed thru, Three Phase Gang-operated Oil

Immersed Load-break rated 300 amps

Impedance: Manufacturer’s Standard per ANSI and NEMA

Paint Color Brown-Federal Spec 20117

Other features:

- a. Stainless Steel Ground Pad in HV and LV Compartments
- b. 20 inch Deep Cabinet
- c. High Security Cabinet per ANSI C57.12.28 with Pentahead Bolt
- d. Anodized Aluminum Nameplate with Non-PCB on Nameplate
- e. 1.0” Fill Plug
- f. 1.0” Drain Plug in HV Compartment
- g. Removable Neutral Ground Straps
- h. Provisions for Pressure/Vacuum Gauge
- i. Pressure Relief Valve
- j. Liquid Level Gauge
- k. Dial Type Thermometer
- l. 1.0” Drain Valve with Sampler Device in LV Compartment
- m. “Danger High Voltage” Warning Decals
- n. Surge Protection, (3) 9/10kV Heavy Duty Distribution Class Dead front Arresters
- o. Feed Through design
- p. Anodized aluminum plate with specs and wiring diagram
- q. Copper winding

**PAINT:** Paint to Barksdale specs. Brown-Federal Spec 20117

**General Notes:**

No shared neutrals for lighting and power branch circuits

Use main breaker panels instead of main lug only panels unless located within line of sight

Label device plates with circuit and panel board information

Label all interior and exterior electrical equipment regarding what it feeds and/or how it is fed

Panel boards must have copper bus and must surge protection TVSS

No refurbished transformers.

Transformers must have copper windings

ONAN generator with 4 pole system

Dry type transformers shall have copper windings

All pad mounted equipment must be secured to the pad

Use Compression type connectors only on all thin wall conduits (EMT etc.)

#12 or larger stranded, #14 or smaller solid or stranded

Transformers will have appropriate k factor rating:

**K-1:** Resistance heating, Incandescent lighting, Motors Transformers control/distribution

**K-4:** Welders, Induction heaters, HID lighting, Fluorescent lighting, Solid state controls

**K-13:** Telecommunications equipment, Branch Circuits in classrooms and health care facilities

**K-20:** Main frame computers, Variable speed drives, Branch circuits with exclusive loads of Data Processing equipment, Desktop computers

\* These ratings are to be used as a guide only. They may vary from one load equipment manufacturer to another. A Spectrum Analysis is the best source.

**Note:** Non-sinusoidal and non-linear are synonymous terms relating to the same transformer type.

All new **poles** will be 12 PSI pressure treated CCA power pole <S> predrilled and ganged to REA specs, birthmark shall be 12 feet from base of pole and remain visible. Install a pole cap. Upon completion all poles shall be number labeled with existing number. (Label feeder – pole number)

Tie wire will be aluminum unless the conductor is copper then it shall be soft drawn copper sized according to conductor size. Aluminum / ACSR conductors will have armor rod installed crossing all insulators. Trim trees as necessary to create the proper line clearance 10 foot from all energized lines and equipment. Attach new guys to pole with angle thimble eye bolt or guy attachments with perform or automatic connectors. Pole guys shall have guy guards.

Pole grounds shall be protected from one foot below grade to 9' above grade. Bond all RGS conduit to ground using a grounding bushing at top of conduit.

Power outages: Coordinate power outages 10 working days in advance through the general contractor. Outages may be required to be completed on weekends unless the Base Civil Engineer authorizes the work to be done HOT. A digging permit will be required and is only good for a 30 day period. Temporary road closures if required will need to be cleared through the fire department, security forces and base civil engineer.

Electrical work shall be performed by a licensed contractor experienced in high voltage overhead line work.

Top line cross arms will be installed four foot from top of pole to allow for the installation of the static wire. New poles shall be installed at a height such that all steel bayonets will not be necessary.

No bolt will extend more than 2 inches past the nut.

All pole hardware will be replaced with new including but not limited to cross arms, braces, guys and anchors.

Removal:

All authorized abandoned guy anchors, all poles and all associated hardware will be removed from Barksdale AFB by the contractor. Construction site area ground landscaping shall be graded and/ or seeded and returned to original condition upon completion on contract. Poles must be backfilled and tamped as required in the Lineman and Cableman's handbook.

Verify label information with electric shop prior to ordering labels

Switch label:

Switch number located in the top right corner of switch on street side with following information and Engraved 1" letter, color coded to match feeder colors for background, with white letters:

PMS feeder #-building # (example: PMS 9-5576 is feeder 9 building 5576)

Also each switch position needs to be labeled to what it feeds located below switch on Vista switches and on the top middle of each door on live front switches. Engraved ½" letter black background, white letters

Example: To PMS 9-5546  
To PMS 9-5645  
To T-6413B  
To PMS 9-6415

Transformer label:

T with building number and letter if applicable and size (example T7710A 500kVA)

Live or dead front

Primary voltage (examples: 1240 delta, 1240GRDY)

Secondary voltage (examples: 120/208, 120/240, 277/480)

Note: if transformer feeds more than one building they need to be listed also.

T4845F

750kVA

Dead front

12470 Delta

120/208 volt

**Manholes:**

Cable shall be labeled with feeder number, wire size, wire type, destination/origination.

Engraved ½” letters black background white letters.

Example: Feeder 9, 4/0 AWG, CU, To/From PMS 9-5546/T6413B

Panels: shall be labeled with source, voltage and amperage

Time clock will be astronomical and operate without the use of a battery. Parking lot and building lights will be controlled with one single photo cell.

Main distribution panels require meter showing amperage and voltage.

Revised February 2024



Attachment 4 – Mechanical\_Typical Comments Base Stds\_3-4-24

ENGINEERING REVIEW COMMENTS		DATE: <b>X</b>	
BASE: <b>Barksdale AFB</b>	PROJECT TITLE: <b>BOLO Dorm Renovations</b>	PROJECT NUMBER: <b>MACC240006</b>	
<input type="checkbox"/> RFP Title 1-A <input type="checkbox"/> 35% DESIGN <input type="checkbox"/> 65% DESIGN <input type="checkbox"/> 95% DESIGN <input type="checkbox"/> 100% DESIGN			
NAME OF REVIEWER	ORGANIZATION/SECTION <b>2CES</b>	PHONE NUMBER: COMMERCIAL: DSN:	
<input type="checkbox"/> Architectural <input checked="" type="checkbox"/> <b>Mechanical</b> <input type="checkbox"/> Electrical <input type="checkbox"/> Civil            Other: _____			
Legend (For ACTION Column) A - APPROVED                      D - DISAPPROVED                      C - CONCUR                      E - EXCEPTION			
ITEM NO.	DRAWING NO. / PARA NO.	COMMENT	ACTION
1		<b>THESE ARE DRAWING/DESIGN/SELECTION, BARKSDALE PREFERENCES AND TYPICAL DESIGN REVIEW COMMENTS THAT HELP DESIGNERS ON ALL OUR PROJECTS</b>	
2	Equipment Selections List	<p><b>LIST for equipment selections / controls for drawings/specs:</b></p> <p><b>CHILLERS (per BAFB soul source letter)</b>          Trane Chillers are only allowed chiller at BAFB per soul source letter          1. Trane CGAM for 20-130 ton applications          2. Trane Ascend Model ACS for 140-230 ton applications          CGAM Options &amp; Example:          Below are following options preferred for CGAM including the warranty preferred          Startup by Equip Mfg, High efficiency/performance, Full factory refrigerant charge (HFC-410A), With factory installed freeze protection, Refrigerant isolation valves (discharge valve)          Factory installed flow switch - set point 60 cm/sec, Std cooling (40 to 65F/4.44 to 18C)          Grooved pipe connection, Factory insulation 0.75", Performance based on water ambient (0 to 125F), Lanced aluminum fins, Across the line starter/direct on line, Single point connection main line unit power-ancillary items require other power, Circuit breaker          Enclosure type UL 1995 rated for outdoor applications, Programmable relays, Default A short circuit rating          With water strainer factory installed, Super quiet, Architectural louvered panels          Elastomeric Isolators/Pads, <b>5 Year Whole Unit – Parts, Labor, and Refrigerant Warranty</b>  <b>10 Year Compressor – Parts</b></p> <p><b>BOILERS</b>          The Benchmark boilers are the standard for Barksdale. These boilers have proven to be efficient and reduce maintenance by an auto air-trim feature that maintains a precise air/fuel ratio with changing environmental conditions such as temperature, humidity and gas pressure fluctuations. The Benchmark Platinum also has the flexibility of a 20:1 turndown ratio for part-load applications and producing less emissions. Additionally, the AM series provides flexibility with a 20:1 turndown ratio, built-in redundancy with multiple heating modules and a 98% efficiency rating as well.          The two models in the Trane family we BOD are as follows:          1. AERCO Benchmark Platinum for 750-5000 MBH          2. AERCO AM Series Boilers for 399-750 MBH</p> <p><b>PUMPS</b>          The models in the WILO family we request are as follows:          1. Top S wet-rotor pumps for heating/cooling applications (inline pump)</p>	

ENGINEERING REVIEW COMMENTS	DATE: X	
		<p>2. Stratos/-D/-Z wet rotor for heating/cooling applications requiring manual self-regulating, inline Electronically Communicated (ECM) type (Z rated for domestic water application.) (inline pump)</p> <p>3. Stratos GIGA built-in VFD (inline pump)</p> <p>4. For GPM/Head applications that fall out of the inline wet rotor capacity we want the NLseries end-suction pump family.</p> <p><b>Computer Room Air Conditioners</b> Liebert-Vertiv (These have direct-drive motors and other features lowering maintenance requirements/costs and are designed for low ambient/year round operation.</p> <p><b>HVAC Controls Building Automation System</b> Johnson Controls N2 Metasys</p> <p><b>Air Flow Measuring Station for Outside Air, AFMS</b> Ebtron Hybrid</p>
3	Local Contacts	<p>Prefer our local representatives are involved throughout designs</p> <p>Local BOD Contact are below:</p> <ul style="list-style-type: none"> <li>a. Chillers - Trane Justin Ivey - 318-540-9483, Justin.Ivey@tranetechnologies.com</li> <li>b. Aerco boilers - Hydronic Technology Connell McCole 318-797-1500, 1-800-673-5737 connell@mccole.org</li> <li>c. JCO - HVAC Controls Justin Hodges, 318-780-6320, justin,ryan.hodges@jci.com</li> <li>d. Liebert - Vertiv CRAC Units, Bob Atchison c:318-402-2661, o: 318-861-5926 batchison@tplan.com</li> </ul>
4	Design Conditions	<p>We know the UFC drives designing at 1% Occurrence, but for the base with so much concrete and military heavy clothing, we prefer and design to 0.4 Occurrence versus 1% (99F db / 76 wb cooling outdoor 74F db indoor; 20F db heating outdoor 72F db indoor). We also change the indoor design conditions for offices as above as people are not comfortable with our high humidity at the indoor setpoints per the UFC.</p>
5	2309.. Controls Specs	<p>BAFB uses N2 controls protocol only. Entire campus is Johnson Controls Metasys which is our preferred choice and shall be used as controls selections. Prefer our local JCI Contacts are involved throughout the design. We have a consolidated Controls Specifications that we share with all Designers if you would like a copy of it per request. Even if it is only used to help with specified items such as PVT, Training, Spare parts. Let us know and would be glad to share.</p> <p>Add this verbiage below to the Controls Specifications:</p> <p>The existing Base wide Energy Management Control System (EMCS) is Johnson Controls Metasys with an existing Server. Entire campus system is based only on N2 protocol at field level and BACnet IP at supervisory level. This Building is to receive a new Direct Digital Controls System (DDC) complete and ready for operation that is N2 protocol at field level and BACnet IP at supervisory level and completely compatible with the existing Johnson Controls Metasys System and Server without the purchase or use of integrators, converters, gateways or special software for use as a building operations terminal. JACE of any framework are not allowed. Barksdale AFB Central EMCS monitoring office shall have graphical monitor and control capability of all points on the existing front end.</p>

ENGINEERING REVIEW COMMENTS		DATE: X	
6			
7		<b>THE FOLLOWING COMMENTS ARE STANDARD COMMENTS THAT SEEM TO BE APPLICABLE TO MOST DESIGNS AND SHALL BE REFLECTED IN THE DRAWINGS AND SPECIFICATIONS</b>	
8	Boilers	Boiler Equipment Selections shall be Aerco. Add these features to the Spec and/or Drawing Schedules: Heat exchanger shall be constructed of Stainless Steel (cast aluminum is allow for boilers under 300MBH). Cast Iron is not allowed. Dual returns (add only if applicable-domestic is close). O2 trim and self-tuning feature.	
9	Drawings & Spec 233000	AHUs: coil casings to be stainless steel	
10	Drawings & Spec 233000	All equipment coil drain pans to be stainless steel	
11	Drawings & Spec 233000	<ul style="list-style-type: none"> <li>• Inside AHU &amp; DOAS: Add thermal breaks to all of AHU downstream of Coiling Coil or entire unit</li> <li>• Outside AHU &amp; DOAS: Add thermal breaks to entire unit</li> </ul>	
12	Mechanical Drawings	Coil and Pump Details: Show PT ports on each side of the coil and pumps for Testing. Add a note to extend TP ports outside of pipe insulation.	
13	Heat Recovery Wheels	On the Makeup Air Units, need to size the cooling coil where it can take the full load if the heat recovery wheel stops working.	
14	Spec 23 05 93	TAB Firm Qualifications: TAB firm shall be certified by NEBB and employ a full time Mechanical Engineer with a current Professional Engineering Licensed.”	
15	Spec 23 05 93	TAB, Add following: “Include NEBB Certification number and expiration of current certifications.”	
16	Spec 23 05 93	<p>TAB: Standard Tolerances:</p> <ol style="list-style-type: none"> <li>1. Equipment with Fans: plus 0% to plus 10%</li> <li>2. All other Air &amp; Water flow: minus 5% to plus 10%</li> </ol> <p>Note: Verify space air pressure relationships meet specified Positive, Negative or Neutral.</p> <p>(this will be standardized for all projects unless application justifies other tolerances)</p>	
18		<p>VAV Schedule Notes and add to specifications:</p> <ol style="list-style-type: none"> <li>1. Provide pre-assembled HW flow piping package including control valve by controls mfg. Provide service switch, transformer, VAV hangers and opposite side controls (field verify accessibility with site location and other trades prior to submittal &amp; ordering)</li> </ol> <p>Provide Controller and associated thermostat compatible with existing Base ECMS</p>	
19	Spec 23 21 13	Exterior condensate piping to Type M or L drawn-temper Copper, wrought-copper fittings, and soldered joints. No PVC	
20		Show a VAV piping isolation valves at each main take off.	
21		Show wall mounted VFDs and BAS Control Panel locations in Mech Room so can confirm space for all components	
22		Show all HVAC Shut Down Switch Locations	
23	HVAC Insulation Specifications 230700	Delete elastomeric cellular pipe insulation from the HVAC pipe insulation table 1 and 2 with exception of dx and condensate piping.	
	Fire Protection	<p><b>The following is Fire Protection Base Preferences:</b></p> <p>Entire Base is Monico Panels &amp; Transmitters to tie into the Emergency Control Center, MNS Sitcom</p>	

ENGINEERING REVIEW COMMENTS      DATE: X

Fire alarm system shall be addressable systems without convertors or translator components and compatible with existing Monico Alarm system.

- A dedicated ADC/SLC for Suppression and Pump monitoring
- One ADC/SLC loop per floor or wing
- Split aircraft hangars into Northside, Southside and Suppression/Foam/Pump loops
- Generally, No ADC/SLC shall monitor more than 32 devices or cover greater than 25,000 square feet. Exceptions considered but require 2 CES Alarm Shop approval.
- BAFB Standardized MAAP+ zone descriptions:

Logical Position	Type of Alarm	Description
1	General Alarm	Manual Pull Stations
2	General Alarm	Heat Detectors
3	General Alarm	Smoke Detectors
4	General Alarm	Flow or Pressure Switches
5**		
6**		
7	Supervisory No Bells Auto reset or General Alarm*	Duct Smoke Detectors
8	Supervisory No Bells Auto reset	OS&Y Sprinkler or Riser Tamper (Normally Open)
9	Supervisory No Bells Auto reset	Low Air (Compressor)
10	Supervisory No Bells Auto reset	Test Header (Normally Closed)
11	Supervisory No Bells Auto reset	Compressor AC Fail
12**		
13	Virtual Fixed	Early Warning
14	Virtual Fixed	Maintenance Alert
15	Virtual Fixed	M/AAC Com Fail
16	Virtual Fixed	Common Panel System Trouble

\*Occupancy dependent. \*\*Reserved for UVIR, Hood, Foam Release or CO Detectors as required.  
If more than 16 positions are necessary an additional unit number will need to be added. Notify Alarm Shop at 456-4267 to coordinate numbering scheme and avoid database corruption.

Suppression

- Have removable face plates for alarm check / riser check and FDC check valves
- BOD should be: FEBCO 850 DC backflow preventer or FEBCO RPZ for high / toxic hazards.
- Monitor jockey pump for AC Fail condition. Add a phase monitor if required.
- Locate water flow and tamper monitor modules with alarm led in visual sight of the switch or valve being monitored.
- Do not combine (series) valve tampers to a single point. Generally, each valve tamper will have a specific address. Exceptions considered but require 2 CES Alarm Shop approval.

ENGINEERING REVIEW COMMENTS		DATE: X	
		Emergency generators <ul style="list-style-type: none"> <li>• Monitor for Commercial power loss and Generator run. Add a phase monitor if required.</li> </ul> Fire alarm and Mass-notification Systems <ul style="list-style-type: none"> <li>• Systems shall each have separate dedicated commercial power sources with surge suppression and power disconnects installed at the panels.</li> <li>• The two base frequencies are:</li> <li>• Prefer not to install Text Signs</li> </ul>	
24	IDS	Base prefers to use Vindicator for the IDS systems.	
25			
26		<b>SPECIFIC COMMENTS</b>	
27		Assume Designer will go thru typical BOD and comments above and incorporate.	
28			

## Attachment 5 – Toilet accessory and interior elevation guidance

### MACC240006 – BOLO Dorm Renovation

-Soap dispensers are manual type foam dispensers with a 1250ml refill cartridge. For drawing purposes, assume 10.5” tall, 6” wide, 5” deep. Operator is at the bottom and should be mounted at ADA compliant height.

-Paper towel dispensers are no-touch manual pull type with a hard wound 8” roll. For drawing purposes, assume 16” tall, 12.5” wide, and 10” deep, with the towel to be pulled protruding out of the bottom. Towel to grab should be ADA height.

-Toilet tissue dispensers should be surface mounted satin stainless steel and accommodate two (2) standard core tissue rolls, be vandal-proof, and shall include one piece molded polyethylene spindles with 1/8” wall thickness.

-Other accessories such as mirrors, robe hooks, shower curtain rods, sanitary napkin disposals and dispensers, and ADA grab rails should be satin stainless steel but are otherwise up to designers discretion and user’s needs. All should be mounted according to the ADA and ABAAS.

All toilet accessories should be indicated and drawn to scale on enlarged plans and interior elevations. I’ve run into too many interference and accessibility issues when they are just specified with a blanket mounting dimensions and installation left up to the contractor, rather than being thought through by the designer.