



CITY OF MOBILE ARENA
CITY OF MOBILE PROJECT NO. CC-034A-22

ADDENDUM NUMBER 04

ISSUE DATE 2/4/25

PROJECT: MOBILE ARENA
OWNER: CITY OF MOBILE

GMC PROJECT NO. AMOB230117

AD4-1 CLARIFICATIONS / RFI RESPONSES / SUBSTITUTIONS / ETC.:

- A. Bidders shall acknowledge receipt of this Addendum via email response.
- B. Any requests for information or clarifications specific to this Addendum shall be forwarded to the following:
- Keith Parker – Project Manager, GMC keith.parker@gmcnetwork.com ;
Sam Matheny – Program Manager, Volkert sam.matheny@volkert.com .
- C. With regards to the lead times on the generator, the City of Mobile's position is as follows:
- The bidder shall assume the equipment of concern (basis of design generator) will be obtainable in time to complete the project. If the selected Contractor, through no fault of their own, cannot procure the generator within the Contract Period of Performance it will be considered an excusable "No Cost" delay assuming the Contractor has issued a purchase order to the manufacturer/supplier as soon as possible following Contract award. Should the City direct the Contractor to perform the work in a different manner or with different equipment, such as a rental unit, this would be considered a compensable change and would be handled in accordance with the Contract requirements for change orders.
- D. RFI Responses to-date are attached for reference.

AD4-2 ISSUED SPECIFICATIONS:

- A. The following revised specification sections are as follows and included herein:
- 271100 Communications Equipment Room Fittings
 - 260910 Centralized Dimming System
 - 263353 Static Uninterruptible Power Supplies
 - 230923 Direct Digital Control for HVAC



AD4-3 ISSUED DRAWINGS:

- A. The following revised drawing sheets are as follows and included herein noted as Addendum#4 on each title block and clouded with Revision #4 at each instance for reference:

Sheet Number	Sheet Name
X1-4	GRID GEOMETRY
X1-5	GROSS SQUARE FOOTAGE PLANS
C1.0	COVER SHEET
C1.1	NOTES AND LEGEND
C2.0	OVERALL SITE PLAN
C3.0	EXISTING CONDITIONS AND DEMO OVERVIEW
C3.1	EXISTING CONDITIONS AND DEMO ZONE 1
C3.2	EXISTING CONDITIONS AND DEMO ZONE 2
C3.3	EXISTING CONDITIONS AND DEMO ZONE 3
C4.0	GEOMETRY PLAN OVERVIEW
C4.1	GEOMETRY PLAN ZONE 1
C4.2	GEOMETRY PLAN ZONE 2
C4.3	GEOMETRY PLAN ZONE 3
C5.0	GRADING AND DRAINAGE OVERVIEW
C5.1	GRADING AND DRAINAGE ZONE 1
C5.2	GRADING AND DRAINAGE ZONE 2
C5.3	GRADING AND DRAINAGE ZONE 3
C5.4	STORM STRUCTURE TABLES
C5.5	STORM PIPE TABLES
C6.0	UTILITIES OVERVIEW
C6.1	UTILITIES PLAN ZONE 1
C6.2	UTILITIES PLAN ZONE 2
C6.3	UTILITIES PLAN ZONE 3
C7.0	CONSTRUCTION DETAILS
C7.1	DRAINAGE DETAILS
C7.2	TRAFFIC CONTROL DETAILS
C8.0	WATER DETAILS
C9.0	SEWER DETAILS 1 OF 4
C9.1	SEWER DETAILS 2 OF 4
C9.2	SEWER DETAILS 3 OF 4



C9.3	SEWER DETAILS 4 OF 4
C10.0	EROSION AND SEDIMENT CONTROL OVERVIEW
C10.1	EROSION AND SEDIMENT CONTROL ZONE 1
C10.2	EROSION AND SEDIMENT CONTROL ZONE 2
C10.3	EROSION AND SEDIMENT CONTROL ZONE 3
C11.0	EROSION AND SEDIMENT CONTROL DETAILS
L1-01	MATERIALS PLAN
L1-02	MATERIALS PLAN
L1-04	MATERIALS PLAN
L2-00	SITE DETAILS
L2-01	SITE DETAILS
L3-01	PLANTING PLAN
L3-02	PLANTING PLAN
L3-03	PLANTING PLAN
L3-04	PLANTING PLAN
L4-01	PLANTING NOTES & SCHEDULE
L4-02	PLANTING DETAILS
L5-03	IRRIGATION PLAN
S0-01	AXONOMETRIC VIEW
S1-1A	REFERENCE FOUNDATION LOAD PLAN - EVENT LEVEL
S1-5	REFERENCE PLAN - HIGH ROOF LEVEL
S2-1	EVENT LEVEL COLUMN BASE PLAN
S2-1A	EVENT LEVEL FOUNDATION & FLOOR PLAN - QUAD A
S2-1B	EVENT LEVEL FOUNDATION & FLOOR PLAN - QUAD B
S2-1C	EVENT LEVEL FOUNDATION & FLOOR PLAN - QUAD C
S2-1D	EVENT LEVEL FOUNDATION & FLOOR PLAN - QUAD D
S2-2A	MAIN CONCOURSE LEVEL - QUAD A
S2-2B	MAIN CONCOURSE LEVEL - QUAD B
S2-2C	MAIN CONCOURSE LEVEL - QUAD C
S2-2D	MAIN CONCOURSE LEVEL - QUAD D
S2-3A	SUITE LEVEL - QUAD A
S2-3B	SUITE LEVEL - QUAD B
S2-3D	SUITE LEVEL - QUAD D
S2-4A	CATWALK AND LOW ROOF LEVEL - QUAD A



S2-4B	CATWALK AND LOW ROOF LEVEL - QUAD B
S2-4C	CATWALK AND LOW ROOF LEVEL - QUAD C
S2-5A	HIGH ROOF LEVEL - QUAD A
S2-5B	HIGH ROOF LEVEL - QUAD B
S2-5C	HIGH ROOF LEVEL - QUAD C
S2-5D	HIGH ROOF LEVEL - QUAD D
S2-10	PARTIAL PLANS
S4-1-01	TYPICAL FOUNDATION DETAILS
S4-2-01	FOUNDATION & CONCRETE DETAILS
S4-2-02	FOUNDATION & CONCRETE DETAILS
S4-3-02	TYPICAL STEEL DETAILS
S4-3-05	TYPICAL STEEL DETAILS
S4-3-08	TYPICAL STEEL DETAILS
S4-4-02	STEEL DETAILS
S4-4-03	STEEL DETAILS
S4-4-04	STEEL DETAILS
S4-4-05	STEEL DETAILS
S4-6-01	PRECAST SEATING DETAILS
S5-1-01	BUILDING ELEVATIONS
S5-1-04	PRECAST CLADDING ELEVATIONS
S6-1-01	BUILDING SECTIONS
S7-1-03	ROOF TRUSS ELEVATIONS
S7-1-04	TRANSFER TRUSS ELEVATIONS
S7-2-02	ROOF TRUSS DETAILS
A0-4	EXTERIOR WALL AND ROOF TYPES
A1-1	REFERENCE PLAN - EVENT LEVEL
A1-2	REFERENCE PLAN - MAIN CONCOURSE LEVEL
A2-1B	EVENT LEVEL - QUAD B
A2-2A	MAIN CONCOURSE LEVEL - QUAD A
A2-2B	MAIN CONCOURSE LEVEL - QUAD B
A2-2C	MAIN CONCOURSE LEVEL - QUAD C
A2-2D	MAIN CONCOURSE LEVEL - QUAD D
A2-3A	SUITE LEVEL - QUAD A
A2-3B	SUITE LEVEL - QUAD B
A2-3C	SUITE LEVEL - QUAD C
A2-3D	SUITE LEVEL - QUAD D



A2-4A	CATWALK LEVEL - QUAD A
A2-4B	CATWALK LEVEL - QUAD B
A2-4C	CATWALK LEVEL - QUAD C
A2-4D	CATWALK LEVEL - QUAD D
A2-5A	ROOF LEVEL - QUAD A
A2-5D	ROOF LEVEL - QUAD D
A2X-3-A	MAIN COURSE LEVEL - SLAB EDGE PLAN - QUAD A
A2X-3-B	MAIN COURSE LEVEL - SLAB EDGE PLAN - QUAD B
A2X-3-D	MAIN COURSE LEVEL - SLAB EDGE PLAN - QUAD D
A3-1-3	ENLARGED PLANS - EVENT LEVEL - RR/LOCKERS/MARKET
A3-1-6	ENLARGED PLANS - EVENT LEVEL - CREW/ELECTRICAL
A4-1A	EVENT LEVEL RCP - QUAD A
A4-1C	EVENT LEVEL RCP - QUAD C
A4-3C	SUITE LEVEL RCP - QUAD C
A5-2-1	EXTERIOR ELEVATIONS ENLARGED - WEST
A5-2-2	EXTERIOR ELEVATIONS ENLARGED - NORTH
A5-2-3	EXTERIOR ELEVATIONS ENLARGED - EAST
A5-2-4	EXTERIOR ELEVATIONS ENLARGED - SOUTH
A6-1-5	INTERIOR ELEVATIONS - EVENT LEVEL - BUNKER CLUB
A6-1-10	INTERIOR ELEVATIONS - EVENT LEVEL - QUAD B
A7-3-1	WALL SECTIONS - WEST
A7-3-4	WALL SECTIONS - SOUTH
A7-3-5	WALL SECTIONS - SOUTH
A8-2-1	EXTERIOR DETAILS
A8-2-2	EXTERIOR DETAILS
A8-2-3	EXTERIOR DETAILS
A8-2-5	EXTERIOR DETAILS
A8-2-7	EXTERIOR DETAILS
A8-3-1	DOOR & WINDOW DETAILS
A8-3-2	DOOR & WINDOW DETAILS
A8-9-1	CEMENTITIOUS PANEL DETAILS
A9-1-1	DOOR SCHEDULES TYPES & FRAMES
A9-1-2	WINDOW & LOUVER SCHEDULES
A9-2-1	FINISH LEGEND
A9-2-2	ROOM SCHEDULE
M0-01	MECHANICAL GENERAL NOTES AND LEGEND



M2-02A	HVAC - 02 - MAIN CONCOURSE PLAN - QUAD A
M2-02B	HVAC - 02 - MAIN CONCOURSE PLAN - QUAD B
M2-02C	HVAC - 02 - MAIN CONCOURSE PLAN - QUAD C
M2-02D	HVAC - 02 - MAIN CONCOURSE PLAN - QUAD D
M2-03A	HVAC - 03 - SUITE LEVEL PLAN - QUAD A
M2-03C	HVAC - 03 - SUITE LEVEL PLAN - QUAD C
M2-11A	PIPING - 01 - EVENT LEVEL PLAN - QUAD A
M2-11C	PIPING - 01 - EVENT LEVEL PLAN - QUAD C
M2-11D	PIPING - 01 - EVENT LEVEL PLAN - QUAD D
M2-12C	PIPING - 02 - MAIN CONCOURSE PLAN - QUAD C
M2-12D	PIPING - 02 - MAIN CONCOURSE PLAN - QUAD D
M5-04	MECHANICAL PIPING DIAGRAMS
M6-02	MECHANICAL CONTROLS
M6-22	SMOKE CONTROL SYSTEM CONTROL DIAGRAMS
M7-02	MECHANICAL SCHEDULES
M7-03	MECHANICAL SCHEDULES
M8-05	MECHANICAL DETAILS
P0-02	PLUMBING SITE PLAN
P2-00A	PLUMBING - 00 - UNDERGROUND PLAN - QUAD A
P2-00B	PLUMBING - 00 - UNDERGROUND PLAN - QUAD B
P2-00C	PLUMBING - 00 - UNDERGROUND PLAN - QUAD C
P2-00D	PLUMBING - 00 - UNDERGROUND PLAN - QUAD D
P2-11A	PLUMBING WASTE & VENT - 01 - EVENT LEVEL PLAN - QUAD A
P2-11B	PLUMBING WASTE & VENT - 01 - EVENT LEVEL PLAN - QUAD B
P2-11C	PLUMBING WASTE & VENT - 01 - EVENT LEVEL PLAN - QUAD C
P2-11D	PLUMBING WASTE & VENT - 01 - EVENT LEVEL PLAN - QUAD D
P2-12A	PLUMBING WASTE & VENT - 02 - MAIN CONCOURSE PLAN - QUAD A
P2-12B	PLUMBING WASTE & VENT - 02 - MAIN CONCOURSE PLAN - QUAD B
P2-12C	PLUMBING WASTE & VENT - 02 - MAIN CONCOURSE PLAN - QUAD C
P2-12D	PLUMBING WASTE & VENT - 02 - MAIN CONCOURSE PLAN - QUAD D
P2-13B	PLUMBING WASTE & VENT - 03 - SUITE LEVEL PLAN - QUAD B
P2-13C	PLUMBING WASTE & VENT - 03 - SUITE LEVEL PLAN - QUAD C
P2-13D	PLUMBING WASTE & VENT - 03 - SUITE LEVEL PLAN - QUAD D
P2-14A	PLUMBING WASTE & VENT - 04 - CATWALK LEVEL PLAN - QUAD A
P2-14B	PLUMBING WASTE & VENT - 04 - CATWALK LEVEL PLAN - QUAD B
P2-21A	PLUMBING WATER & GAS - 01 - EVENT LEVEL PLAN - QUAD A



P2-21B	PLUMBING WATER & GAS - 01 - EVENT LEVEL PLAN - QUAD B
P2-21C	PLUMBING WATER & GAS - 01 - EVENT LEVEL PLAN - QUAD C
P2-21D	PLUMBING WATER & GAS - 01 - EVENT LEVEL PLAN - QUAD D
P2-22D	PLUMBING WATER & GAS - 02 - MAIN CONCOURSE PLAN - QUAD D
P2-24A	PLUMBING WATER & GAS - 04 - CATWALK LEVEL PLAN - QUAD A
P2-24B	PLUMBING WATER & GAS - 04 - CATWALK LEVEL PLAN - QUAD B
P4-00	PLUMBING ENLARGED PLANS
P4-02	PLUMBING ENLARGED PLANS
P4-03	PLUMBING ENLARGED PLANS
P4-05	PLUMBING ENLARGED PLANS
P4-06	PLUMBING ENLARGED PLANS
P4-07	PLUMBING ENLARGED PLANS
P4-08	PLUMBING ENLARGED PLANS
P4-10	PLUMBING ENLARGED PLANS
P4-13	PLUMBING ENLARGED PLANS
P4-14	PLUMBING ENLARGED PLANS
P4-15	PLUMBING ENLARGED PLANS
P4-16	PLUMBING ENLARGED PLANS
P4-17	PLUMBING ENLARGED PLANS
P4-18	PLUMBING ENLARGED PLANS
P4-19	PLUMBING ENLARGED PLANS
P4-21	PLUMBING ENLARGED PLANS
P5-02	PLUMBING RISERS
P5-04	PLUMBING RISERS
P5-07	PLUMBING RISERS
P7-01	PLUMBING SCHEDULES
P8-03	PLUMBING DETAILS
F2-01A	FIRE PROTECTION - 01 - EVENT LEVEL RCP - QUAD A
F2-01B	FIRE PROTECTION - 01 - EVENT LEVEL RCP - QUAD B
F2-01C	FIRE PROTECTION - 01 - EVENT LEVEL RCP - QUAD C
F2-01D	FIRE PROTECTION - 01 - EVENT LEVEL RCP - QUAD D
F2-03D	FIRE PROTECTION - 03 - SUITE LEVEL RCP - QUAD D
E0-1	ELECTRICAL GENERAL NOTES AND LEGEND
E0-2	ELECTRICAL SITE PLAN
E0-3	LIGHTING SITE PLAN



E0-4	LIGHTING SITE ENLARGED PLAN
E2-01A	POWER - 01 - EVENT LEVEL PLAN - QUAD A
E2-01B	POWER - 01 - EVENT LEVEL PLAN - QUAD B
E2-01C	POWER - 01 - EVENT LEVEL PLAN - QUAD C
E2-01D	POWER - 01 - EVENT LEVEL PLAN - QUAD D
E2-02A	POWER - 02 - MAIN CONCOURSE PLAN - QUAD A
E2-02B	POWER - 02 - MAIN CONCOURSE PLAN - QUAD B
E2-02C	POWER - 02 - MAIN CONCOURSE PLAN - QUAD C
E2-02D	POWER - 02 - MAIN CONCOURSE PLAN - QUAD D
E2-03A	POWER - 03 - SUITE LEVEL PLAN - QUAD A
E2-03B	POWER - 03 - SUITE LEVEL PLAN - QUAD B
E2-04C	POWER - 04 - CATWALK LEVEL PLAN - QUAD C
E2-11A	EQUIPMENT CONNECTION - 01 - EVENT LEVEL PLAN - QUAD A
E2-11B	EQUIPMENT CONNECTION - 01 - EVENT LEVEL PLAN - QUAD B
E2-11C	EQUIPMENT CONNECTION - 01 - EVENT LEVEL PLAN - QUAD C
E2-11D	EQUIPMENT CONNECTION - 01 - EVENT LEVEL PLAN - QUAD D
E2-12A	EQUIPMENT CONNECTION - 02 - MAIN CONCOURSE PLAN - QUAD A
E2-12B	EQUIPMENT CONNECTION - 02 - MAIN CONCOURSE PLAN - QUAD B
E2-12C	EQUIPMENT CONNECTION - 02 - MAIN CONCOURSE PLAN - QUAD C
E2-12D	EQUIPMENT CONNECTION - 02 - MAIN CONCOURSE PLAN - QUAD D
E2-13A	EQUIPMENT CONNECTION - 03 - SUITE LEVEL PLAN - QUAD A
E2-13B	EQUIPMENT CONNECTION - 03 - SUITE LEVEL PLAN - QUAD B
E2-13C	EQUIPMENT CONNECTION - 03 - SUITE LEVEL PLAN - QUAD C
E2-13D	EQUIPMENT CONNECTION - 03 - SUITE LEVEL PLAN - QUAD D
E2-14A	EQUIPMENT CONNECTION - 04 - CATWALK LEVEL PLAN - QUAD A
E2-14B	EQUIPMENT CONNECTION - 04 - CATWALK LEVEL PLAN - QUAD B
E2-14C	EQUIPMENT CONNECTION - 04 - CATWALK LEVEL PLAN - QUAD C
E2-14D	EQUIPMENT CONNECTION - 04 - CATWALK LEVEL PLAN - QUAD D
E2-15C	EQUIPMENT CONNECTION - 05 - ROOF LEVEL PLAN - QUAD C
E2-21A	LIGHTING - 01 - EVENT LEVEL PLAN - QUAD A
E2-21B	LIGHTING - 01 - EVENT LEVEL PLAN - QUAD B
E2-21C	LIGHTING - 01 - EVENT LEVEL PLAN - QUAD C
E2-21D	LIGHTING - 01 - EVENT LEVEL PLAN - QUAD D
E2-22A	LIGHTING - 02 - MAIN CONCOURSE PLAN - QUAD A
E2-22B	LIGHTING - 02 - MAIN CONCOURSE PLAN - QUAD B
E2-22C	LIGHTING - 02 - MAIN CONCOURSE PLAN - QUAD C
E2-22D	LIGHTING - 02 - MAIN CONCOURSE PLAN - QUAD D



E2-23A	LIGHTING - 03 - SUITE LEVEL PLAN - QUAD A
E2-23B	LIGHTING - 03 - SUITE LEVEL PLAN - QUAD B
E2-23C	LIGHTING - 03 - SUITE LEVEL PLAN - QUAD C
E2-23D	LIGHTING - 03 - SUITE LEVEL PLAN - QUAD D
E2-24A	LIGHTING - 04 - CATWALK LEVEL PLAN - QUAD A
E2-24B	LIGHTING - 04 - CATWALK LEVEL PLAN - QUAD B
E2-24C	LIGHTING - 04 - CATWALK LEVEL PLAN - QUAD C
E4-01	ENLARGED ELECTRICAL PLANS
E4-02	ENLARGED ELECTRICAL PLANS
E4-03	ENLARGED ELECTRICAL PLANS
E4-04	ENLARGED ELECTRICAL PLANS
E4-05	ENLARGED ELECTRICAL PLANS
E4-06	ENLARGED ELECTRICAL PLANS
E4-07	ENLARGED ELECTRICAL PLANS
E4-08	ENLARGED ELECTRICAL PLANS
E4-09	ENLARGED ELECTRICAL PLANS
E4-11	ENLARGED ELECTRICAL PLANS
E4-21	ENLARGED ELECTRICAL PLANS
E4-22	ENLARGED ELECTRICAL PLANS
E5-01	ELECTRICAL ONE-LINE DIAGRAMS
E5-02	ELECTRICAL ONE-LINE DIAGRAMS
E5-03	ELECTRICAL ONE-LINE DIAGRAMS
E5-04	ELECTRICAL ONE-LINE DIAGRAMS
E5-05	ELECTRICAL ONE-LINE DIAGRAMS
E5-06	ELECTRICAL ONE-LINE DIAGRAMS
E5-07	ELECTRICAL ONE-LINE DIAGRAMS
E5-08	ELECTRICAL ONE-LINE DIAGRAMS
E5-09	ELECTRICAL ONE-LINE DIAGRAMS
E6-01	ELECTRICAL SCHEDULES
E6-02	ELECTRICAL SCHEDULES
E6-03	ELECTRICAL SCHEDULES
E6-04	ELECTRICAL SCHEDULES
E6-05	ELECTRICAL SCHEDULES
E6-06	ELECTRICAL SCHEDULES
E6-07	ELECTRICAL SCHEDULES
E6-08	ELECTRICAL SCHEDULES
E6-09	ELECTRICAL SCHEDULES



E6-10	ELECTRICAL SCHEDULES
E6-11	ELECTRICAL SCHEDULES
E6-12	ELECTRICAL SCHEDULES
E6-13	ELECTRICAL SCHEDULES
E6-15	ELECTRICAL SCHEDULES
E6-16	ELECTRICAL SCHEDULES
E6-17	ELECTRICAL SCHEDULES
E6-18	ELECTRICAL SCHEDULES
E6-19	ELECTRICAL SCHEDULES
E6-20	ELECTRICAL SCHEDULES
E6-21	ELECTRICAL SCHEDULES
E6-22	ELECTRICAL SCHEDULES
E6-23	ELECTRICAL SCHEDULES
E6-24	ELECTRICAL SCHEDULES
E7-06	ELECTRICAL DETAILS
E8-01	LIGHTING CONTROLS AND SCHEDULES
E8-02	LIGHTING CONTROLS AND SCHEDULES
E8-03	LIGHTING CONTROLS AND SCHEDULES
E8-04	LIGHTING CONTROLS AND SCHEDULES
E8-05	LIGHTING CONTROLS AND SCHEDULES
E8-06	LIGHTING CONTROLS AND SCHEDULES
E8-07	LIGHTING CONTROLS AND SCHEDULES
E8-09	LIGHTING CONTROLS AND SCHEDULES
E8-10	LIGHTING CONTROLS AND SCHEDULES
E8-11	LIGHTING CONTROLS AND SCHEDULES
E8-12	LIGHTING CONTROLS AND SCHEDULES
TN401	TECHNOLOGY ENLARGED - 01 - EVENT LEVEL PLAN
TN402	TECHNOLOGY ENLARGED - 01 - EVENT LEVEL PLAN
TN403	TECHNOLOGY ENLARGED - 02 - MAIN CONCOURSE PLAN
TN404	TECHNOLOGY ENLARGED - 03 - SUITE LEVEL PLAN

AD4-4 ATTACHMENTS:

A.



END OF ADDENDUM 4

Issued by:

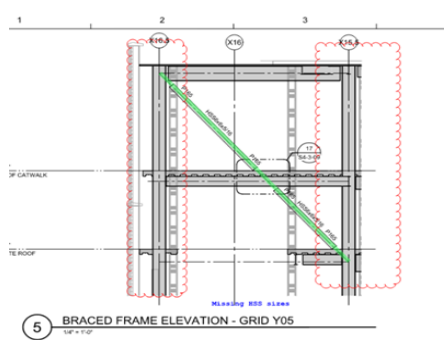
Keith Parker
Sr. Architect / Project Manager
Goodwyn Mills Cawood



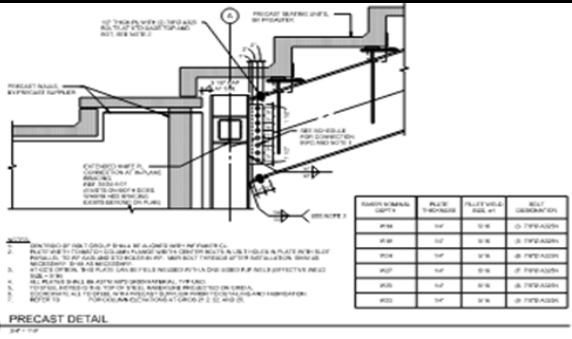
REQUEST FOR INFORMATION							
PROJECT: MOBILE ARENA		DESIGN PHASE:		BID DOCUMENTS			
CONTRACTOR QUESTION / REQUEST					ARCHITECT CLARIFICATION / RESPONSE		
RFI	QUESTION / REQUEST	Dwg. Ref.	Spec. Ref.	Date	CLARIFICATION / RESPONSE	DATE	ADDENDUM
256	Please provide a copy of the Additions and Deletions Report for the AIA A101 contract and A201 general conditions.			12/20/2024	No Additions and Deletions Report exist at this time	1/29/2025	4
257	Reference A8-2-6 – Can a CAD file or Revit model be provided for this custom pattern?	A8-2-6		1/7/2025	CAD files for specific design items may be provided for shop drawing coordination purposes at that phase of the project.	1/23/2025	4
258	For the Builders Risk Insurance, how much Named Storm limit would the Owner require?			1/7/2025	Limits of coverage shall be for the full amount of the Contract.	1/29/2024	4
259	For the Builders Risk Insurance, who will be responsible for deductibles?			1/7/2025	The Contractor will be responsible for the deductibles.	1/29/2025	4
260	Can the ERRCS (Emergency Responder Radio Coverage) scope of work be carried as an owner allowance? It will be difficult for Contractors to have an apples-to-apples bid on a design build scope of work that will not be truly known until the Building is fully constructed so that the signal survey can be completed. Please advise			1/7/2025	The Contractor shall comply with sections 273244 and 273523. The Contractor shall provide a firm fixed price with this scope of work.	1/28/2025	4
261	FR6: Plan A7-6-2 is showing a wall going across the elevator shaft near the back, shows the wall 6' 6.5" off the back wall - what is this wall/structure in the shaft? *Plans A1-1, A1-2, A1-3 and A1-4 show the freight elevator shaft not being able to accommodate the full 23' x 10'4" size platform shown on VT06 with that wall/structure.	A7-6-2, A2-1C, A2-2C, A2-3C, A2-4C		1/10/2025	New freight elevator is being designed to fit in space and will be issued in ADD4	1/29/2025	4
262	Please provide tonnage or monetary value contingencies that need to be included to cover the note on S6-1-01. Note is in top right corner.	S6-1-01		1/13/2025	This is an old note that can be ignored. It will be removed in Addendum 04	1/29/2025	4
263	Refer to A8-2-1 / D9 – High Roof Edge Detail ; It appears that the Sarnaclad edge metal is to be nailed into the ½” gypsum coverboard. Is this correct? Secondly, the detail shows 5/8” exterior plywood over the metal decking on the dome. Is the plywood to cover the entire dome structure?	A8-2-1/D9		1/14/2025	Moved the edge metal back to fasten to the p.t. blocking. Also, the error has been corrected and will reflect on Addendum 4. The roof shall be 5/8" glass mat sheathing throughout entire project.	1/29/2025	4
264	Refer to A8-2-1 / A9 – High Roof Edge Detail; The detail Shows 5/8” glass mat sheathing over the dome (detail D9 shows 5/8” plywood). Where do these conditions switch (plywood to gypsum)? Is the intention to have one singular sheathing material at these locations?	A8-2-1/A9		1/14/2025	It doesn't. Should be glass mat throughout.	1/29/2025	4
265	Refer to A8-2-1 – Note 10; The note states to “provide ¾” plywood topped with 5/8” gyp. Board on all cold formed framing at all interior exposed roofs/lids. Provide fall arrest at these locations.” Where does the ¾” plywood topped with 5/8” gyp board occur? Is this pertaining to the wall framing only? It says “roofs/lids”, however there appears to be no other detail of this condition. Additionally, is the fall arrest permanent? Is there a detail for how to install, manufacturer or any information on the fall arrest system?	A8-2-1 – Note 10		1/14/2025	Fixed. There shouldn't be plywood in any roofing system.	1/29/2025	4
266	Refer to A8-2-1 / J8 – Thru-Wall Scupper; The detail shows a 3/8” shear connector sticking up through the metal scupper flange. Is this correct? If so, is there a detail to seal around the connector?	A8-2-1 / J8		1/14/2025	No, that is not correct. Will remove the shear connector in Addendum 4.	1/28/2025	4
267	271100 2.2.C Four Post Racks – The specification requires an integral 6” wide vertical cable management system. The drawing scale depicts the rack to be 20” wide and without a 6” wide vertical cable management system. Please provide a basis of design that meets design intent or provide clarity on requirements for vertical cable managers.		271100	1/14/2025	See Addendum #4. Delete the requirement for integrated vertical cable managers in lieu of rear lacing bars and 6-inch patch cords.		4
268	TN010 Note T29 – Please provide basis of design for extended range ethernet module required.			1/14/2025	See 276000 section 2.3. NVT 1701+ or equal.		4
269	TN010 Note T30 – Please provide basis of design for emergency call station required.			1/14/2025	See 1/TY502. Provide Code Blue CB-RT with extended light option.		4

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270	TN600 – Please provide clarification/requirements on fiber count/connections for the following: (some of the reference loops contradict each other) Headend 01.23.03 to MDF 01.29.02 Headend 01.23.03 to Video 03.21.01 Video 03.21.01 to MDF 01.29.02 EF 01.29.02 to MDF 01.29.02			1/14/2025	Headend to MDF-96 strand SM OS2; Headend to Video Room-96 strand SM OS2; Video Room to MDF-96 strand SM OS2; EF (service Provider Cabinets) to MDF-24 strand SM OS2 X2.		4
271	The large spiral ductwork at the Catwalk is exposed. Is this ductwork Single wall or Double wall and what thickness and R-value is required for the insulation for this ductwork.		23-31-13	1/16/2025	Refer to specifications for direction on insulation for exposed ductwork. If double wall ductwork is preferred to duct liner it may be provided at the contractors discretion.	1/28/2025	4
272	The metal duct specification only addresses single wall spiral and does not address any double wall spiral.		23-31-13	1/16/2025	If double wall ductwork is preferred to duct liner it may be provided at the contractors discretion.	1/28/2025	4
273	The insulation specification does not specifically address double spiral either.		23-31-13	1/16/2025	If double wall ductwork is preferred to duct liner it may be provided at the contractors discretion.	1/28/2025	4
274	Addendum One revised the Alternates. Does Alt 2 only add the SW Balcony? Same for Alt 3 - the wording is confusing.			1/16/2025	Alt 2 - only SW balcony is added. NW balcony to remain in base bid. Alt 3 - only NE balcony is added NW balcony to remain in base bid.	1/29/2025	4
275	It is not clear on the plans that the Interior Fit out in Alt 7 and Alt 8 are not part of the base bid. Please revise the plans to match the Alternates with appropriate labels calling out the Alternates.			1/16/2025	Please refer to sheet A1-1 for clarification on alternates.	1/29/2025	4
276	The Site Furnishings Spec is a shell of a spec. Please provide a new one.			1/16/2025	Site furnishings will be considered FFE and bid under seperate cover.	1/29/2025	4
277	Reference Sheet A9-1-1-(Door Schedule)-At the 01- Event Level, the first twoopenings on the schedule are missing the door tags. One has an aluminum door with hardware set 7.1; however, the first one with hardware set 13 does not have any other information. Please clarify.	A9-1-1		1/16/2025	Refer to addendum #3	1/29/2025	4
278	Reference Sheet A9-1-1(Door Schedule)-Opening 01.02.05A is missing the door type. Is this expected to be A- hollow metal door?	A9-1-1		1/16/2025	Added the door type and yes this is a hollow metal door	1/29/2025	4
279	Reference Sheet A9-1-1(Door Schedule)- Opening 01.04.11A is missing the door type. Is this expected to be J- aluminum door?	A9-1-1		1/16/2025	Added the door type and yes it is intended that this door is from kawneer or similar approved manufacturer.	1/29/2025	4
280	Reference Sheet A9-1-1(Door Schedule)- Many of the openings listed in the door schedule have frame types that are missing. Please clarify all openings with the correct frame type.	A9-1-1		1/16/2025	All doors should have an updated type. See addendum 4.	2/3/2025	4
281	5. Reference Sheet A9-1-1(Door Schedule)-Please verify the type of door and frame for 01.31.03G & 01.31.03H. The door schedule is blank.	A9-1-1		1/16/2025	Refer to addendum #3	1/29/2025	4
282	Reference Section 08 14 16 of the specifications & sheet A9-1-1 (Door Schedule)- The section indicates that wood doors can be either quarter sawn white oak for a transparent finish or rotary cut birch for an opaque finish. However, the finish schedule and door schedule do not specify the type of finish required. Could you please confirm whether the wood doors should be quarter sawn white oak or rotary cut birch? If birch is selected, should it be natural or white birch?	A9-1-1	08 14 16	1/16/2025	Please follow finishes provided in door schedule	2/3/2025	4
283	Refrence sheet A2-1A, A2-1C, & A 9-1-2. Window type 15, referenced on Sheet A2-1A (Admin Offices), is not shown on the window schedule (Sheet A9-1-2). Window types 17 & 18, referenced on sheet A2-1C at the security office, are also missing from the window schedule. Please confirm and update the window schedule to include these window types	A2-1A, A2-1C & A9-1-2		1/16/2025	Updated Window Schedule	02.03.2025	4
284	AHU's- the spec calls for paint. The VTS units come standard with a 2000 hour salt spray coating. If VTS is approved as an equal is that sufficient?			1/15/2025 Previously Asked	Bid per contract documents. Note that Henderson has not received a substitution request for VTS units.	1/28/2025	4

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285	Need to confirm how many passes the evaporators have, and that the flows through the evaporator are correct. They are on the low side.			1/15/2025 Previously Asked	Bid per contract documents.	1/28/2025	4
286	Spec 23 31 13 Metal ducts. 2.1.R states that supply and return duct exposed to view will have duct liner. Spec section does not include information on double wall duct. Will ducts exposed to view be double wall? If so, please provide spec section for double wall rectangular and double wall round spiral duct as applicable. Also, please confirm that exterior insulation will not be required on ducts exposed to view.		23 31 13 2.1.R	1/17/2025	Refer to specifications for direction on insulation for exposed ductwork. If double wall ductwork is preferred to duct liner it may be provided at the contractors discretion. Supply air and return air duct exposed to view are to be lined per specifications.	1/28/2025	4
287	Please confirm which type of spark resistance is required for Utility Vent Sets. Type A, B, and C are listed in the specification 23 51 13		23 51 13	1/17/2025	No specific spark resistance type required for utility vent set fans. Fans included in section 23 51 13 Draft Control Devices are to be type B spark resistance per specifications.	1/28/2025	4
288	Reference unit heater schedule on sheet M7.03. The listed MBH cannot be achieved at the scheduled 130 EXT. It appears the selected MBH was based on 200 EWT. Please advise.	M7-03		1/17/2025	This will be clarified as part of the addendum package.	1/28/2025	4
289	Reference Sheet S4-3-06 - Detail 13 – Typical Beam Penetration. We cannot find this detail cut on the plans, please provide locations where this detail is required. Also, provide the size of the required penetration.	S4-3-06		1/21/2025	This is needed at two locations in Main concourse area A. This will be added in Addendum	1/30/2025	4
290	Reference Sheet TA102.D and TA202.D - There is hatching indicating Alternate #3. Is this area still an alternate? Please verify.	TA102.D and TA202.D		1/21/2025	Alternate for Market/Restrooms on Main Concourse area D is no longer an alternate. Design for these areas are to be included in the base bid.	1/30/2025	4
291	Reference Sheet A9-1-1- Opening 01.06.01C is listed as aluminum on door schedule. Please confirm if this is correct or is to be steel like all the other overhead coiling doors.	A9-1-1		1/22/2025	Steel - change reflected in Schedule	01.28.2025	4
292	Reference Specification 08 33 13(coiling counter shutters) and sheet A9-1-1 (door schedule) No locations for coiling counter shutters are indicated on the door schedule or elsewhere in the drawings. Please confirm if there are any locations for these shutters or if this specification can be removed.	A9-1-1	08 33 13	1/22/2025	that is correct - there are no coiling counter shutters	01.28.2025	4
293	Reference Specification 08 33 23 section 2.2 A and section 1-E on sheet S0-02. Please confirm if the exterior doors are to comply with the 20 PSF design wind load, instead of the building wind loads specified in Part I E of drawing S0-02.	S0-02 section 1-E	08 33 23 section 2.2A	1/22/2025	Exterior doors should comply with the buildings loads on S0-02.		4
294	Reference Specification 08 33 23 section 2.2 B (overhead coiling doors). This specification calls for seismic performance. This isn't typically a requirement for our area, please advise if this is required.		08 33 23 section 2.2B	1/22/2025	This is seismic category B and if this door is not used for egress, it does not need to be designed for seismic.	0.1.29.2025	4
295	Reference sheet A8-3-1(Door & Window Details)- Details # 27 and #10 states that overhead doors are "insulated where required." Typically, interior doors do not require insulation. Please advise if non-insulated interior doors are acceptable for this project.	A8-3-1		1/22/2025	Confirmed, non-insulated overhead doors are acceptable for interior applications.	1/28/2025	4
296	Reference 2/A0-4 – Is a horizontal flashing/reveal at EVERY horizontal joint on the Exterior System required at 3B walls? Please confirm.	2/A0-4		1/22/2025	Confirmed for 3B walls.	1/28/2025	4
297	Reference 2/A0-4 – Has it been confirmed that the vertical panel supports can span 36” vertically with Mobile’s proximity to coastal wind loads?	2/A0-4		1/22/2025	Confirmed, the vertical panel supports are designed to span 36" between supports. However the vertical supports shall be spaced 12"-18" OC in plan, to be confirmed by the cement panel manufacturer's requirement for supports to resist wind loading.	1/28/2025	4
298	Reference D9/A8-2-1 – Can another horizontal support be added to the face of the insulated panel? The vertical fiber cement extrusions cannot “seesaw” on a single horizontal attachment.	D9/A8-2-1		1/22/2025	Attachments shall be provided to appropriately support the fiber cement panels per manufacturer requirements.	1/29/2025	4
299	Reference A9/A8-2-1 – Can another horizontal support be added to the face of the insulated panel at the top of the panel? The vertical fiber cement extrusions will need an attachment point at the top.	A9/A8-2-1		1/22/2025	Attachments shall be provided to appropriately support the fiber cement panels per manufacturer requirements.	1/29/2025	4
300	Reference Sheet A8-2-6 - Detail 1 indicates a continuous drink rail at all locations with walkable pavers. Detail 9/A8.2.2 is a cut section through the “drink rail” and calls for a sloped Solid Surface top at the parapet. Is this the correct detail and what type solid surface material?	A8-2-6 & A8-2-2		1/22/2025	Detail has been revised and clarified in Add. 2	1/28/2025	4

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301	RCP sheet A4-1D show a ceiling at 9'-0" in rooms 01.26.06 and 01.26.07 but the room schedule is blank, please confirm ceiling type.	A4-1D		1/22/2025	9'-0" CL is only indicated over the entry, the rest of 01.26.06 is shown accurately in the Room Schedule and the RCP. 01.26.07 is showing correctly in both the RCP and in the Room Schedule at a CL2	01.31.2025	4
302	 Reference Sheets S8-1-01 & S8-1-02 - Need size for HSS Columns at Y04, Y05/~X15 – see brace detail below for reference.	S8-1-01 & S8-1-02		1/23/2025	These will be tagged on S2-4C in Addendum 4	1/29/2025	4
303	Please confirm which lockers are phenolic, metal or wood.		10-51-13	1/23/2025	millwork - not phenolic	01.31.2025	4
304	6/A3-1-3 is the location for Home Locker Room and Coaches Lockers. Home Locker room has a detail 2/A6-1-10 to show these lockers but this page does not exist.	A6-1-10		1/23/2025	Sheet added to latest Addendum #4	01.31.2025	4
305	In the Coaches Lockers Room, there is a cut through on 9/A8-7-8 that shows a swinging laminated door in lieu of phenolic. Detail 1 on this page are the Home Hockey Locker but does not call out if it is Phenolic or Wood.	A8-7-8		1/23/2025	millwork - not phenolic	01.31.2025	4
306	1/A3-1-2 is the location of the Star Dressing/Officials Lockers. This sheet shows Portable Millwork Lockers, but the specs call for "Officials" lockers to be phenolic.	A3-1-2		1/23/2025	millwork - not phenolic	01.31.2025	4
307	There are many rooms that do not have any flooring called out (chair storage, ballroom storage, etc..). Are we to assume that it is unfinished concrete or sealed concrete?			1/23/2025	Sealed concrete	1/28/2025	4
308	Service Corridor 01.13.06, Tunnel 01.28.01, and Event Concourse 01.28.02 have the wall finishes scheduled as either P16,T or P16,T however there is no specification for "T". Please clarify what tile spec should be used			1/23/2025	Only provide P16 - Schedule has been updated	01.31.2025	4
309	There are several missing interior elevations specifically on the event level that would show the wall tiles. Will these drawings be provided?			1/23/2025	can you specify which locations are missing and we can direct you in the right direction	01.31.2025	4
310	On Sheet A2-C1 Event Level – Quad C, the curtains/drapery located in Team Corridor 01.17.02 are noted as Premium Drapery, Premium Upholstery. On Sheet A4-1C Event Level RCP – Quad C, the curtains/drapery in the same location is noted as Blackout Curtain, Re: Spec. Please verify which specification should be followed at this location.	A4-2C1		1/23/2025	Premium	01.31.2025	4
311	On Sheet A4-2A Main Concourse Level RCP – Quad A, there are Blackout Curtains located at Bar A 02.03.01. However, there are not any curtains noted at the same location on Sheet A2-2A Main Concourse Level – Quad A. Please confirm whether Blackout Curtains and required at this location. If so, please confirm which specification should be followed at this location.	A4-2A		1/23/2025	Yes, please provide curtains per RCP. Use blackout curtain spec for this location	01.31.2025	4
312	On Sheet A4-3E/8 Enlarged RCP – Loge Club – Lounge Seating , the curtains/drapery are noted as F1 Premium Drapery. On Sheet A2-3A Suite Level, the curtains/drapery in the same location are noted as F1 Blackout Drapery. Please verify which specification should be followed at this location.	A4-3E		1/23/2025	Premium	01.31.2025	4
313	On Sheet A4-3E/5 Enlarged RCP – Suite Lounge D the drapery is noted as F1, Blackout Drapery and on Sheet A4-3E/8 Enlarged RCP – Loge Club – Lounge Seating the drapery is noted as F1 Premium Drapery. Due to the adjacency of these draperies, should they all be noted as the same type? If so, please confirm which specification should be followed at these locations.	A4-3E		1/23/2025	Premium	01.31.2025	4

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314	On Sheet A4-1E/1 Enlarged RCP – Bunker Club, the drapery located in Home Team Tunnel 01.15.01 and Visitor Tunnel 01.17.01B are noted as Blackout Drapery, Re: Spec. In BC Corridor 01.16.03, the drapery is called out as Premium Blackout Drapery (F2), Re: Spec. Due to the adjacency of these draperies, should they all be noted as the same type? If so, please confirm which specification should be followed at these locations.	A4-1E		1/23/2025	Yes, they should be the same...all premium	01.31.2025	4
315	On Sheet A9-1-1 Door Schedule, Door Number 01.04.11A does not list any door or frame type information. Please provide the missing information.	A9-1-1		1/23/2025	See addendum 4.	2/3/2025	4
316	On Sheet A9-1-1 Door Schedule, Door Number 01.04.11B only provides the door type. Please provide the missing information.	A9-1-1		1/23/2025	See addendum 4.	2/3/2025	4
317	On Sheet A9-1-1 Door Schedule, Door Numbers 01.31.03G & 01.31.03G does not provide any information. Please provide the missing information.	A9-1-1		1/23/2025	See addendum 3.	2/3/2025	4
318	On Sheet A9-1-1 Door Schedule, there are multiple door numbers that do not provide the frame type. Please provide the missing information.	A9-1-1		1/23/2025	See addendum 4.	2/3/2025	4
319	Refer to detail A8 on sheet A7-3-2; Exterior soffit EX 2 is called out at the underside of the concourse plaza balcony. Now refer to detail 22 on sheet A8-2-3; This detail call for a fiber cement panel at the same soffit location. Please confirm that the soffit at the underside of the concourse plaza balcony is to be EX 2 insulated metal panel and not insulated panel with fiber cement cladding.	A7-3-2		1/24/2025	EX-2 should be metal panel with metal rainscreen for vertical application and soffit application.	1/28/2025	4
320	Reference A4-1A & A4-1A – There is a note for CL10 to be mounted to the slab above the CL15 baffles in the Grand Hall. Please provide a layout for the CL10 panels similar to what is shown in the Ballroom on A4-1A.	A4-1A & A4-1A		1/24/2025	Ref A4-2A & A4-2D	01.28.2025	4
321	Reference A4-3C – There appears to be some baffles shown between Elevator EP-4 and Service Corridor 03.21.03. These are not tagged and are also shown going into TR 03.21.05. Please clarify.	A4-3C		1/24/2025	these are not baffles - removed from model and updated	01.31.2025	4
322	Please reference on Arch General Finish Note Q (SheetsA2-1A through A2-3D) . "Provide Laminate Partitions at Public Restrooms. Provide Ironwood Toilet Partitions in Premium Restrooms." Please designate which restrooms are considered public and premium as this is not clearly identified in the Architectural plans.	A2-1A thru A2-3D		1/24/2025	all suite level and club restrooms are considered premium, all other multi-person toilets are considered public other unless noted as "employee"	01.31.2025	4
323	The hoistway size is not dimensioned on the drawings. The minimum hoistway size for the car size on the abstract is 13'-7" wide * 18'-0" deep. The hoistway on the drawings scales approximately 13'-11" wide * 17'-4" deep, which allows a maximum overall platform depth of 16'-8" (vs.17'-4.25" platform depth on the abstract) . The drawings call for an elevator size of 23' * 11'. The minimum hoistway size for 11'-0" wide * 23'-0" deep overall platform size is 14'-3" wide * 23'-8" deep, which is a much larger hoistway than indicated and requires an increase in capacity to 13,000 lb. This quote does not allow 11' * 23' car size indicated on the drawing. Please advise if our platform sizes are okay.	A7-6-2 details A5, D5, K5		1/24/2025	New freight elevator is being designed to fit in space	1/29/2025	4
324	Reference Sheet S4-3-02 - Please provide a thickness for HSS base plates. For example, we are provided detail 3/S4-3-02 – but it does not provide thickness or anchor bolt sizes.	S4-3-02		1/24/2025	1" thick base plate and the typical anchor rods called out on S0-02, Part V.E. This will be updated on the detail in Addendum 04.	1/29/2025	4
325	Reference Sheet S5-1-01 - There are still multiple HSS column sizes missing.For example: X03-Y10, Y04-~X05.5, HSS columns on 10/S5-1-01, X03-Y07.5. Please provide these sizes.	S5-1-01		1/24/2025	These will be tagged in Addendum 04	1/29/2025	4
326	Reference Sheet S2-10 - Please provide HSS post sizes for the elevator popups – 4,5,6,20,21 /S2-10	S2-10		1/24/2025	This size is called out in 14/S4-4-03 (HSS5x5x1/4), which is cut on plan.	1/29/2025	4
327	Reference Section 03 41 34 - What is the vibration requirement for the precast stadia?		03 41 34	1/24/2025	The lower bowl precast seating needs 6" stems as shown in 1 and 2/S4-5-01.	1/31/2025	4

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328	 3. Reference S2-2A Detail 2/S4-6-01 cut through column line A near column line 3. This detail (below) indicates a precast wall (highlighted in gray) running parallel to the stadia. However, this wall is not shown on the referenced sheet or indicated at the event level S2-1A. This occurs at several locations throughout the structural plans. Please review detail and clarify where this detail is required.	S2-2A		1/24/2025	Reference section 8/S4-2-01 for conditions where precast wall is to bear on foundation. See plans for grade beam foundation supports and provide vertical reinforcing with slab on grade turndown as shown in referenced section. Precast wall attachment shall be coordinated between precast manufacturer and GC.	1/30/2025	4
329	Reference Sheet S4-5-01 - Detail 20 shows form savers at edge of slab where slab on metal deck and precast meet. A roughened construction joint is shown with a secondary pour that will overlap the precast member. 1. Where does the steel deck stop? At the roughened joint or does it extend out through the secondary pour? 2. If the deck stops at initial roughened joint, is it acceptable to use foam between top of precast and bottom of cast in place concrete as our bottom form? 3. Can the foam be left in place? 4. Is it acceptable to drill and epoxy the dowels in lieu of using the form saver dowels? Using the form savers would make it extremely difficult to make all of the bent ends line up in the correct downward pointing direction. 5. If acceptable, please confirm that the manufacturers' (TBD) recommended depth of drilled hole will be sufficient.	S4-5-01		1/24/2025	1. At the roughened joint, the deck does not extend out. 2. Yes, only as a form, and it must be removed. 3. No, the precast is not intended to support the slab extension permanent. 4. No drilling and epoxying as it won't cantilever. However as an alternate, we have seen #3 U bars bent up out of the way of the precast, then bent back down after the precast was installed. This takes a dedicated effort to quality, though. 5. See #4.	1/29/2025	4
330	Reference Sections 05 31 00 and 09 96 00 - Section 053100 calls for all deck to be galvanized G90, Section 099600-3.9 states that HPC applies to metal decking. Is all metal deck to receive the 2-coat system in 099600? If so, can you substitute a paint system to be applied over the G90 galvanizing?	Sections 05 31 00 and 09 96 00		1/24/2025	HPC is not required for all G90 galvanized decking. A paint coating shall be applied where underside of deck is exposed and called to be painted per the finish schedule. The upper long span roof does not need to be painted. GMC please advise on whether Populous needs to provide paint spec for galvanized metals.	1/30/2025	4
331	REF: A4-1A & A9-2-2 – Womens RR 01.01.01 is scheduled to have EXP3 exposed ceilings on A9-2-2. The RCP on A4-1A shows gyp and CL1. Please clarify.	A4-1A & A9-2-2		1/24/2025	Please provide finishes per the RCP. Finish schedule will be updated in the next addendum	1/28/2025	4
332	REF: A4-1A & A9-2-2 – Jan 01.02.05 is scheduled to have EXP1 exposed ceilings on A9-2-2. The RCP on A4-1A shows gyp. Please clarify.	A4-1A & A9-2-2		1/24/2025	Please proceed with EXP1. Errant Tag showing Gyp will be removed in the next addendum.	1/28/2025	4
333	REF: A4-1A & A9-2-2 – Market 01.03.05 is scheduled to have EXP2 exposed ceilings on A9-2-2. The RCP on A4-1A shows gyp. Please clarify.	A4-1A & A9-2-2		1/24/2025	Please provide Gyp. Finish Schedule will be updated in next addendum.	1/28/2025	4
334	REF: A4-1A & A9-2-2 – Tunnel 01.05.01 is scheduled to have EXP2 exposed ceilings on A9-2-2. The RCP on A4-1A shows gyp. Please clarify.	A4-1A & A9-2-2		1/24/2025	Tunnel extents are from gridlines DL - A. The structure in this area will be exposed and painted. The gyp shown in RCP is part of Corridor 01.05.02.	1/28/2025	4
335	REF: A4-1A & A9-2-2 – Event Concourse 01.05.02 is scheduled to have EXP2 exposed ceilings on A9-2-2. The RCP on A4-1A only shows CL8 & gyp. Please clarify.	A4-1A & A9-2-2		1/24/2025	Please provide CL8 and Gyp as shown in RCP. Struture above CL8 will be painted EXP2. We will Clarify this in the finish legend in the next Addendum.	1/28/2025	4
336	REF: A4-1B & A9-2-2 – Tunnel 01.11.01 is scheduled to have EXP2 exposed ceilings on A9-2-2. The RCP on A4-1B shows gyp. Please clarify.	A4-1B & A9-2-2		1/24/2025	Tunnel extents are from gridlines DL - A. The structure in this area will be exposed and painted. The gyp shown in RCP is part of Corridor 01.13.06.	1/28/2025	4
337	REF: A4-1B & A9-2-2 – Service Corridor 01.13.06 is scheduled to have EXP2 exposed ceilings on A9-2-2. The RCP on A4-1B only shows CL8 & gyp. Please clarify.	A4-1B & A9-2-2		1/24/2025	Please provide CL8 and Gyp as shown in RCP. Struture above CL8 will be painted EXP2. We will Clarify this in the finish legend in the next Addendum.	1/28/2025	4
338	REF: A4-1B & A9-2-2 – Laundry 01.13.08 is scheduled to have EXP1 exposed ceilings on A9-2-2. The RCP on A4-1B shows CL1. Please clarify.	A4-1B & A9-2-2		1/24/2025	Please provide CL1. Finish schedule will be updated in next addendum.	1/28/2025	4

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339	REF: A4-1B & A9-2-2 – Storage 01.14.19 is scheduled to have EXP1 exposed ceilings on A9-2-2. The RCP on A4-1B shows CL1. Please clarify.	A4-1B & A9-2-2		1/24/2025	Please provide CL1. Finish schedule will be updated in next addendum.	1/28/2025	4	
340	REF: A4-1C & A9-2-2 – Storage 01.20.09 is scheduled to have EXP1 exposed ceilings on A9-2-2. The RCP on A4-1C shows CL1. Please clarify.	A4-1C & A9-2-2		1/24/2025	Please provide EXP1. RCP will be corrected in next addendum	1/28/2025	4	
341	REF: A4-1C & A9-2-2 – Tunnel 01.22.01 is scheduled to have EXP2 exposed ceilings on A9-2-2. Please clarify where the structure stops on A4-1C as it is not clear.	A4-1C & A9-2-2		1/24/2025	Please clarify what you mean by "where does the structure stop?" Both the marshalling area and the tunnel receive EXP2. All structure will be EXP2	1/28/2025	4	
342	Please provide lateral capacities of the piles. Additionally, if all piles are subject to lateral loading or if there are going to be any piles that could be considered compression only.			1/24/2025	Per note 3 on sheet S2-1A and note 4 on sheets S2-1B, S2-1C, and S2-1D, piles noted with "T" on plan are to be designed for 40 kips tension load and 25 kips shear (lateral) load. All piles are to be designed for 200 kips compression load. Also reference note 2 of "SITE AND FOUNDATION" general notes on S0-04.	1/28/2025	4	
343	The following tube columns are not sized on the design dwgs. 1 large tube-C/L X03-Y10- Section S5-1-01, 1 @ C/L Y09.9-0X01.4- Section 12/S5-1-01, 1 @ C/L Y09.9-X02--Same section, 1 @C/L X07.5-X04-Section 10/S5-1-01, 1 @ C/L X07.6-X03 - same section, 1 @ C/L X07.6- X04- same section	S2-2A		1/27/2025	These sizes will be shown on S5-1-01 in Addendum 04		4	
344	Please clarify which EP Series Root Barrier Panel is to be used.			1/27/2025	Model SM-3620. See Addendum 4, Detail 6/L4-02, Basis of Design	1/30/2025	4	
345	There is a project limits line that runs down the sidewalk between the Parking Garage and the new construction on Landscape plan L3.03 and Irrigation plan L5.03. It shows the landscape and irrigation in this area outside the project limits. Is landscape and irrigation in this area to be included or not??			1/27/2025	Landscape and Irrigation are included between the sidewalk and service area. See Addendum 4.	1/30/2025	4	
346	Root Barrier Location – Per Sheet L3-01, L3-02, and L3-03 the Note shows the Root Barrier pointing to the area where the sod meets the shrub bed area. Are we to provide root barrier in <u>all</u> the surrounding beds enclosed by hardscapes and sidewalks and does the root barrier need to be installed where the bed meets the sod area. Some areas do not show root barrier specified			1/27/2025	See Addendum 4. Root barrier to be installed per plan. Locations where root barriers meet sod areas are intended to protect future development sites.	1/30/2025	4	
347	Video Surveillance Server: Is a separate Failover Server required and if so, what is the ratio of primary to secondary failover?			1/27/2025	Basis of Design includes quantity 4: 2U Wisenet WAVE Network Video Recorder with 4 Professional licenses, Wisenet WAVE pre-installed, 96TB, 470 Mbps recording B/W, 12 HDD Bay (3.5"), Intel Xeon 4410Y, 16GB RAM, Dual 480GB SSD OS drives (RAID 1), Windows Server 2022, Support RAID 0/1/5/6 + 8GB NV cache, mDP output, VGA output, 4 x 1GbE NICs, IPMI, Redundant 800W power supplies, Keyboard and mouse included, Rail kit included.	1/28/2025	4	
348	Regarding the requirement for the security contractor to enroll personnel badging/access cards, What is the required quantity of prox cards?			1/27/2025	Provide quantity 500 cards and include enrollment programming for 100.	1/28/2025	4	
349	Is the security contractor to provide the badges/access cards, and if so, how many are required and what is the part number for badge?			1/27/2025	See answer 477.	1/28/2025	4	
350	Is video from Intercom stations required to be stored on the NVR?			1/27/2025	No, however, a live intercom video feed to Security Room 01.23.05 is.	1/28/2025	4	
351	What does 'ES' stand for? Refer to the symbol on page 2			1/27/2025	ES is an Emergency Call Station see also Answer 153.	1/28/2025	4	
352	If ES stands for Emergency Call Station, what is the preferred manufacturer?			1/27/2025	See answer 153.	1/28/2025	4	
353	Please confirm that the mechanical screen walls are to be 6' overall height.	S4-4-04		1/27/2025	We don't understand the question. Is it asking for clarification on the dimensions on detail 13/S4-4-01?		4	
354	REF: A0-1, A2-1B, A2-1C, & A2-1D – Sheet A2-1B shows a wall type "S6KB.2" at Stair Core 01.ST-2. Sheet A2-1C shows this wall type at Freight EF-5. Sheet A2-1D shows this at Stair Core 01.ST-4. We cannot determine what this wall type is based on the Partition Type Legend on A0-1. Please clarify.	REF: A0-1, A2-1B, A2-1C, & A2-1D		1/27/2025	Typ Shaft Wall per A0-1	01.28.2025	4	
355	REF: A0-1 & Floor Plans – None of the floor plans call out whether the gyp goes to deck or stops 4" inches above the ceilings. Please clarify locations of 0G2 vs. 0G2D and 0G1 vs. 0G1D.	REF: A0-1		1/27/2025	Ref A0-1	1/28/2025	4	

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356	Reference Sheet A9-1-2 – please provide a material description for elevations 1 through 12 Are these hollow metal, stainless steel, aluminum, or storefront?	A9-1-02		1/27/2025	IN PROGRESS	01.28.2025	4	
357	Ref A3-1-3 / A6-1-10 Detail 8 & 9 “Women’s RR 01.12.06” - Drawing A6-1-10 is missing from the construction documents.	Ref A3-1-3 / A6-1-10		1/27/2025	Sheet A6-1-10 has been added to X1-2 and Addendum #4 Set	1/31/2025	4	
358	Ref A3-1-3 / A6-1-1-10 Detail 6 & 11 “Toilets/ Grooming 01.13.01” - Drawing A6-1-10 is missing from the construction documents.	Ref A3-1-3 / A6-1-1-10		1/27/2025	Sheet A6-1-10 has been added to X1-2 and Addendum #4 Set	1/31/2025	4	
359	Ref A3-1-4 / A6-1-10 Detail 7 & 13 “Coaches Grooming 01.12.02” - Drawing A6-1-10 is missing from the construction documents.	Ref A3-1-4 / A6-1-10		1/27/2025	Sheet A6-1-10 has been added to X1-2 and Addendum #4 Set	1/31/2025	4	
360	REF: 6/A3-1-3 – The Enlarged Plan for Home Team Campus on 6/A3-1-3 has several elevations that reference A6-1-10. This sheet is not included in the set nor is shown on X1-2 Sheet Index. Please provide this sheet.			1/27/2025	Sheet A6-1-10 has been added to X1-2 and Addendum #4 Set	1/31/2025	4	
361	REF: A10-1C – Restroom 01.21.06 has T6/P13 tagged on 2 walls. Please clarify the height of the T6 wainscot.			1/27/2025	Provide the wainscoat 5' tiles high	01.31.2025	4	
362	Request for Sheet “X1-4 GRID GEOMETRY” seen listed in the drawing index.	Sheet X1-4		1/27/2025	It appears that X1-4 & X1-5 didn’t make into in the set. They will be released in addendum #4.	1/29/2025	4	
363	If required for shipping, can a splice be added to the Transfer Trusses in drawings 2, 5, 8 & 11 on sheet S7-1-04?	Sheet S7-1-04		1/27/2025	Confirmed. Proposed splice shall be coordinate with precast support, slab support and ceilings.	1/28/2025	4	
364	Please confirm that the Fire Alarm contractor is responsible for the smoke control sequence through the fire alarm system per sheet FO-01 "Smoke control system scope of work". It appears to read all smoke control including equipment, manual stations and it's wiring is via the fire alarm system and it should be programmed and provided per mechanical sheet sequences M6-21 and M6-22. We believe this is the way it should work but wanted confirmation since the sequences are shown on the mechanical sheets for smoke control.	F0-01 & M6-21 thru M6-22		1/27/2025	This is a correct reading of the documents.	1/28/2025	4	
365	Reference L4-02 - Detail 6 - Please clarify which EP Series Root Barrier Panel is to be used.	L4-02		1/27/2025	Model SM-3620. See Addendum 4, Detail 6/L4-02, Basis of Design	1/30/2025	4	
366	Reference Sheets L1-01 thru L1-04 - On the Landscape Materials Plans I do not see any locations for Site Furnishings F-103 Fixed Bollard. Can you provide locations for these Bollards?	L1-01 thru L1-04		1/27/2025	Fixed bollards added to drop off area. See Addendum 3, Sheet L1-02	1/30/2025	4	
367	Reference Sheet L2-00 - On Detail the edging is detailed as “4” Black Metal Edging”. I did not see a specific callout for the material in the specs. Can you clarify the edging manufacturer/make/model?	L2-00		1/27/2025	See Addendum 4, Detail 4/L2-00.	1/30/2025	4	
368	If EP-1/EP-2, EP-3, and EP-4 Hoistway dimensions must remain at 9’8” wide x 6’11.5” deep, extra steel for guiderail supports will need to be provided for all elevator companies (this hoistway is too large for a 3500lb elevator platform). * a 4000lb elevator would fit in the 9’8” hoistway width – would it be preferred to have a 4000lb in lieu of 3500lb for all passenger elevators? / if so, will the spec be changed to call for all passenger elevators to be capacity of 4000lb, center opening 4’0 wide doors?	SHEET A7-6-1, A7-6-2		1/27/2025	4000 LBs with center opening doors is acceptable	1/29/2025	4	
369	Sheet S6-1-07 shows only Elevator 1-2 to have intermediate supports. No intermediate support is show for Elevators 3-6, confirm that this is correct?	S6-1-07		1/27/2025	All elevators need to have guide rail HSS supports. The sizes shown are in the tables below each elevator section on S6-1-07. See notes regarding typical details.	1/28/2025	4	
370	EP1-2, EP-3, EP-4&SE-5 - Plans A-7-6-1-A7-6-3show to have 8' entrance frames(this might be considering rough opening), but spec calls for 7' entrance height. Please confirm entrance height and cab height for passenger elevators and SE5. *Minimum clear overhead under hoistbeam is 13’4" for EL1-4 and SE5 with an 8ft cab height/7ft doors. If 8' doors / 9' cab is desired, clear overhead increases.	A7-6-1	142100 2.4.A.12 / B.12 /C.12 / D.12	1/27/2025	All passenger and service doors are 7’-0” high, we believe this refers to the rough opening height needed.	1/29/2025	4	
371	Reference Section 14 31 00 Para. 1.7 Coordination - (item C) Escalator machine is located in the upper pit as standard. The spec mentions Machine Space different than the pit. Please clarifv.		Section 14 31 00	1/27/2025	Controller location in upper pit.	1/29/2025	4	
372	Reference Section 14 31 00 Para. 1.7 Coordination - (item E) No heating or colling is normally required for escalator’s truss. Pleae verify.		Section 14 31 00	1/27/2025	Assuming conditioned air in space, this should be fine	1/29/2025	4	
373	Reference Section 14 31 00 Para. 1.7 Coordination (Item F) is truss cladding required from the escalator supplier or is it by others?		Section 14 31 00	1/27/2025	By others	1/29/2025	4	

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374	Reference A2-1B and A2-1C – Detail 4/8-1-1. This detail indicates a door over the ice melt pit. Measuring the ice melt pit it appears to be +/- 35’ long by 3’-6” wide. How large is the door indicated in this detail? Is there a grate over the additional area?	A2-1B and A2-1C		1/27/2025	Refer to Specifications section 08 31 13 (2.3) for Heavy-Duty Floor Access Doors and Frames.	1/30/2025	4
375	The intercoms that are spec’d in the Security Section, are they to be programmed and tied into the VOIP phone system?			1/27/2025	See Section 281523. No, Telephone interface with the VoIP system is not a requirement. The system includes Video Door Stations along with a Master Station and Client for the Command Station + any necessary programming and special licensing for the video component.	1/28/2025	4
376	Please clarify the PoE switches required for the camers, intercoms, emergency call stations, and access control boards are being provided by the telecommunications company?			1/27/2025	All switch port counts for cameras, intercoms, call stations, and access control panels are included in Division 276000.	1/28/2025	4
377	If security integrator is to provide PoE switches which switch spec’d does the customer want to use for the cameras, intercoms, emergency call stations, and access control boards.			1/27/2025	Switches are the responsibility of the Divsion 276000 Contractor.	1/28/2025	4
378	On the Landscape Materials Plans I do not see any locations for Site Furnishings F-103 Fixed Bollard. Can you provide locations for these Bollards?			1/27/2025	Fixed bollards added to drop off area. See Addendum 3, Sheet L1-02	1/30/2025	4
379	On Detail 5/ L2-00 the edging is detailed as “4” Black Metal Edging”. I did not see a specific callout for the material in the specs. Can you clarify the edging manufacturer/make/model?			1/27/2025	See Addendum 4, Detail 4/L2-00	1/30/2025	4
380	“The hoistway size is not dimensioned on the drawings. The minimum hoistway size for the car size on the abstract is 13’-7” wide * 18’-0” deep. The hoistway on the drawings scales approximately 13’-11” wide * 17’-4” deep, which allows a maximum overall platform depth of 16’-8” (vs.17’-4.25” platform depth on the abstract) . The drawings call for an elevator size of 23’ * 11’. The minimum hoistway size for 11’-0” wide * 23’-0” deep overall platform size is 14’-3” wide * 23’-8” deep, which is a much larger hoistway than indicated and requires an increase in capacity to 13,000 lb. This quote does not allow 11’ * 23’ car size indicated on the drawing. Please advise if our platform sizes are okay.”	A7-6-2 for details A5 & D5 & K5		1/27/2025	New freight being designed to fit space	1/29/2025	4
381	Please clarify the material and finish for the rail on the Grand Hall Stair on drawing A7-5-5. Neither that drawing, nor the metalwork detail drawings seem to indicate what material that rail should be.	A7-5-5		1/27/2025	Finishes are shown on A6-1-1/3	1/28/2025	4
382	Drawings L1-02 and L1-04, near detail 5/L2-01, shows the symbol for a R-101 guardrail, but there is no label indicating that there is one located there. Please provide clarification on if there is a guardrail located here or not.	L1-02 and L1-04		1/27/2025	Refnotes added to drawing. See Addendum 4.	1/30/2025	4
383	Escalator machine is located in the upper pit as standard. The spec mentions Machine Space different than the pit. Please clarify			1/27/2025	Controller located in upper pit	1/28/2025	4
384	No heating or colling is normally required for escalator’s truss. Please clarify if this is required.			1/27/2025	Assuming conditioned air in space, this should be fine	1/28/2025	4
385	Is truss cladding required from the escalator supplier or is it by others?			1/27/2025	By others	1/28/2025	4
386	I am looking for a drawing that points out the location of the different curbs that are in the detail drawings.	C4.0-4.3, C7.0		1/27/2025	Reference cut section labels on geometry plan. Denoted by a cut section label, detail number, and page number where detail can be found. Arrow of label denotes direction of detail.	2/3/2025	4
387	Ref. 3/A0-4 – Can a typical panel layout be provided for this Exterior System type like what was provided for Exterior System – 3B on 2/A5-3-4?	A0-4		1/20/2025	See sheet A8-9-1	1/29/2025	4
388	Will Stainless Steel 441 be accepted in lieu of Stainless Steel 304 for elevator materials (Doors/Frames/Ceilings/fixtures)?			1/23/2025	441 is acceptable for all elevators inside.	1/29/2025	4

SECTION 271100**COMMUNICATIONS EQUIPMENT ROOM FITTINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Backboards.
 - 2. Racks.
 - 3. Cabinets.
 - 4. Power strips.
 - 5. UPS.

1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. RCDD: Registered communications distribution designer.
- C. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- D. TGB: Telecommunications grounding bus bar.
- E. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of Technician.
 2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall always be present when Work of this Section is performed at Project site.
 3. Field Inspector: Currently registered by BICSI as Technician to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 BACKBOARDS

- A. Backboards: A/C grade, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm) Plywood, fire-retardant treated, comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.2 RACKS

- A. Manufacturers: Subject to compliance with requirements.
- B. General Frame Requirements:
 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
 3. Finish: Manufacturer's standard, baked powder coat.
- C. Four Post Floor-Mounted Racks:
 1. 84" high, modular-type, steel construction.
 2. ~~Integral 6 inch (150 mm) wide vertical cable management with metal hinged covers. Plastic removable covers are prohibited.~~

3. Baked powder coat finish, black in color.

2.3 MODULAR WALL CABINETS

1. Minimum 36" overall high x 23.4" wide x 36" deep.
2. Steel construction.
3. Treated to resist corrosion.
4. Lockable front door and rear pivot frame.
5. Louvered side panels.
6. Cable access provisions top and bottom.
7. Horizontal optical fiber cable management.
8. Grounding lug.
9. Roof-mounted, 250 (118-L/s)-cfm fan.
10. Horizontal power strip.

2.4 MODULAR FREESTANDING CABINETS:

1. Cabinet shall have overall dimension of 83-1/2 H x 20 W x 36 D inches.
2. Fully welded construction with static load of 10,000 lbs.
3. 14-gauge steel top and bottom panels.
4. 19 inch (482 mm) wide 11-gauge adjustable rack-rails.
5. 10-32 threaded holes on EIA standard spacing.
6. Removable and lockable steel side panels.
7. Hinged and lockable front Plexiglas and vented rear steel doors.
8. ~~Built-in 4.25 inch (108 mm) front vertical cable management with hinged covers.~~
9. Adjustable feet for leveling.
10. Cable access and conduit provisions in the roof and base.
11. Grounding bus bar.
12. Four (4) Roof-mounted 4.5 inch (114 mm) fans.
13. Vertical 20Amp Power Strip.
14. Baked-polyester powder coat black finish.
15. Cable access provisions in the roof and base.
16. Baked powder coat finish, black in color.
17. All cabinets keyed alike.

2.5 OPTICAL FIBER HORIZONTAL CABLE MANAGEMENT FOR RACKS AND CABINETS

1. Metal, 3.5-inch-high (89 mm) (2RU) front integral wire retaining fingers and hinged front cover. Plastic removable covers are prohibited.
2. Baked-polyester black powder coat finish.
3. Provide one (1) 2RU horizontal cable manager below each optical patch panel.

2.6 POWER STRIPS

- A. Power Strips: Equipment rack power strips shall be 125-volt, 20-amp, 3 wire, single circuit type with 10 NEMA 5-20R single receptacle outlets on 6" centers.
 1. Horizontal rack mounting.
 2. Six, 15-A, 120-VAC, NEMA WD 6, Configuration 5-20R receptacles.
 3. LED indicator lights for power and protection status.
 4. LED indicator lights for reverse polarity and open outlet ground.

5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Cord connected with 15-foot (4.5-m) line cord.
8. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.7 RACK MOUNT UPS

- A. UPS: Equipment UPS shall be Smart-UPS, 3000VA, 120V with SmartConnect Port.
 1. Horizontal rack mounting.
 2. Output power capacity: 2.7kWatts / 2.88kVA
 3. Rack Height: 2U
 4. Output Connections: (2) NEMA 5-20R (Battery Backup); (6) NEMA 5-15R (Battery Backup)
 5. Nominal Output Voltage: 110V, 120V, 125V
 6. Nominal Input Voltage: 110V, 120V, 125V
 7. Input Connections: NEMA L5-30P
 8. Cord Length: 8.01ft (2.4meters)

2.8 GROUNDING

- A. Comply with requirements in Division 27 Section "Grounding and Bonding for Communications Systems." for grounding conductors and connectors.
- B. Telecommunications Main Grounding Bus Bar:
 1. Connectors: Mechanical type, cast silicon bronze, solder less compression-type wire terminals, and long-barrel, two-bolt non-twisting connection to ground bus bar.
 2. Main Telecommunications Ground Bus (MTGB) bar: Copper, minimum 1/4-inch-thick by 4 inches wide (6 mm thick by 100 mm wide) with two vertical 5/16-inch (8-mm) holes spaced 5/8 inches (16 mm) apart.
 3. Telecommunications Ground Bus (TGB) bar: Copper, minimum 1/4-inch-thick by 2 inches wide (6 mm thick by 50 mm wide) with two vertical 5/16-inch (8-mm) holes spaced 5/8 inches (16 mm) apart.
 4. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
 5. Provide a TMGB in the Main Equipment Room and a TGB in each Telecommunications Room.
- C. Comply with TIA-607.
- D. Comply with NECA-BICSI-607.

2.9 LABELING

- A. Comply with TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers. Reference sheet T-601 for owner approved labeling standard

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Comply with NECA 1.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
 - 1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
 - 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- G. Backboards:
 - 1. Install from 6 inches (150 mm) to 8 feet, 6 inches (2588 mm) above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
 - 2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
 - 3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569.

3.2 BE ROOM AND TR REQUIREMENTS

- A. Provide ceiling-hung lighting with a wall switch at the door.
- B. Provide power to HVAC equipment.
- C. Provide dedicated 120-volt, 20 ampere circuits to duplex receptacles 48" AFF and 10' apart on the plywood backboards. Plywood backboards are by others.
- D. Provide dedicated 120-volt, 30 ampere circuits to NEMA L5-30R receptacles and provide dedicated 120-volt, 20 ampere circuits to power strips on the telecom equipment racks. See Standard Details.
- E. In rooms with DAS, ERRC, and Security equipment plywood backboards, provide two dedicated 120-volt, 20 ampere circuits to quad receptacles on each DAS backboard.

- F. Provide one 120-volt, 20 ampere normal power circuit to a duplex receptacle on the wall near the door.
- G. Coordinate all receptacle locations with Owner.
- H. Provide a copper ground bus bar where shown. Connect it to the unit substation room ground bus bar and to the ground bus bars in the receptacle panels feeding the telecom room receptacles. Ground cables shall be No. 6 AWG green insulated, stranded, copper. The resistance to building ground shall be 1 ohm maximum.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION 271100

SECTION 26 0910 - CENTRALIZED DIMMING SYSTEM**PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. Contractor shall install, provide, and test State of Alabama energy code compliant architectural dimming control system(s) as specified herein for the areas indicated on the drawings and load schedules. Contractor shall coordinate all work described in this section with applicable plans and specifications, including but not limited to, wiring diagrams, conduit diagrams, emergency power systems, A/V systems, shade devices, fire alarm, and security systems.
- B. Work within this section shall include low voltage wallbox controls, low voltage wired control devices, architectural dimming panels, interface components, and/or modules, emergency transfer system, and Digital-Network Lighting Control System equipment and software including wired devices for energy code compliance. System to contain internet connected processing Hub with Ethernet connection and dedicated IP address furnished by owner for internet diagnostics and connection to BAS system. System to connect to building Wi-Fi system and to include networked dimming panels for normal and emergency loads as designated and with networked power supply units. Refer to Section 27 for coordination with internet requirements and IP addressing. All network equipment, including routers, network switches, and network cables to be included in base bid, whether supplied by manufacturer or by others that comply with ETC requirements. System to also be compatible with iPad tablet devices already furnished by owner for portable control of entire system with CAD-based footprint of all areas described herein including the exterior façade and site, vestibules and entry lobbies, concourse areas, lounge and suites, and event level tunnel inscribed on iPad for clarity and ease of controlling lighting scenes, individual zone control, and remote visualization and control of rooms. Architect to provide CAD footprints of spaces to manufacturer at their requested schedule in order to imbed spatial footprints into server. Dimming system manufacturer to provide iPad App and license agreement for installing on to owner provided iPads.
- C. System to include a total of nine (9) wired Mosaic/ Pharos Tessera/TPC wall recessed touch screen panels connected via Cat5/6 cable to a remote EXT series single universe controllers and to light fixture's DMX wiring and DMX control boxes. These NINE (9) Pharos/ Tessera DMX touch screens and EXT single universe controllers to be provided as such: **1.** Event Level Grand Hall storage area under stair for control of type "RL1A" DMX backbone as indicated per plans. **2.** Event Level Staff offices-room 01.05.04 for control of fixture type "SL1", "SL2", "SL6", "SL7", "SL8", "SL10", and "SL13" only. **3,4,5,6.** Event Level north ballrooms-rooms 01.07.01 to 01.10.01. Each of four (4) rooms to be furnished with Pharos/ Tessera touch screen as indicated per plan for control of type "WL2" fixtures and "RL1A" DMX backbone. Programming of the DMX touch screen to include additional pages for combinations of partitioned rooms typical for other convention center designs. **7.** Event Level west ballroom-rooms 01.31.02. Furnished with Pharos/ Tessera touch screen as indicated per plan for control of type "RL1A" DMX backbone. **8.** Event Level Home Locker Room-01.13.02 for control of fixtures "FL10" and "FL11" within room with separate pages to control color and color temperature. An additional page to control the tunnel experience with fixture type "TL5" and "TL6". **9.** Suite Level Video Production Room-03.21.02 to control fixture types "LL2", "SL2", "SL7", "SL8", "SL9", "SL13", "TL5", "TL6", "TL12", "TL13", "WL4", and "WL7" associated with site lighting poles "SLP1, SLP2, SLP5 series. Programming of the DMX touch screen to include pages for: Plaza Experience so that from the touch screen or through the 3rd party theatrical console, the plaza DMX based fixtures can be manipulated to coincide with arena activities, Arena activities, for fixtures "LL2", "TL12", "TL13", "WL4", and "WL7" for blackout conditions or pre-game festivities, and a final page for player introduction to control fixtures "TL5" and "TL6" of the tunnel area.

- D. Each of these "MTS" designated Mosaic/ Pharos touch screen device to playback scenes or macros as developed during commissioning with programming through computer program and not through TPC device due to complexity of macros. Color to be white as verified by architect. Costs for said devices and all programming time required to develop color scene triggers or macros/ programs at the request of the owner representative to be part of specified dimming system manufacturer's overall Bill of Materials and included in base bid. Time required for days or weeks worth of programming time based on the nine (9) areas to be included in the base bid for dimming system. Dimming system manufacturer to be responsible for DMX interface equipment to allow color and scene "triggers" from Mosaic/Pharos DMX control devices.
- E. At all corners of the catwalk/roof level, contractor to install a wireless DMX antenna connected to Acclaim's Aria wireless DMX transmitter/receiver on the roof and then connected via wired DMX within the building to the Pharos/ Mosaic single universe DMX touch screen designated as station "MTS" in the Event Level administration office. From the southwest antenna and wireless DMX transmitter/ receiver, an additional run of wired DMX running through the building to also connect to the Pharos touch screen noted above. The northwest Acclaim's Aria transmitter/ receiver and antenna to be within field of view of fixture types "SL1" and "SL2" along Civic Center Drive. The six (6) existing poles along Civic Center Drive to support the Acclaim Aria wireless transmitter/ receiver as per manufacturer's requirements so that existing power wiring to these poles can be re-used without additional expense of providing DMX control wiring. The southwest Aria transmitter/receiver and antenna to be within field of view of fixture types "SL6", "SL7", "SL8", "SL10", and lighting poles "SLP1", "SLP2", and "SLP5" series at the circular plaza. The northeast and southeast antennas to control DMX fixtures associated with site lighting poles "SLP5" series. A transmitter/receiver to be mounted to each of the "smart" site lighting poles, types "SLP1", "SLP2", and "SLP5" series which connects to specific fixtures on said poles through wired DMX. The wireless DMX system for Civic Center Drive and within the new southwest plaza and connecting paths allows DMX control without the need to run DMX or Ethernet cable underground.
- F. Within the Control booth/ video Production room-#03.21.02 at the Suite Level, and at the exit corridor of Event Level-room 01.27.10, both a DMX receptacle and Ethernet based receptacle at a designated wall to be provided by contractor for the use of a owner supplied or 3rd party temporary theatrical control console for outdoor stage productions with the capability of "take-command" functions. Only fixture types "LL2" at the main concourse with DMX control, type "SL2"- RGBW flood on existing poles along Civic Center Drive, type "SL7" RGBW flood at the new circular plaza, type "SL13" at the roof, and types "TL5" and "TL6" RGBW floods and spots at the player tunnel, types "TL12" and "TL13" mounted to the catwalk to illuminate underside of arena roof, type "WL4" at the south end of the Main Concourse, and type "WL7" along the main concourse to be controlled by this 3rd party theatrical control console in the Control booth. For the Event Level corridor location-room #01.27.10, the 3rd party temporary theatrical console by theatrical production company to have access to site poles "SLP1" and the temporary pipe clamp mounted fixtures to be provided by theatrical production company as well as the roof mounted fixtures, type "SL13". Per type "SLP1" specification, the site pole to include a dedicated 120v service to feed 1-1/2" O.D black theatrical pipe permanently secured to these type "SLP1" poles for future theatrical stage lighting with DMX wireless control. The DMX/ Ethernet receptacles to be connected to the ETC or approved centralized architectural dimming system for control of DMX based architectural light fixtures. Only the specific fixtures noted in the schedule and per this section to be controlled at this position. The "take-command" function of the theatrical console to allow network or owner personnel the opportunity for black-out conditions or for the opportunity to control architectural light fixtures for pre-game activities. Control booth/Video Production room to also include an ETC 2-button preset station to control all suites, except the steplights required for egress during blackout, for blackout condition. In addition, said 2-button station to also control type "DL5A" accent fixtures in the suite level and on the arena side of the blackout curtain for control of these non-DMX fixtures for blackout conditions. Only the DMX based lighting equipment on the interior and exterior as defined in Section C. above to be controlled in this room; public areas including restrooms and bars that cannot be affected by blackout conditions for egress needs shall not be controlled from this room.

- G. For A/V integration within the Ballrooms or other designated spaces, the transferring of final, approved programmed scenes, fade rates, and zone intensity levels to the AMX/ Crestron control system as supplied by A/V provider shall be performed by A/V provider as needed. Costs associated with time required to transfer data from ETC or other manufacturers listed to A/V device included in base bid as well as interface devices required.
- H. Manufacturer to submit Shop Drawings as required by Division 1 and the GENERAL CONDITIONS.
- I. Submit riser diagram showing components and interconnecting wiring. Indicate size, type, and number of conductors.
- J. Manufacturer to submit a dimming load schedule with respective control zones and dedicated circuits indicated. Standard cut sheets shall be presented for additional control devices.

1.2 QUALIFICATIONS

- A. The architectural dimming system shall have been in production for a minimum of 10 years.

1.3 REGULATORY REQUIREMENTS

- A. Provide products listed and classified by Underwriter's Laboratories, Inc. as suitable for purpose intended. Each module shall be specifically listed by U.L. for control of type of load; i.e., incandescent, 0-10v LED, electronic, or magnetic low voltage, or phase-adaptive (PWM).
 - 1. Manufacturer shall be ISO 9001 certified. Provide a copy of the certificate if required.

1.4 MAINTENANCE MANUALS

- A. Provide operating instructions for all components.
- B. Provide record wiring diagrams of the system.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. ETC Electronics shall be the preferred Basis of Design manufacturer for the project. System shall be based on ETC's centralized dimming system with integral Paradigm processor and main lug and feed through dimming panels for 277V normal or normal/emergency service with capabilities to control 0-10v loads or ELV loads as noted in the light fixture schedule or other panels as needed with 120V or 277V ELV/ Phase Adaptive loads as indicated. System to also include wireless ceiling occupancy (vacancy) sensors and daylight sensors with wired mini-hubs to send signals to wireless devices around the mini-hub as well as wired low voltage preset stations. System to include all component parts required for an operational and energy code compliant system. Furthermore, system to include any DMX interface network device and/ or contact closure interfaces to allow a "trigger" that accesses preset color scenes or macros through dimming system iPad devices furnished by dimming system manufacturer. During the installation and programming phase, dimming manufacturer to coordinate with university personnel to ensure communication with existing color-changing lighting equipment for a single point of control. Architectural dimming system manufacturer shall not be responsible for programming of color-changing scenes or effects; only the recall of said scenes and colors. Costs associated with programming time to establish colors and macros associated with color-changing fixtures to be coordinated through the contractor and local programmers as noted in light fixture schedule. As required with an A/V system, manufacturer to also provide network interfaces for coordination with A/V touch screen devices. Comparable systems from Lutron Electronics or Crestron to be an acceptable alternate manufacturer.

2.2 COMPONENTS

- B. General: ETC system includes computer-based software that provides control, configuration, monitoring, alerting and reports. Software to be installed within the desktop computer provided by dimming system manufacturer as noted in Section 1.1 System includes:
1. Lighting Management Panel
 2. Light management computer software.
 3. Building Automation System (BAS) communication through network/ IP address interface
 4. Factory assembled dimming and switching panels
 5. Low voltage wired wall stations
 6. Wired occupancy and daylight sensors to link back to central processor
 7. Network Interface Devices for AV integration as required
 8. Computer jacks for remote programming within all electrical closets.
 9. DMX input/ output interface for recall scenes and take-command function from console
 10. iPad control app and licenses by dimming system manufacturer for iPads provided by owner as part of their existing stock. Dimming system manufacturer is not required to supply iPads.

2.3 DIMMING CABINETS AND DIMMING PANELS

- A. Project Conditions:
1. Ambient temperature: 0 degrees to 40 degrees C (32 degrees to 104 degrees F).
 2. Relative humidity: Maximum 90 percent, non-condensing.
 3. Lighting control system must be protected from dust during installation.
 4. Ambient temperature for Q-Manager, system computer: 10 degrees C to 35 degrees C (50 degrees F – 90 degrees F)
- B. General:
1. Dimmers designed and tested to specifically control LED sources from specific manufacturers, inclusive of 0-10V dimming drivers, ELV drivers with requirements for Pulse-width modulation (PWM) modules, and MLV transformers operating LED sources. Dimmers to also be tested for standard, non-LED sources including incandescent/tungsten, magnetic low voltage, electronic low voltage, neon/cold cathode, fluorescent dimming ballasts, and non-dim loads.
 2. Utilize universal 16A continuous-use UL listed dimmer.
 3. Limit current rise time to minimum 350 μ sec as measured from 10-90 percent of load current waveform and minimum 525 μ sec as measured from 0-100 percent of load current waveform at 50 percent rated dimmer capacity at a 90 degree conduction angle. Current rise to be minimum 400 μ sec as measured from 10-90 percent of load current waveform and minimum 600 μ sec as measured from 0-100 percent of load current waveform at 100 percent rated dimmer capacity at a 90 degree conduction angle.
 1. Dimmers controlling public egress designated fixtures to have low end threshold factory set so as not to go below required code light levels.
- C. The dimmer cabinet shall be fabricated from 10 gauge formed steel. It shall have black epoxy painted finish. Contractor shall reinforce wall as required for wall-mounted panels.
- D. The cabinet door shall have a keyed lock. Manufacturer to furnish 2 spare keys.
- E. Dimming panel shall be completely pre-wired by the manufacturer. The contractor shall be required to provide input feed wiring and load wiring which terminates to a set of clearly marked terminals. No other wiring or assembly by the contractor shall be permitted. Contractor shall not remove jumpers or safety device load protection to dimmers until factory field commissioning has determined all loads are connected properly.

- F. Dimming cabinets shall be cooled via free-convection or integral fan. Panels shall allow full-rated dimmer capacity. Panels shall provide airflow across the heat sink areas and through the dimmer chassis. Contractor shall not install multiple cabinets directly above one another, or in any other means that restricts airflow and heat dissipation
- G. For a hybrid control system involving distributed load dimming packs, said devices shall be suitable for plenum conditions.

2.4 DIMMING MODULES

- A. General
 1. Dimmer modules shall be a self-contained assembly, factory wired and installed in a cabinet prior to shipment to the site.
 2. Quantities and sizes of each type of dimmer module shall be provided to control each type of load shown on the load schedule and/or drawings.
 3. All dimmers shall provide a smooth and continuous "square" law dimming curve throughout the range.
 4. A positive air gap relay shall be employed with each dimmer to ensure that the load circuits are open when the "off" function is selected.
 5. The maximum allowable asymmetry in the load wave form shall be ± 1 VDC.
 6. Electrolytic capacitors to operate at least 20 degrees C below the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40 degrees C (104 degrees F) ambient temperature.
 7. Load Handling Thyristors (SCRs and triacs), Field Effect Transistors (FETs), and Isolated Gate Bipolar Transistors (IGBTs): The component's maximum current rating to be at least two times the dimmer's/relay's rated operating current.
 8. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer/relay.
 9. Design and test dimmers/relays to withstand line-side surges without impairment to performance.
 10. Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
 11. When power is interrupted and subsequently returned, within 3 seconds lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption
- B. Incandescent and Low Voltage Magnetic Transformer Dimmers
 1. Filtering shall be provided in each dimmer so that current rise time shall be at least 350 ma/microsecond at 50% rated dimmer capacity and at no point rise faster than 30ma/microsecond, measured from 10-90% of load-current waveform.
 2. Dimmers shall be capable of dimming lamps to 0% (Blackout)
 3. Each dimmer shall incorporate an electronic "soft-start" default at initial turn-on that smoothly ramps lights up to designated levels within 0.5 seconds.
 4. Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage/cycle), frequency shifts (plus or minus 2 Hz change in frequency/second), dynamic harmonics, and line noise.
 5. Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.
- C. Low Voltage Electronic Transformer Dimmers
 1. Dimming shall not adversely affect sound rating of the electronic transformers. In addition dimmer shall not allow any "flicker" at any point within the dimming range.
 2. Each dimmer shall incorporate an electronic "soft-start" default.

3. Dimmer to operate electronic low voltage transformers via reverse phase control. All ELV based loads, whether LED or quartz-based shall be connected to a Pulse-width modulation (PWM) module internal or external to the dimming cabinet or proper dimming of ELV loads.
- D. 0-10V dimming modules
 1. Dimming shall operate as constant current for all conditions including dimming from 10% to 1% where indicated. PWM (pulse width modulation) dimming for 0-10V shall not be allowed.

2.5 LOW VOLTAGE WALL STATIONS

- A. Allows control of any devices or parts of the Lutron System.
- B. Wired devices designated as SW1 to be a Heritage series 1-button devices (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW1" on documents. Button to be programmed so that during hours of operation button is disengaged. During after hours, button to turn all lights in restrooms to full output if vacancy sensor in restrooms turn off lights.
- C. Wired devices designated as SW2 to be a Heritage series 2-button devices (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW2" on documents. 2-button station to represent scenes on and scene 13 of bars to allow (2) alternate scenes for operator. 2-button stations for other areas to represent on/off scenes if vacancy sensor turns off lights. Buttons to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- D. Wired devices designated as SW3 to be a Heritage series 3-button devices (color to be white as verified by architect or otherwise designated by architect/ interior designer) for individual suites or other areas defined as "SW3" on documents. 3-button station to represent scenes 1-3 with NO "off" scene available for suites or scenes 1 and 2 with "off" scene as defined per area. 3 scenes consistent for each space to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- E. Wired devices designated as SW5 to be a Heritage series 5-button device (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW5" on documents. 5-button station to represent scenes 1-4 with "off" scene available or scenes 1-5 without "off" scene as defined per individual area. 4 or 5 scenes to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- F. Wired devices designated as SW7 to be 7-button device (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW7" on documents. 7-button station to represent scenes 1-4 with "off" scene available with separate raise/lower function to control all zones with universal raise/lower function. Scenes to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- G. Wired device designated as MS to be a multi-page 14" wide AMX/ Crestron, or ETC touch-screen panel for master control of all dimming system public domain controlled areas. Master control station to be located in Security Office-room 01.23.06 with separate pages for: Event Level, Main concourse, and Suite Level. Master control station shall not be able to access locker rooms or individual suites, however, master control station can control suite lounges or loge clubs. 14" wide touch screen with programming of pages for each level and additional pages per level of individual rooms and scene names and Sequence of Operations to be included in base bid. An interface device required by dimming system manufacturer to communicate and coordinate with switch MS to be included by dimming system manufacturer.
- H. Wired devices designated as MTS to be a Mosaic/ Pharos TPC wall recessed touch screen panel connected via Cat5/6 cable to a remote EXT series single- universe controller and to light fixture's

DMX wiring and DMX control boxes. Refer to documents regarding location of devices to be coordinated and approved by architect and operator representative prior to final installation of devices. Each "MTS" designated Mosaic/ Pharos touch screen device to playback scenes or macros as developed during commissioning with programming through computer program and not through TPC device due to complexity of macros. Color to be white as verified by architect. Costs associated with actual DMX devices and control boxes to be provided by dimming system manufacturer as stated in Section 1.1.D. All ten (10) DMX touch screen devices and controllers to be indicated on one-line control diagrams for coordination and located per space.

- I. Confirm Sequence of Operation with owner during commissioning. Stated sequences and labeling is for reference only.
- J. Electronics
 - 1. Use RS485 wiring for low voltage communication.
- K. Functionality
 - 1. Upon button press, LEDs to immediately illuminate.
 - 2. LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.
 - 3. Engrave wall stations in English with appropriate button, zone, and scene engraving descriptions. Scene names and engraving to be determined by owner after project completion. Costs associated with engraving to be included in base bid.

2.6 WIRELESS/ WIRED CEILING SENSORS

- A. Wireless or wired occupancy sensor operating at 431 MHZ on ceilings of spaces as indicated and designated as per electrical documents. During "occupied" hours, as times so stated by the operator, occupancy sensor to act as means to turn lights to 100% upon detection with the capability of dimming to 50% after 30 minutes of inactivity. During "unoccupied" hours, as so determined by the operator, occupancy sensor to act as means to turn lights to 50% upon detection and turning off after 30 minutes of inactivity. Vacancy sensors to be indicated where noted and designated as per electrical documents. "Vacancy" sensor in rooms noted to turn lights off automatically after a period of non-activity, but with manual "on" requirement. Sensor to be disengaged by wallstations.
- B. Wireless daylight sensors designated with a "D" on ceilings as indicated on electrical documents. Wired daylight sensors to control only those zones as indicated on the control matrix. Light levels above 20fc measured by sensor to dim controlled zones.
- C. Power Savr wireless hub to connect wireless devices. Quantity of devices and distance from hub to devices not to exceed manufacturer's requirements. Wireless hub to be wired back to main hub as per one-line diagram.

2.7 INFRARED PARTITION CONTROLS

- A. For the Ballrooms with partition, system to include an infrared receiver/ transmitter pair located at the terminating point of the partition. Infrared receiver/ transmitter to automatically connect (or disconnect) individual rooms together without need for manual connection or other graphic interface. Device to include additional contact closure interface. Devices to be located 5 feet away from wall surface partitions run into to allow intended gap for passage between rooms with rooms acting independently. A/V system to access partition condition through network interface. Dimming system manufacturer is not required to provide additional equipment for A/V interface specific to partition control.

2.8 A/V INTERFACE AND CONTACT CLOSURE CONTROLS

- A. As required, system to include A/V interface device and contact closure devices for “take command” operation of lighting scenes in ballrooms as indicated. Motorized shade control to be controlled only through A/V system and not through dimming system.

2.9 COMPUTER JACKS

- A. Dimming system's main server and processor to be located in Fire Command Center-room 01.23.04 with computer jack to allow access to software and manual override of all loads associated with dimming system. Additional computer jacks that allow programming and download to the system's hub to be located in every electrical closet and with public concourses at each corner of concourse. Costs associated with data/ network wiring to these locations to be included in base bid and included in one-line diagram. Manufacturer to label computer jacks and cover plate as “dimming system”.

2.10 OVERCURRENT

- A. Provide a UL 489 molded case main breaker.
- B. Primary circuit breakers in the dimmer module shall be rated at the same capacity as the dimmer. Both the Primary and the secondary breakers shall be thermal magnetic or magnetic for both overload and dead short protection, and shall have a minimum rating of 10,000 A.I.C. with a visual trip indicator. The breaker shall serve as disconnect for the dimmer.
- C. Each dimmer shall operate over an input range of 90 to 140 VAC, at 60Hz in an ambient air Temperature from 0° to 40° C. Each dimmer shall have a thermal sensor to shut down the dimmer's output when the heatsink temperature exceeds 185°F (85°C).
- D. Each dimmer shall be solid state with encapsulated silicon controlled rectifiers to provide symmetrical alternating current output to the load at any output level from OFF to FULL intensity.
- E. The solid state switch devices shall be mounted in a substrate material for heat dissipation. The substrate shall be encapsulated in an epoxy filled high impact plastic case with an optical isolator, a snubbing network and gating circuitry on the high voltage side of an integral opto-coupled control voltage isolator. Provide a minimum of 2500V RMS isolation between line and control in the switch device.

2.11 EMERGENCY SYSTEM

- A. Contactor shall refer to one-line schematic documents and dimming panel schedule on electrical sheets for loads which shall be connected to normal/ emergency power or normal power. Normal/ emergency panels to be Feed-through type panels only.
- B. In event of power failure those loads designated as normal/emergency shall pass to designated transfer cabinet as supplied by dimming manufacturer transfer cabinet shall be listed as U.L. 1008 and U.L 924 standard. Transfer relay shall be connected in line as per manufacturer's one-line diagram so that during power failure all loads controlled in transfer cabinet default to full light levels; regardless if the load is ELV, MLV, or 0-10V. in the case of 0-10V loads, the emergency transfer shall not interrupt the control signal and a signal shall be sent across the control wires to ensure that fixture retains its full output status.
 - 1. Transfer cabinet shall comprise voltage sensing circuitry to automatically transfer loads from normal to emergency feed when one or more of the phases in the normal feed drops to 55% (65 Volts) or below.
 - 2. Transfer cabinet shall contain an integral test switch to simulate normal power source failure for periodic verification of system operation Access inside the transfer cabinet for test purposes shall not be necessary.

3. Contractor shall connect normal/ emergency dimming panels to generator or redundant system able to provide full power through ETC device or other means of transfer to designated fixtures. ETC device to bring designated fixture to full power for emergency egress regardless of current dimmed setting during power failure.
- C. Emergency loads with self-contained batter back-up ballast connected to dimming system shall be contained within dedicated dimming panel as indicated on one-line diagram and as per load panel schedule per engineering documents. Contractor shall connect emergency ballast to "B" or constant hot of terminal block as per manufacturer's wiring diagram so as to provide constant power to emergency battery..

2.12 QUALITY CONTROL

- A. Components used in the lighting control system shall be inspected per the most current revision of Military Standard 105 or equivalent.
- B. Dimming module main power semiconductors shall be tested at a case temperature of 100 degrees C and with rated voltage applied for a minimum of 48 hours.
- C. Prior to shipment, the completely assembled dimming system shall be operated at full-rated load for a period of time long enough to identify and replace any components or subassemblies which would have failed within a short time of system star-up. All the dimmer and/or relays within a panel shall be full-load tested at the same time. Manufacturer shall prove that they have the capability of proving this full- load test as specified.
- D. Finished system shall also be fully tested for proper operation of all control functions per the approved submittal drawings.
- E. Each panel shall be certified by the technician who built the equipment or a quality assurance inspector of the successful completion of the tests described in 2.8, C and D above.

2.13 WARRANTY

- A. All bidding manufacturers to provide owner/ operator with full 100% coverage of parts and material for 8-years with pro-rating schedules. Custom, 8-year pro-rated warranties to be written for pro-rated coverage spanning 8 years starting with the date of system start-up completion. Costs associated with 8-year pro-rated warranty to be included in base bid associated with system and specifically noted. 8-year warranty to exclude labor costs.
- B. Paradigm processor is covered by a 1-year parts and labor warranty

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The system shall be installed utilizing complete manufacturer's shop drawings and in accordance with these specifications.
- B. The electrical Contractor shall run separate neutrals for all branch load circuits.
- C. Provide dedicated network between server/ processors and dimming panels.
- D. Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
- E. Facility Representative to coordinate meeting between Facility Representative, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures.

3.2 TRAINING AND SYSTEM COMMISSIONING

- A. At the end of Substantial Completion, the system shall be completely commissioned by a factory-trained engineer. During the design and construction process, dimming system factory agent shall conduct three (3) site visits. Visit 1 to be a pre-shop drawing submittal meeting between approved manufacturer, A/V system provider (as required), operator's IT director or other personnel, and a BAS/ BMS commissioning agent to review design and coordinate and ensure compatible components prior to official dimming system submittals. Required changes to the electrical one-line diagram to account for coordination equipment shall be provided to design team. Visit 2 shall be a "pre-wire" commissioning exercise by factory-trained personnel that shall include review of installed dimming system wiring to date as well as other non- dimming system specific wiring systems including BMS/ BAS wiring or coordination with fire-alarm system and coordination with sports lighting DMX control system interfacing and coordination verified during Visit 1. Second visit to include review of IP address interface and means for BAS/ BMS operator to seamlessly and effectively extract information programmed through the architectural dimming system to be accessed through the BAS without added programming time. "Pre-wire" commissioning to ensure compliance and coordination with the dimming system design intent and other systems so as to reduce future complications at substantial completion. Visit 3 to be a final commissioning exercise at substantial completion and to be performed upon notification by the electrical contractor that the system installation is complete and that all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. The electrical contractor shall provide both the manufacturer and the Architect with ten working days' notice of the scheduled commissioning date. Pre-established factory start-up costs shall be included in the base bid for all three (3) visits and shall include adequate number of days on site by commissioning agent to perform all tasks, provide troubleshooting as required, train necessary facility personnel, and ensure system is completely operational and functioning to the owner representative's satisfaction. Base bid costs associated with the commissioning exercises shall be clearly defined with time on site as noted in Section 3.2.C.
- B. Startup and Programming
1. Provide factory certified field service engineer to make site visits to ensure proper system installation and operation under following parameters
 - a. Qualifications for factory certified field service engineer:
 - 1) Minimum experience of 2 years training in the electrical/electronic field.
 - 2) Certified by the equipment manufacturer on the system installed.
 - b. Make visit prior to installation of wiring. Review:
 - 1) Low voltage wiring requirements.
 - 2) Separation of power and low voltage/data wiring.
 - 3) Wire labeling.
 - 4) Lighting Management Panel locations and installations.
 - 5) Control locations.
 - 6) Computer jack locations.
 - 7) Load circuit wiring.
 - 8) Network wiring requirements.
 - 9) Connections to other equipment and other Lutron equipment.
 - 10) Installer responsibilities.
 - 11) Power Panel locations.
 - 12) BACNet system and confirmation of dimming system compliance and interface ability without additional program time from BAS operator.
 - c. Make final visit upon completion of installation of Centralized Lighting Control System:
 - 1) Verify connection of power wiring and load circuits.
 - 2) Verify connection and location of controls.
 - 3) Energize Lighting Management Panels and download system data program.
 - 4) Address devices.
 - 5) Verify proper connection of panel links (low voltage/data) and address panel.
 - 6) Download system panel data to dimming/switching panels

- 7) Check dimming panel load types and currents and supervise removal of by-pass jumpers.
 - 8) Verify system operation control by control.
 - 9) Verify proper operation of manufacturers interfacing equipment.
 - 10) Verify proper operation of manufacturers supplied PC and installed programs.
 - 11) Coordinate with owner password protection to ensure specific computers with software can control only designated areas of the facility and not the entire facility.
 - 12) Configure initial groupings of ballast for wall controls, daylight sensors and occupant sensors.
 - 13) Initial calibration of sensors.
 - 14) Ensure interface coordination between architectural dimming system and sports lighting DMX control
 - 15) Obtain sign-off on system functions
 - 16) Create and install Sequence of Operation functions for wall stations, preset scenes, etc. as defined in this document or subsequent documents for review by owner or owner's representative as a starting point. Commissioning agent to coordinate with owner to modify Sequences of Operation to their satisfaction.
 - 17) Demonstrate and educate Owner's representative on system capabilities, operation and maintenance.
- C. Programming of the centralized dimming system and scope areas noted below shall be done under the direction of the Architect, owner's representative, and/or Lighting Designer and during the period of final focusing. The factory field commissioning agent shall perform the programming as per criteria established in the Sequence of Operations noted within this document or subsequent documents during construction for more detailed and accurate Sequence of Operations and modified and adjusted by client and owner during the commissioning phase. Transferring final, approved programmed scenes, fade rates, and zone intensity levels to the AMX/ Crestron A/V system , if required by owner, or to the master control panel per requirements stated in Section 2.5.F shall be performed by A/V provider or building's IT operator. Lighting designer shall only be responsible for input and direction and not for actual programming or commissioning. Upon notification by Contractor that all fixtures affected by dimming or other control devices are functioning and properly landed to appropriate circuits and zones, Lighting Designer shall coordinate with Contractor as to a mutually agreed upon time to coincide with focusing efforts. Programming time as aforementioned shall be included in dimming manufacturer's commissioning costs. Programming time for DMX equipment and Pharos/ Mosaic touch-screens and color scenes and programming macros by dimming system manufacturer or 3rd party theatrical programmer well-versed in the Pharos/Mosaic systems to be a separate line-item for time dedicated to those functions, especially the time required for the Tunnel Experience to meet client demands. Manufacturer to include costs associated with three (3) visits as such: Visit 1-meeting one full day, Visit 2-pre-installation visit accounting for 1 week, and Visit 3-final commissioning and training accounting for a minimum of 2-week period of time due to large number of control zones to be coordinated and verified. Actual time required for visits to be coordinated with contractor and manufacturer, however, said schedules and fees as stated to be provided as a base bid cost.

PART 4 - SYSTEMS

4.1 OVERALL SYSTEM

- A. General Description
1. Contractor shall install a centralized/ networked dimming system with one (1) central processor/ hub as per electrical documents and noted as "Hub" and coordinated with owner representative and dimming system manufacturer during shop drawing submittal. Designated space on plans include Server that contains software and access and master

control of all lighting zones associated with system for security needs. Final locations and quantities to be determined and coordinated with architect. Hubs to contain Ethernet connection and dedicated IP address furnished by owner for internet diagnostics and connection to BAS system located in the area as per plans or otherwise designated by owner's representative. System to connect to building Wi-Fi system and to include networked dimming panels for normal and emergency loads as designated and with networked power supply units. All network equipment, including routers, network switches, and network cables to be included in base bid, whether supplied by manufacturer or by others that comply with ETC requirements. Wired ceiling mounted occupancy sensors, daylight sensors, and low-voltage wired wall-mount preset stations to be included. Separate wall-mounted AMX/ Crestron touch-screen panels furnished for the facility in quantities and locations indicated on A/V documents shall be furnished by A/V supplier/ consultant and to be coordinated with dimming system for "take-command" operation of architectural dimming programmed scenes, zone intensities, and fade rates as per Sequence of Operations. Ethernet/ network cable interface devices to communicate BAS system to be furnished by dimming system manufacturer. Central processor/ lighting management hub to be included with software package to allow diagnostics and alerts, energy management, and remote viewing and control of the entire facility with a CAD-based layout of the facility. Software to reside in the computer server located furnished by owner in the area stated by owner with password protected access. System to include iPhone App and programming software license to allow owner provided iPads as noted per Section 2.1.1 access to remote viewing and control of facility with iPads as part of owner stock (as noted by IT department). Manufacturer to coordinate with owner representative during commissioning to determine which areas can be controlled from specific iPads. Quantum Hub processors to allow scene and zone programming for downloading directly through hub. All preset control and master control stations to be engraved with room name.

- B. Refer to Section 1.1.C regarding wired Mosaic/ Pharos Tessera/TPC wall recessed touch screen panels connected via Cat5/6 cable to a remote EXT series single universe or 4-universe controllers and to light fixture's DMX wiring and DMX control boxes. Dimming system manufacturer to be responsible for DMX interface equipment to allow color and scene "triggers" from Pharos DMX control devices furnished by light fixture manufacturer.
- C. Within the Control booth/ video Production room-#03.21.02 at the Suite Level, both a DMX receptacle and Ethernet based receptacle at a designated wall to be provided by contractor for the use of a owner supplied theatrical control console with the capability of "take-command" functions. Only fixture types "LL2" at the main concourse with DMX control, type "SL2"-RGBW flood on existing poles along Civic Center Drive, type "SL7" RGBW flood at the new circular plaza, type "SL13" roof mounted RGBW lights and types "TL5" and "TL6" RGBW floods and spots at the player tunnel, types "TL12" and "TL13" mounted to the catwalk to illuminate underside of arena roof, type "WL4" at the south end of the Main Concourse, and type "WL7" along the main concourse to be controlled by this 3rd party theatrical control console in the Control booth. The DMX/ Ethernet receptacle to be connected to the ETC or approved centralized architectural dimming system for control of DMX based architectural light fixtures. Only the specific fixtures noted in the schedule and per this section to be controlled at this position. The "take-command" function of the theatrical console to allow network or owner personnel the opportunity for black-out conditions or for the opportunity to control architectural light fixtures for pre-game activities
- C. Within the overall controlled system there will be connected areas that operate from exclusive timeclock/ astronomic timeclock control or in addition to the DMX control console noted in Section C above. These spaces to not have local preset stations as defined for specific spaces in Section 4.2. These spaces to also be accessed through iPad control as defined by owner representative
 1. Event Level concourse within public access areas not controlled by Home Team Locker Room
 2. All concourse level markets
 3. Main and Suite level concourses.
 4. All concourse levels Hot and Cold Market interiors (not Back of House pantries or kitchens)

5. All concourse level restrooms with override station SW1 for toggled on/off operation after hours and occupancy sensors to turn lights on automatically at all times of day.
 6. Exterior lighting for egress
- D. Equipment
1. To reduce and ensure network lengths are not overextend, system to include the number of Paradigm processors as directed by dimming system manufacturer. Components to include power panel links and all dimming panels
 2. Manufacturer shall provide common loaded dimming cabinets for 277V or 120V normal or emergency loads with required ETC device for UL-924 requirements. Common load main lug cabinets to maximize capacity and reduce locations of panels with specific panels indicated on electrical documents. Dimming cabinets to be, capable of accepting load inputs as per load/power panel schedule in engineering documents. Dimmers shall accept loads indicated on electrical documents.. Refer to manufacturer's equipment list for component parts.

4.2 EVENT LEVEL-GRAND HALL

- A. General Description
1. Contractor shall install wireless daylight sensors along western window wall and within vestibules as indicated to control Zones within vestibules and types DL17, FL2A, PL7 and WL1 fixtures within daylight zone.
 2. Contractor shall install wired preset station within secured storage area under stairs and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"- master control station in office reception- room 01.04.04.
 3. Contractor to install "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen within storage area under for control of specific color-changing equipment within this area. Color scenes and macros programmed into the Mosaic/ Pharos touch screen to be transferred to iPad with password protection for Grand Hall/ Ballroom.
 4. Contractor to install DMX interface in storage area connected to DMX-based architectural lighting within Grand Hall for connection to DMX controller and touch screen as noted above.
 5. Owner provided iPad for this area to import type TR1/ TL1/ TL2 manufacturer's mesh network app so that iPad control can pan/ tilt all fixtures indicated on plan separately for remote control of aiming from the ground. Manufacturer of types TR1/ TL1/ TL2 to coordinate with dimming system manufacturer and owner representative so that mesh network and app can be accessed from owner provided Ipads and not from a phone app.
 6. Contractor shall install A/V interface device within same storage area under stairs to allow A/V touch screen to "take command" of architectural light fixtures. Theatrical color changing fixtures and DMX distribution system, type "RL1/RL1A" to only be controlled through the Pharos DMX touch screen. Provide additional interface for on/off control of TVs in this area in lieu of remote control. Content of TV to be accessed through separate A/V touch screen or iPad.
 7. Market area within Grand Hall area to be controlled with all other markets through the "MS" station in the Security Office.
 8. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by woner representative and commentary throughout the commissioning process.

4.3 EVENT LEVEL-WEST AND NORTH BALLROOMS

- A. General Description

1. Contractor shall install vacancy sensors to be located within specific ballrooms on the west side as designated. During occupied hours and after 30 minutes of no activity, vacancy sensor to control type WL12 associated with each ballroom, typical of one (1), and turn fixture off. During occupied hours whenever any scene is pressed on the SW7 preset station, type WL12 associated with each of three (3) ballrooms shall turn to 100% to indicate to those in the Grand Hall or VIP bar area that the room is occupied and activities occurring.
2. Contractor shall install wired preset station SW7-for (4) scenes with "off" scene and raise/lower buttons as indicated on plans for west ballrooms and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. An additional preset SW2- 2 button at certain entry doors to control scenes 1 and security scene 13. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station office reception- room 01.04.04.
3. Contractor shall install wired preset station SW7-for (4) scenes with "off" scene and raise/lower buttons as indicated on plans for the north ballrooms and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. An additional preset SW2- 2 button at the entry from the service corridor-room 01.13.06 to control all type pl3e fixtures in the entire area for security. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station office reception- room 01.04.04.
4. Contractor to install "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen as indicated per plans for control of specific color-changing equipment within this area. Color scenes and macros programmed into the Mosaic/ Pharos touch screen to be transferred to iPad with password protection for Grand Hall/ Ballroom.
5. Contractor to install DMX interface above accessible ceiling or Back-of-House corridor ceiling and connected to DMX-based architectural lighting within ballrooms for connection to DMX controller and touch screen as noted above.
6. Owner provided iPad for this area to import type TR1/ TL3/ TL4 manufacturer's mesh network app so that iPad control can pan/ tilt all fixtures and select color temperature indicated on plan separately for remote control of aiming from the ground. Manufacturer of types TR1/ TL3/ TL4 to coordinate with dimming system manufacturer and owner representative so that mesh network and app can be accessed from owner provided Ipad and not from a phone app.
7. Contractor shall install A/V interface device within accessible area in corridor to allow A/V touch screen to "take command" of architectural light fixtures. Theatrical color changing fixtures and DMX distribution system, type "RL2/RL1A" to only be controlled through the Pharos DMX touch screen.
8. Contractor to install wireless, Infra-red receiver/ transmitter for automatic partition control of space. Receiver/ transmitter on opposite sides of the partition as indicated on architectural plans to be located 5 feet from the partition's end connection to the wall to prevent mistaken use of partition. With partition open, either station SW5 within the back hall entrance to ballrooms control to engage all fixtures within open ballrooms.
9. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

4.4 EVENT LEVEL-BUNKER CLUB

1. No daylight or vacancy sensors to be located within Bunker Club. Contractor to provide occupancy sensors within the restroom hallway only as indicated on plans.
2. Contractor shall install wired preset station SW7 for (4) scenes with "off" scene and raise/lower as indicated on plans at bar area and SW2 station for scene 13 and 14 at entry to club from player corridor to control zones within this area and corridor to player tunnel,

but not individual restrooms. Station SW1 at the entry from the player tunnel to be included and shall control of only type DL3 in the corridor and type DL10 at the bar. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station.

3. All TVs to be controlled by remote control at bar. No AV interface needed for power control of TVs.
4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

4.5 EVENT LEVEL LOCKER ROOM COMPLEX

A. General Description

1. Contractor shall install wireless occupancy sensors within corridor areas, wet areas of the locker room, treatment room, hydrotherapy room, and individual offices and coaches locker rooms. A vacancy sensor to be located for the home team locker room itself. Fixture types "LL10", "LL11" and "DL6" in the wet area to be on emergency circuit and 24-hours for security. Occupancy sensor in corridor surrounding locker room grooming area- room 01.13.01 to be engaged during occupied and non-occupied hours. During occupied hours, occupancy sensor to turn all zones of control to full output. During non-occupied hours, occupancy sensor to turn all zones to 50% output. Stations SW2 at corridor entries or stations within locker room to override 50% output as needed.
2. Contractor shall install wired preset station SW7 for 5 scenes with no "off" and raise/lower at locker room entry and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. An additional station SW2 at the other entry off the wet area plus station SW2 to control the hallway. An additional station SW1 to be located at the exit from the locker room to the player tunnel to control non-DMX based light fixtures, types "DL4" and "FL14" for a "Go-Time" scene in conjunction with the DMX light fixtures controlled by the "MTS" DMX touch screen in the locker room. Treatment area, hydrotherapy, Street Locker and coach's locker-room 01.12.03 to be equipped with SW3 preset stations at room entries for control of scenes 1 and 2 plus "off" scene. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area will not be controlled through "MS"-master control station in Security Office.
3. Contractor to install "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen as indicated per plans for control of specific color-changing equipment within this area. Color scenes and macros programmed into the Mosaic/ Pharos touch screen to be transferred to iPad with password protection for locker room and player tunnel. Said touch screen to be programmed with separate pages for "locker room" and "player tunnel" to control fixture types "TL5" and "TL6". Within the "locker room" page buttons to be programmed to allow control of types "FL10" and "FL11" separately.
4. Contractor to install DMX interface above accessible ceiling or corridor ceiling and connected to DMX-based architectural lighting within locker room and player tunnel and player corridor for connection to DMX controller and touch screen as noted above.
5. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

4.6 EVENT LEVEL AUXILIARY LOCKER ROOMS

A. General Description

1. Contractor shall install wireless occupancy sensors within entry vestibules to auxiliary locker rooms as indicated on plans as well as wet areas of the locker room and treatment rooms. A vacancy sensor to be located for the locker room itself.
2. Contractor shall install wired preset station SW3 at room entries for control of scenes 1 and 2 plus "off" scene as indicated on plans. Stations SW3 to also be located at treatment rooms and individual restrooms as indicated. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area will not be controlled through "MS"-master control station in Security Office.
3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

4.7 EVENT LEVEL-GREEN ROOM

1. No daylight, occupancy, or vacancy sensors to be located within Green Room Lounge or dressing rooms. Occupancy sensors to be located in Officials locker rooms and meeting room
2. Contractor shall install wired preset station SW5 for (4) scenes plus "off" scene as indicated on plans at all entry points to green room lounge. Individual dressing rooms and Star/Officials toilet to be equipped with station SW3 for scene 1, and raise/lower function. The mirror lights within rooms to be locally dimmed. Restrooms or locker rooms to be equipped with station SW1 for "on" scene with control of all light fixtures. Preset station SW5 to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office.
3. All TVs to be controlled by remote control within individual spaces. No AV interface needed for power control of TVs.
4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

4.8 EVENT LEVEL SUPER VOMS-CORRIDORS-PLAYER CORRIDOR

A. General Description

1. Contractor shall install wireless occupancy sensors suspended from structural ceiling to be located 6" above bottom of open grid black ceiling where applicable or attached to ACT ceiling in other locations. For open grid conditions, occupancy sensor to be black finish and white everywhere else.
2. No preset stations to be provided for the concourse. Only the "MS" master control station in the officereception-room 01.04.04 or iPad control to have access to the zones associated with the concourse or the individual markets. Refer to the section associated with public restrooms for control requirements.
3. DMX touch screen station designated as "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen within the locker room as noted in Section 4.5 to also control types "TL5" and "TL6" within the player tunnel as well as within the player corridor. No additional DMX touch screens required for the player corridor.
4. Contractor shall install A/V interface device at exposed ceiling on underside of slab for on/off control of TVs in this main concourse in lieu of remote control. Content of TV to be accessed through separate A/V touch screen or iPad.
5. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

4.9 MAIN CONCOURSE-SIDELINE CLUB**A. General Description**

1. No daylight, occupancy, or vacancy sensors to be located within public area of club itself. Occupancy sensor to be located within restrooms as typical for all public restrooms.
2. Contractor shall install wired preset station SW5 for (5) with no "off" scene as indicated on plans at central bar to control all lights within this area only and not the other individual bars on this concourse. An additional preset station SW2 for on/off function to be located at the display kitchen. As per all public restrooms preset station SW1 to be provided at restroom entries with operating function as defined in section associated with public restrooms.
3. All TVs to be controlled by remote control at bar. No AV interface needed for power control of TVs.
4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

4.10 MAIN CONCOURSE LEVEL BARS-ALL AREAS**A. General Description**

1. No daylight, occupancy, or vacancy sensors to be located within the confines of the bar itself. Occupancy sensors to be located for the concourse, not the bar.
2. At each individual bar, typical of four (4) bars, contractor shall install wired preset stations designated as station SW3 at back bar area in location that does not interfere with architectural details. Stations SW3 to control only those zones associated with the bar for temporary override and preference of light levels and connects to scenes 1-3 with no "off" scene. Master control station at the Security office to have access to "off" scene only. Preset station to be programmed to be engaged during operating hours as stated by owner representative.
3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

4.11 MAIN CONCOURSE PUBLIC AREAS**A. General Description**

1. No preset stations to be provided for the concourse. Only the "MS" master control station in the officereception-room 01.04.04 or iPad control to have access to the zones associated with the concourse or the individual markets. Refer to the section associated with public restrooms for control requirements.
2. Contractor shall install wireless daylight sensors at each vestibule as indicated on plans to control only type "DL6" fixtures within vestibules. Additional daylight sensors to be located within markets with access to windows only.
4. Contractor to install DMX interface at exposed ceiling to control DMX-based light fixtures, types "LL2", "WL4", and "WL7" and connected to DMX-touch screen within Video Production room-03.21.02 for control during blackout conditions. No DMX touch screen to be located in concourse; only in Video Production room.
1. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

4.12 SUITE LEVEL INDIVIDUAL SUITES**A. General Description**

1. No daylight, occupancy, or vacancy sensors to be located within suites.
2. Contractor shall install wired preset station SW3 within each suite to control zones within those individual suites based on quantities of suites indicated. Preset stations to be programmed to be engaged during operating hours as stated by owner representative.
3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.
4. All zones within suite except the zones dedicated for the food service/ entry steplights, type "WL18" to be accessed through an override within the Video Production room- 03.21.02 master control of the arena for blackout conditions. The steplights to remain on during blackout requirements

4.13 SUITE LEVEL LOUNGES

A. General Description

1. No daylight, occupancy, or vacancy sensors to be located within suites.
2. Contractor shall install wired preset station SW5 for (5) scenes with no "off" scene as indicated on plans at bar area. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office. Only the master control station of iPad control to have access to an "off" scene.
3. All TVs to be controlled by remote control at bar. No AV interface needed for power control of TVs.
5. All zones within suite except the zones dedicated for the food service/ entry steplights, type "WL18" to be additionally accessed through an override within the Video Production room- 03.21.02 master control of the arena for blackout conditions. The steplights to remain on during blackout requirements
6. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

4.14 SUITE LEVEL BARS

A. General Description

1. No daylight, occupancy, or vacancy sensors to be located within bars.
2. Contractor shall install wired preset station SW5 for (5) scenes with no "off" scene as indicated on plans at bar area. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office. Only the master control station of iPad control to have access to an "off" scene.
3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

4.15 SUITE LEVEL LOGE CLUB AND PUBLIC AREAS

A. General Description

1. No daylight, vacancy or occupancy sensors provided. Due to drapery along window wall daylight sensors to be rendered ineffective.
2. Contractor shall install wired preset station SW5 for (5) scenes with no "off" scene as indicated on plans at northwest buffet area-room 03.07.04 on west side of column for control of loge club-room 03.03.02 in areas A and B of plans. Buffet areas themselves to

be controlled only through master control station-"MS" along with markets in the main concourse. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office. Only the master control station of iPad control to have access to an "off" scene.

3. Control of type "DL5A" fixtures to also be accessed from Video Production Room as referenced in Section 1.1.F
4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

4.16 CATWALK LEVEL

A. General Description

1. Contractor to install DMX interface at exposed ceiling to control DMX-based light fixtures, types "TL12" and "TL13" and to DMX-touch screen within Video Production room-03.21.02 for control during blackout conditions. No DMX touch screen to be located in concourse; only in Video Production room.

4.17 ALL LEVEL PUBLIC RESTROOMS

A. General Description

1. Contractor shall install wireless occupancy sensors as indicated to control zones within these areas. Occupancy sensors to be engaged during operating hours.
2. Contractor shall install wired preset station noted as "SW1" single button station for use during off hours for cleanup requirements if occupancy sensor turns lights off. Preset stations to be located for each multi-occupant restroom indicated on every level except those restroom associated with player locker rooms. Preset station programmed to be engaged only during non-operating hours and dis-engaged during normal hours as stated by owner representative.

4.18 FAÇADE AND SITE LIGHTING

A. General Description

1. At the northwest and southwest corners of the catwalk/roof level, contractor to install a wireless DMX antenna connected to Acclaim's Aria wireless DMX transmitter/receiver on the roof and then connected via wired DMX within the building to the Pharos/ Mosaic single universe DMX touch screen designated as station "MTS" in the Event Level administration office. From all corners of the building at the roof, an Acclaim Aria series antenna to be connected to wireless DMX transmitter/ receivers at each indicated site pole, types "SLP1", "SLP2", and "SLP5/A/B" series. The northwest Acclaim's Aria transmitter/ receiver and antenna to be within field of view of fixture types "SL1" and "SL2" along Civic Center Drive. The six (6) existing poles along Civic Center Drive to support the Acclaim Aria wireless transmitter/ receiver as per manufacturer's requirements so that existing power wiring to these poles can be re-used without additional expense of providing DMX control wiring. The southwest Aria transmitter/receiver and antenna to be within field of view of fixture types "SL6", "SL7", "SL8", "SL10" at the circular plaza, and "SL13" at the roof. A transmitter/receiver to be mounted to each of the "smart" site lighting poles, types "SLP1", "SLP2", and "SLP5" series which connects to specific fixtures on said poles through wired DMX. The wireless DMX system for Civic Center Drive and within the new southwest plaza and connecting paths allows DMX control without the need to run DMX or Ethernet cable underground.

2. Zones within these areas to be operated by iPad control with password protection and automatic astronomic timeclock function with preliminary Sequence of Operations.
3. No preset stations to be provided for the concourse. Only the "MS" mater control station in the officereception-room 01.04.04 or iPad control to have access to the zones associated with the concourse or the individual markets. Refer to the section associated with public restrooms for control requirements.

END OF SECTION

SECTION 26 33 53 - STATIC UNINTERRUPTIBLE POWER SUPPLIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Three-phase, on-line, double-conversion, static-type, UPS units with the following features:
 - 2. Surge suppression.
 - 3. Input harmonics reduction.
 - 4. Rectifier-charger.
 - 5. Inverter.
 - 6. Static bypass transfer switch.
 - 7. Battery and battery disconnect device.
 - 8. Remote UPS monitoring provisions.
 - 9. Battery monitoring.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on features, components, ratings, and performance.
- B. Shop Drawings: For UPS. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Manufacturer Certificates: For each product, from manufacturer.
- E. Factory Test Reports: Comply with specified requirements.
- F. Field quality-control reports.
- G. Performance Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.
- H. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals.
 - 1. Manufacturer's written instructions for testing central battery equipment.
 - 2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 3. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points.
- I. Warranties: Sample of special warranties.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. LCD: Liquid-crystal display.
- C. LED: Light-emitting diode.
- D. PC: Personal computer.

- E. THD: Total harmonic distortion.
- F. UPS: Uninterruptible power supply.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. UL Compliance: Listed and labeled under UL 1778 by an NRTL.
- E. NFPA Compliance: Mark UPS components as suitable for installation in computer rooms according to NFPA 75.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
 - 2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - 3. Humidity: More than 95 percent (condensing).
 - 4. Altitude: Exceeding 3300 feet (1000 m).
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items.

1.6 WARRANTY

- A. Special UPS and Battery Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within special warranty period.
 - 1. Special Warranty Period: Two years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 - 2. Cabinet Ventilation Filters: One complete set(s).

PART 2 - PRODUCTS

2.1 OPERATIONAL REQUIREMENTS

- A. Automatic operation includes the following:

1. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
 2. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
 3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.
 4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
 5. If the battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.
 6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.
 7. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.
 8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.
 9. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.
- B. Manual operation includes the following:
1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
 2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.
- C. Environmental Conditions: The UPS shall be capable of operating continuously (non-derated) in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.
1. Ambient Temperature for Electronic Components: 32 to 104 deg F (0 to 40 deg C).
 2. Ambient Temperature for Battery: 41 to 95 deg F (5 to 35 deg C).
 3. Relative Humidity: 0 to 95 percent, noncondensing.
 4. Altitude: Sea level to 4000 feet (1220 m).

2.2 PERFORMANCE REQUIREMENTS

- A. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:
1. Inverter is switched to battery source.
 2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
 3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
 4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
 5. Load is 50 percent unbalanced continuously.
- B. Minimum Duration of Supply: If battery is sole energy source supplying rated full UPS load current at 80 percent power factor, duration of supply is 5 minutes.

- C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 15 percent from nominal voltage.
- D. Overall UPS Efficiency: Equal to or greater than 89 percent at 100 percent load, 88 percent at 75 percent load, and 87 percent at 50 percent load.
- E. Maximum Acoustical Noise: 75 dBA, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 5 feet from nearest surface of component enclosure.
- F. Maximum Energizing Inrush Current: Five times the normal full-load current.
- G. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.
- H. Power Walk-In: Configurable from 20% to 100% over 20 seconds
- I. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.
- J. Limitation of harmonic distortion of input current to the UPS shall be as follows:
 - 1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 10 percent, maximum, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.
- K. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for rated full load with THD up to 50 percent, with a load crest factor of 3.0.
- L. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.
- M. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:
 - 1. 50 Percent: Plus or minus 5 percent.
 - 2. 100 Percent: Plus or minus 8 percent.
 - 3. Loss of AC Input Power: Plus or minus 1 percent.
 - 4. Restoration of AC Input Power: Plus or minus 1 percent.
 - 5. Manual Return of Load to UPS: Plus or minus 45 percent.
- N. Input Power Factor: A minimum of 0.85 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current without input filter.
- O. EMI Emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.
- P. Fault Clearing Current: Up to 1000% for 16 milliseconds or up to 500% for 40 milliseconds.
- Q. Output Phase Balance: 120 degrees plus or minus 1 degree for balanced loads, 120 degrees plus or minus 3 degrees for 50% unbalanced load.
- R. Overload: 125% of full load for 5 minutes. 150% of full load for 30 seconds.
- S. Load Power Factor: Unity to rated lagging power factor with no derating.

2.3 UPS SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide APC, Schneider Electric, Easy UPS 3S 20kVA 208V with 3 battery strings (E3SUPS20KFBS) or comparable product by one of the following:
 - 1. ABB.

2. Eaton Corporation Inc.
 3. Emerson Electric Co.
 4. APC; Schneider Electric.
 5. Mitsubishi Electric Automation, Inc.
 6. Toshiba Power Electronics.
 7. Vertiv Group Corp.
- B. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.
- C. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.
- D. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.
- E. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch. Protect rectifier-charger, inverter, controls, and output components.
1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category B.
 2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41.1 and IEEE C62.41.2. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 40-Hz, 180 percent voltage surges described in IEEE C62.41.1 and IEEE C62.41.2.

2.4 RECTIFIER-CHARGER

- A. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.
- B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.
- C. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.
1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.
- D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

2.5 INVERTER

- A. Description: Pulse-width modulated, with sinusoidal output. Include a bypass phase synchronization window adjustment to optimize compatibility with local engine-generator-set power source.

2.6 STATIC BYPASS TRANSFER SWITCH

- A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.
- B. Switch Rating: Continuous duty at the rated full UPS load current, minimum.

2.7 BATTERY

- A. Description:

1. Lithium-ion, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch. Or
 2. Valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Schneider Electric (Galaxy)
 2. C&D Technologies, Inc.; Standby Power Division.
 3. Eaton Corporation; Powerware Division.
 4. EnerSys.
 5. Panasonic Corporation of North America; Panasonic Industrial Company

2.8 CONTROLS AND INDICATIONS

- A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.
- B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.
- C. Indications: Plain-language messages on a digital LCD or LED.
1. Quantitative indications shall include the following:
 - a. Input voltage, each phase, line to line.
 - b. Input current, each phase, line to line.
 - c. Bypass input voltage, each phase, line to line.
 - d. Bypass input frequency.
 - e. System output voltage, each phase, line to line.
 - f. System output current, each phase.
 - g. System output frequency.
 - h. DC bus voltage.
 - i. Battery current and direction (charge/discharge).
 - j. Elapsed time discharging battery.
 2. Basic status condition indications shall include the following:
 - a. Normal operation.
 - b. Load-on bypass.
 - c. Load-on battery.
 - d. Inverter off.
 - e. Alarm condition.
 3. Alarm indications shall include the following:
 - a. Bypass ac input overvoltage or undervoltage.
 - b. Bypass ac input overfrequency or underfrequency.
 - c. Bypass ac input and inverter out of synchronization.
 - d. Bypass ac input wrong-phase rotation.
 - e. Bypass ac input single-phase condition.
 - f. Bypass ac input filter fuse blown.
 - g. Internal frequency standard in use.
 - h. Battery system alarm.
 - i. Control power failure.
 - j. Fan failure.
 - k. UPS overload.
 - l. Battery-charging control faulty.
 - m. Input overvoltage or undervoltage.
 - n. Input transformer overtemperature.
 - o. Input circuit breaker tripped.
 - p. Input wrong-phase rotation.

- q. Input single-phase condition.
- r. Approaching end of battery operation.
- s. Battery undervoltage shutdown.
- t. Maximum battery voltage.
- u. Inverter fuse blown.
- v. Inverter transformer overtemperature.
- w. Inverter overtemperature.
- x. Static bypass transfer switch overtemperature.
- y. Inverter power supply fault.
- z. Inverter transistors out of saturation.
- aa. Identification of faulty inverter section/leg.
- bb. Inverter output overvoltage or undervoltage.
- cc. UPS overload shutdown.
- dd. Inverter current sensor fault.
- ee. Inverter output contactor open.
- ff. Inverter current limit.
- 4. Controls shall include the following:
 - a. Inverter on-off.
 - b. UPS start.
 - c. Battery test.
 - d. Alarm silence/reset.
 - e. Output-voltage adjustment.
- D. Dry-form "C" contacts shall be available for remote indication of the following conditions:
 - 1. UPS on battery.
 - 2. UPS on-line.
 - 3. UPS load-on bypass.
 - 4. UPS in alarm condition.
 - 5. UPS off (maintenance bypass closed).
- E. Emergency Power Off Switch: Capable of local operation and operation by means of activation by external dry contacts.

2.9 MONITORING BY REMOTE STATUS AND ALARM PANEL

- A. Description: Labeled LEDs on panel faceplate indicate five basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.
 - 1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

2.10 BASIC BATTERY MONITORING

- A. Manufacturers:
 - 1. Albercorp.
 - 2. Schnieder Electric.
 - 3. BTECH, Inc.
 - 4. Eaton.
- B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.
- C. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C occurs within the compartment.
- D. Annunciation of Alarms: At UPS control panel.

2.11 SOURCE QUALITY CONTROL

- A. Factory test complete UPS system before shipment. Use simulated battery testing. Include the following:
 - 1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.
 - 2. Full-load test.
 - 3. Transient-load response test.
 - 4. Overload test.
 - 5. Power failure test.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Equipment Mounting: Install UPS on concrete base for locations at concrete slabs. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

3.2 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the UPS.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 IDENTIFICATION

- A. Identify components and wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify each battery cell individually.

3.4 BATTERY EQUALIZATION

- A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 1. Comply with manufacturer's written instructions.
 2. Inspect interiors of enclosures, including the following:
 - a. Integrity of mechanical and electrical connections.
 - b. Component type and labeling verification.
 - c. Ratings of installed components.
 3. Inspect batteries and chargers according to requirements in NETA Acceptance Testing Specifications.
 4. Test manual and automatic operational features and system protective and alarm functions.
 5. Test communication of status and alarms to remote monitoring equipment.
 6. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for unit's rating. Use instruments calibrated within the previous six months according to NIST standards.
 - a. Simulate malfunctions to verify protective device operation.
 - b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
 - c. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.
 - d. Test output voltage under specified transient-load conditions.
 - e. Test efficiency at 50, 75, and 100 percent of rated loads.
 - f. Test remote status and alarm panel functions.
 - g. Test battery-monitoring system functions.
- D. The UPS system will be considered defective if it does not pass tests and inspections.
- E. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.
- F. Prepare test and inspection reports.

3.6 PERFORMANCE TESTING

- A. Monitoring and Testing Schedule: Perform monitoring and testing in a single 10-day period .
 1. Schedule monitoring and testing activity with Owner, through Architect, with at least 14 days' advance notice.
 2. Schedule monitoring and testing after Substantial Completion, when the UPS is supplying power to its intended load.
- B. Monitoring and Testing Instruments: Three-phase, recording, power monitors. Instruments shall provide continuous simultaneous monitoring of electrical parameters at UPS input terminals and at input terminals of loads served by the UPS. Instruments shall monitor, measure, and graph voltage current and frequency simultaneously and provide full-graphic recordings of the values of those parameters before and during power-line disturbances that cause the values to deviate from normal beyond the adjustable threshold values. Instruments shall be capable of recording either on paper or on magnetic media and have a minimum accuracy of plus or minus 2 percent for electrical parameters. Parameters to be monitored include the following:
 1. Current: Each phase and neutral and grounding conductors.
 2. Voltage: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
 3. Frequency transients.
 4. Voltage swells and sags.
 5. Voltage Impulses: Phase to phase, phase to neutral, phase to ground, and neutral to ground.

6. High-frequency noise.
 7. Radio-frequency interference.
 8. THD of the above currents and voltages.
 9. Harmonic content of currents and voltages above.
- C. Monitoring and Testing Procedures:
1. Exploratory Period: For the first two days, make recordings at various circuit locations and with various parameter-threshold and sampling-interval settings. Make these measurements with the objective of identifying optimum UPS, power system, load, and instrumentation setup conditions for subsequent test and monitoring operations.
 2. Remainder of Test Period: Perform continuous monitoring of at least two circuit locations selected on the basis of data obtained during exploratory period.
 - a. Set thresholds and sampling intervals for recording data at values selected to optimize data on performance of the UPS for values indicated, and to highlight the need to adjust, repair, or modify the UPS, distribution system, or load component that may influence its performance or that may require better power quality.
 - b. Perform load and UPS power source switching and operate the UPS on generator power during portions of test period according to directions of Owner's power quality specialist.
 - c. Operate the UPS and its loads in each mode of operation permitted by UPS controls and by the power distribution system design.
 - d. Using loads and devices available as part of the facility's installed systems and equipment, create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients. Maintain normal operating loads in operation on system to maximum extent possible during tests.
 - e. Make adjustments and repairs to UPS, distribution, and load equipment to correct deficiencies disclosed by monitoring and testing and repeat appropriate monitoring and testing to verify success of corrective action.
- D. Coordination with Specified UPS Monitoring Functions: Obtain printouts of built-in monitoring functions specified for the UPS and its components in this Section that are simultaneously recorded with portable instruments in this article.
1. Provide the temporary use of an appropriate PC and printer equipped with required connections and software for recording and printing if such units are not available on-site.
 2. Coordinate printouts with recordings for monitoring performed according to this article, and resolve and report any anomalies in and discrepancies between the two sets of records.
- E. Monitoring and Testing Assistance by Contractor:
1. Open UPS and electrical distribution and load equipment and wiring enclosures to make monitoring and testing points accessible for temporary monitoring probe and sensor placement and removal as requested.
 2. Observe monitoring and testing operations; ensure that UPS and distribution and load equipment warranties are not compromised.
 3. Perform switching and control of various UPS units, electrical distribution systems, and load components as directed by power quality specialist. Specialist shall design this portion of monitoring and testing operations to expose the UPS to various operating environments, conditions, and events while response is observed, electrical parameters are monitored, and system and equipment deficiencies are identified.
 4. Make repairs and adjustments to the UPS and to electrical distribution system and load components, and retest and repeat monitoring as needed to verify validity of results and correction of deficiencies.
 5. Engage the services of the UPS manufacturer's factory-authorized service representative periodically during performance testing operations for repairs, adjustments, and consultations.

- F. Documentation: Record test point and sensor locations, instrument settings, and circuit and load conditions for each monitoring summary and power disturbance recording. Coordinate simultaneous recordings made on UPS input and load circuits.
- G. Analysis of Recorded Data and Report: Review and analyze test observations and recorded data and submit a detailed written report. Include the following in report:
 - 1. Description of corrective actions performed during monitoring and survey work and their results.
 - 2. Recommendations for further action to provide optimum performance by the UPS and appropriate power quality for non-UPS loads. Include a statement of priority ranking and a cost estimate for each recommendation that involves system or equipment revisions.
 - 3. Copies of monitoring summary graphics and graphics illustrating harmonic content of significant voltages and currents.
 - 4. Copies of graphics of power disturbance recordings that illustrate findings, conclusions, and recommendations.
 - 5. Recommendations for operating, adjusting, or revising UPS controls.
 - 6. Recommendation for alterations to the UPS installation.
 - 7. Recommendations for adjusting or revising generator-set or automatic transfer switch installations or their controls.
 - 8. Recommendations for power distribution system revisions.
 - 9. Recommendations for adjusting or revising electrical loads, their connections, or controls.
- H. Interim and Final Reports: Provide an interim report at the end of each test period and a final comprehensive report at the end of final test and analysis period.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the UPS.

END OF SECTION

ADD4 SECTION 23 09 23 - DIRECT-DIGITAL CONTROL FOR HVAC**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. System Description.
- B. Operator Interface.
- C. Controllers.
- D. Electrical Control Power Wiring and Low Voltage Wiring.
- E. Local Area Network.
- F. System Software.
- G. Controller Software.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Coordinate routing of DDC power wiring and conduits requiring a fire-resistive protective assembly or electrical circuit protective system. Fire-resistive protective assembly or electrical circuit protective system shall have a fire-resistance rating of not less than 2 hours and shall be provided where required by NFPA or local building codes. Types of DDC power wiring and conduits requiring a fire-resistive protective assembly include, but are not limited to:
 - 1. Wiring for Emergency Power systems.
 - 2. Smokeproof Enclosure Pressurization systems.
 - 3. Smoke Control systems.
 - 4. Smoke Removal systems.
 - 5. Fire service and Occupant Evacuation Elevator systems.

1.3 DEFINITIONS

- A. ASC: Application Specific Controller. Examples include controllers for specific applications (e.g., FCU, VAV box, etc.) that can be configured through any network services software.
- A. ATU: Air Terminal Unit (e.g., VAV boxes, fan-powered boxes, fan coil units).
- B. BAS: Building Automation System.
- C. BTL: BACnet Testing Laboratories. Third party independent testing and listing program for devices which have been tested according to ASHRAE Standard 135.
- D. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations
- E. DDC: Direct Digital Control.
- F. EMT: Electrical Metallic Tubing
- G. High voltage: 50 volts or higher.
- H. IP: Internet Protocol.

- I. LAN: Local Area Network.
- J. VLAN: Virtual Local Area Network.
- K. Low voltage: Below 50 volts.
- A. NiCS: Niagara Compatibility Statement license.
- L. OSI: Open System Interconnection
- M. PC: Personal Computer.
- N. PICS: Protocol Implementation Conformance Statement.
- O. Point: Point is a generic term used to describe a single item of information in a BAS. Points may be further described as input, output, digital, binary, discrete, analog, modulating, internal, external, virtual or global. Each unique point used by digital controllers, or in a BAS, is typically identified by an address.

1.4 CONTRACTOR RESPONSIBILITIES

- A. Reference the following sections for additional contractor responsibilities and coordination:
 - 1. Division 23 Section "Electrical Coordination for Mechanical Equipment."
 - 2. Division 23 Section "Commissioning for HVAC."
 - 3. Division 23 Section "Instrumentation and Control Devices for HVAC."
- B. Reference Part 3 for additional electrical contractor responsibilities for BAS controls.

1.5 SUBMITTALS

- A. Refer to Division 01 and Division 23 Section "General Mechanical Requirements" for submittal procedures.
- B. General:
 - 1. The drawings and specifications are not intended to show all details. The BAS contractor shall secure satisfactory information before submitting the proposal and include in the proposal a sum sufficient to cover all items of labor and material required for the complete installation for the devices and system described.
 - 1. Inform Engineer in writing of any deviation in the exhibits submitted from the requirements of the drawings, specifications, and sequences of operations.
- C. Product Data:
 - 1. Submit manufacturer technical data for each system component and software module required for a complete installation.
 - 2. Indicate dimensions, weights, and enclosure construction for all BAS distributed controllers.
 - 2. Submit technical data on all new software supplied including description of functions performed by software and location within the system where software shall reside. Include all software licensing agreements.
 - 3. Submit the PICS for each BACnet device used in the BAS.
 - 4. Submit the NiCS for each type of Niagara station in the BAS.
- D. Power and Communication Wiring Transient Protection:
 - 1. Submit catalog data sheets providing evidence that all BAS products offered by the manufacturer are tested and comply with IEEE C62.41.2.
 - 2. Testing shall include power and communication trunk wiring.
 - 3. Compliance with IEEE C62.41.2 shall imply conformance with IEEE C37.90.1 based on the stated position of ANSI and IEEE.
- E. Shop Drawings:

1. Submit a trunk cable schematic showing locations of all programmable control units, controllers, and workstations, with associated network wiring.
 - a. Indicate equipment served by each controller on the diagram.
 - b. Indicate switches, power requirements to each controller, and daisy chained controllers.
3. Submit detailed schematic control drawings for each controlled device and equipment.
 - c. Reference all control components to manufacturer make and model number.
 - d. Include all control and power wiring with termination point (controller and terminal number).
 - e. Include clearly indicated and written sequences of operation referenced to specific control components (e.g., "shall modulate valve V-3").
 - f. Include default position (e.g., N.O., N.C., etc.) for all components where applicable.
 - g. Clearly differentiate between existing components and new components.
 - a. Include detailed wiring diagrams showing methods of connections to VFDs, motor starters, energy meters, and all other devices, and all other field wiring necessary for system installation.
 - b. The use of "typicals" will be allowed where appropriate.
2. Submit detailed drawings for each individual BAS distributed controller.
 - a. Include controller identification.
 - b. Include components included in the controller.
 - c. Include numbering of terminals and communications ports.
 - d. List connected data points, including connected control unit and input device.
 - e. Include type of cable connected to each terminal port.
 - f. Identify specific field devices wired to each terminal including identification of each field device and application.
 - g. Clearly differentiate between existing controllers and new controllers.
 - h. Indicate source (electrical panel ID) of 120V power to each panel to which 120V power is connected.
 - i. Indicate method of connecting controller to equipment supplied by others and to existing communications networks.
 - j. Indicate device instance and network number.
3. Submit floor plans that indicate the following:
 - a. Location of all new BAS distributed controllers and control panels.
 - b. Routing of all new building level network communications wiring not located in mechanical and electrical rooms.
 - c. Routing of wiring to controllers, sensors, and control points not located in mechanical and electrical rooms.
 - d. Location of building system connection to Owner's campus wide data network.
4. Submit methods and materials used to integrate into existing networks.
5. Submit proposed smoke control system testing procedure based on Smoke Control Rational Analysis Report and smoke control drawings. Testing procedures to be approved by life safety consultant and engineer.
6. All control drawings and schematics shall be generated using AutoCAD software or equivalent. All project drawings shall be supplied to the Owner in a format as desired by the Owner upon project completion.
4. Submit system identification nomenclature.
 - a. Nomenclature shall be consistent throughout the network and consistent with any existing networks that are integrated. If not defined, nomenclature shall be similar to the point names shown on the drawings.
 - b. Object name and ID number shall be unique within a control device.
 - c. Control device instance name and ID number shall be unique within the network.
 - d. Network number shall be unique for each unique electrical segment in the BAS.
7. Indicate system graphics indicating monitored systems, data (connected and calculated) and operator notations.

- a. Submit example graphic visualizations and screenshots for the BAS. At a minimum, submit examples for major HVAC equipment components, including chillers, boilers, air handling units, fan coil units, heat pumps, fans, etc.
 - b. Font size and type shall be manufacturer standard.
 - c. Provide graphics demonstration package in a format as desired by the Owner.
8. Indicate description and sequence of operation of operating, user, and application software.
- F. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 1. Revise shop drawings to reflect actual installation and operating sequences.
 2. Include submittals data in final "Record Documents" form.
 3. All additions or changes to the BAS during the course of construction shall be reflected upon the drawings and submitted to the Engineer before project close-out.
- J. Testing and Commissioning Reports and Checklists: Submit completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of Part 3, Startup and Demonstration.
- K. Operation and Maintenance Data:
 1. Include maintenance data and recommended spare parts list for digital control equipment and control components.
 2. Include trouble-shooting maintenance guides.
 3. Include interconnection wiring diagrams showing complete field installed systems with identified and numbered system components and devices.
 4. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 5. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 6. Include a maintenance manual which contains the information listed above, product data, shop drawings, final software code for sequences of operation and maintenance data in accordance with requirements of Division 01.
 7. Include logbook for documentation of software updates and patches applied BAS for the time period included in the software licensing agreement.
 8. Provide names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
- L. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- M. Maintenance Materials:
 1. Refer to Division 01 for additional provisions.
 2. Extra Stock Materials: Two printer cartridges and cartons of printer paper.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. BACnet devices used in the BAS shall be BTL listed according to its device profile.

- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of the type specified and with minimum documented experience as follows:
 - 1. All personnel of the BAS Contractor shall have a minimum of three years of experience within their appropriate trades.
 - 2. All subcontractors utilized by the BAS Contractor shall have a minimum of five years experience within their appropriate trades.
- F. Additional BAS Contractor Requirements:
 - 1. Personnel, Coverage and Response Capabilities: The BAS Contractor shall have a fully staffed office with service technicians and systems engineers within a 50 mile radius of the project location.
 - 2. Emergency Service: The BAS Contractor shall have an established 24 hour emergency service organization. A dedicated telephone number shall be provided to the Owner for requesting emergency service. A maximum of four hour, electronic service technician on sight, response time shall be guaranteed by the BAS Contractor.
 - 3. Parts Stocking: The BAS Contractor shall have an independently verifiable inventory of electronic service parts. This electronic service parts inventory must have a worth of at least \$100,000 per year over the last five years.
 - 4. Past Projects: The BAS Contractor shall have completed a minimum of five projects within the last five years which are at least equal in dollar value and comparable scope to this project. A list of similar projects, dollar volume, scope, contact name and contact number shall be provided by the BAS Contractor if asked for by the Owner.

1.7 WARRANTY

- A. Refer to Division 01 for additional project warranty requirements.
- B. Labor and materials for the BAS specified shall be warranted free from defects in workmanship and material for a period of 1 year after Substantial Completion and system acceptance.
- C. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.
- D. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start data and period.
- E. Provide updates to operator workstation software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
- F. Provide five year manufacturer's warranty for field programmable micro-processor based units.
- G. Special warranty on instrumentation:
 - 1. All instrumentation shall be covered by manufacturer's transferable one-year "No Fault" warranty. If manufacturer warranty is not available, the BAS installer shall provide the same.

1.8 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
 - 1. Limiting use of software to equipment provided under these specifications.
 - 2. Limiting copying.

3. Preserving confidentiality.
 4. Prohibiting transfer to a third party.
- B. Software provider shall provide software updates and patches to the BAS as part of the software licensing agreement as the updates and patches are released. If any security vulnerabilities are discovered by the provider, the provider shall notify the client within five business days.
- C. Ownership of Proprietary Material: Project-specific software and documentation shall become Owner's property upon project completion. This includes, but is not limited to the following:
1. Graphics.
 2. Record drawings.
 3. Database.
 4. Application programming code.
 5. Documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Corporate Edition Products: The following manufacturers and product lines shall be manufacturer's most current vintage and of open protocol design. Corporate editions shall be based on manufacturer developed software.
1. Automated Logic, WebCtrl.
 2. Delta Controls, enteliBUS.
 3. Johnson Controls, Metasys.
 4. Siemens, Apogee – Desigo CC.
- B. Niagara Framework Products: Products and stations supplied from the list of acceptable manufacturers in the following table shall be based on the latest version of the Niagara Framework and be supplied with an open NiCS license that shall not limit access or connectivity to the Niagara station in any way. Open access to the station shall allow any brand compatibility in and out of the station and tool compatibility in and out of the station.
1. Distech Controls: EC-Net.
- C. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, building controllers, custom application controllers, and application specific controllers. All other products specified under Division 23 Section "Instrumentation and Control Devices for HVAC" need not be manufactured by the above manufacturers.

2.2 SYSTEM DESCRIPTION

- A. General:
1. The BAS shall consist of all necessary hardware and software to perform the control sequences of operation as called for in the Specifications and Drawings. Contractor shall install and commission all necessary devices to ensure a reliable and stable network.
 2. System design is based on a distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
 3. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
 4. The BAS shall be capable of integrating multiple devices, sensors, and functions from multiple control vendors into a common front end, including equipment supervision and control, alarm management, energy management, and trend data collection.
 5. The BAS shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASC's, and operator devices.

6. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- B. Local Area Network:
 1. The BAS shall be set up as a physically separate network within the building.
- C. Network Architecture: The BAS network architecture shall be based upon the OSI basic reference model in accordance with ISO 7498.
 1. Application/Network Layer:
 - a. BACnet protocol complying with ASHRAE Standard 135.
 2. Physical/Data Link Layer:
 - a. Hard-wired type:
 - 1) Ethernet according to ISO 8802-2 protocol.
 - 2) EIA-485 Twisted Cable Pair according to Master Slave/Token-Passing (MS/TP) protocol.
 3. Communication between operator workstation(s) and building controller(s):
 - a. Ethernet.
 4. Communication between building controller(s) and application specific and custom application controllers:
 - a. MS/TP.
 - b. PTP.
- D. Web Services Enabled Network:
 1. The network shall be capable of being accessed remotely over the internet via a virtual link according to Internet Protocol.
 2. System software shall be based on a client/server architecture, designed around the open standards of web technology. The BAS server shall be accessed using a web browser over the BAS network, Owner's LAN, and remotely over the Internet (through the Owner's LAN).
 3. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to edit programming. Connection shall be browser agnostic.
 4. Software applications shall be designed and optimized for hand-held device interface (e.g., tablets, smart phones, etc.). Interface shall grant visibility and control access, at a minimum, to the following data: Summary, Alarm, Setpoints, Status, Schedule, and Trending.
- E. Network Integration:
 1. The BAS network shall be integrated with other automation networks controlled by the Owner. Coordinate with the Owner's information technology (IT) department for networks that shall be integrated.
 2. Provide gateways or other integration devices across networks with different communication protocol to provide a single network visibility and interoperability at the operator workstation. Coordinate communication protocol with each automation system specified.
 3. Interoperable networks shall be capable of sharing all point and point information across networks to a single BAS front end.
 4. Interoperable networks shall be capable of automatically downloading application program changes.
 5. For integrated networks that cannot automatically download application program changes, provide a link to the Controller Manual Download Schedule, as defined in the submittals section of Part 1 on the BAS front end summary page
 6. Integrate the following networks:
 - a. Boiler plant master firing controller.
 - b. Chiller controller.
 - c. Life safety systems.
 - d. Fire alarm control panels.
 - e. Refrigerant monitoring controller.

7. Uninterruptible Power System (UPS): Provide a UPS to allow for continuous operation of all equipment during loss of normal power until stand by power is achieved.
 - a. Applicable Systems:
 - 1) BAS.
 - 2) Smoke Control System.
 - b. Size the UPS to operate for a minimum of 15 minutes.
 - c. Elements of the control system susceptible to power surges shall be protected by conditioners, suppressors or other approved means.
 - d. Coordinate the size of the UPS with Division 26.
 8. Requirements for Smoke Control Networks:
 - a. Network controllers and components used for smoke control operations shall be U.L. 864 – UUKL rated.
 - b. Control wiring used for smoke control operations shall be installed in a fire-resistive cable assembly. Reference Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.”
 - c. Control system shall be capable of communicating with the building’s fire alarm system to fulfill the sequences of operation specified in this section or on the drawings.
 - d. The BAS Contractor shall provide a Fire Fighter’s Smoke Control Panel to manually control the smoke evacuation system. Reference Section 230913 for panel requirements.
- F. Network Interoperability:
1. Provide communication between control units over local area network (LAN).
 2. Communication services over the LAN shall result in operator interface and value passing that is transparent to the network architecture as follows:
 - a. Connection of an operator interface device to any one controller on the network shall allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the network.
 - b. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the network. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller’s database. An operator/installer shall not be required to set up any communication services to perform network value passing.

2.3 OPERATOR INTERFACE

- A. General:
1. The Operator Interface shall provide overall BAS supervision and system software interface. Communications from the workstation shall be executed directly to and between the integration level building controllers and field level controllers.
 2. The operator interface shall be capable of command entry, information and alarm management, database management, access of all system data, and be independent of hardware technology.
- B. Hardware:
1. Laptop:
 - a. Laptop(s) to be provided by BAS controls manufacturer.
 - b. Laptop shall be general purpose and commercially available, with sufficient memory and processing capability to meet the requirements of the BAS.
 - c. Quantity: 1.
 - d. Minimum RAM: 4.0 Gigabytes.
 - e. Minimum Processing Speed: Intel i3 Dual Core Microprocessor or better running at no less than 3.0 gigahertz.

- e. Minimum Hard Drive Memory: 500 Gigabyte.
- f. Drives: External 32X CD/8X DVD drive with USB connection.
- g. Ports: Minimum of 2 USB 2.0 or faster.
- h. Display: Minimum 15 inch.
- i. Network Connection:
 - 1) Suitable for network technology provided.
 - 2) Ethernet interface card with minimum speed: 10/100/1000.
 - 3) Wireless interface card, dual band.

1.2 CONTROLLERS

C. Building Controllers

- 1. General:
 - a. Input Power Requirements: 24Vac.
 - b. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - c. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - d. Share data between networked controllers.
 - e. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
 - f. Utilize real-time clock for scheduling.
 - g. Continuously check processor status and memory circuits for abnormal operation.
 - h. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - i. Communication with other network devices to be based on assigned protocol.
 - j. Monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
- 2. Communication:
 - a. Perform routing when connected to a network of custom application and application specific controllers.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 1) Port shall be USB type.
- 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within NEMA 4X waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F and 95 percent RH, non-condensing.
 - b. Conditioned Space:
 - 1) Mount within NEMA 1 dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 4. Local Keypad and Display for each Controller:
 - a. Use for interrogating and editing data.
 - b. System security password prevents unauthorized use.
 - c. If the manufacturer does not normally provide a keypad and display for the controller, provide software and interface cabling needed to use a portable operator terminal for the system.
- 5. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 7. Power and Noise Immunity:

- a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention.
 - d. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
- 8. Surge and Transient Protection:
 - a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
 - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- D. Custom Application Controllers
 - 1. General:
 - a. Input Power Requirements: 24Vac.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked, microprocessor based controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
 - i. Monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
 - 2. Communication:
 - a. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within NEMA 4X waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F and 95 percent RH, non-condensing.
 - b. Conditioned Space:
 - 1) Mount within NEMA 1 dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
 - 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 - 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 - 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Upon restoration of normal power, the Digital Panel shall automatically resume full operation without manual intervention.
 - d. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
 - 7. Surge and Transient Protection:

- a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
 - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- E. Application Specific Controllers
 - 1. General:
 - a. Input Power Requirements: 24Vac.
 - b. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - c. Customized for operation within the confines of equipment served.
 - d. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - e. Communication with other network devices to be based on assigned protocol.
 - 1) Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 - f. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - 2. Communication:
 - a. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within NEMA 4X waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within NEMA 1 dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F and 95 percent RH, non-condensing.
 - 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 - 5. Memory. In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 - 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention.
 - d. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
 - 7. Surge and Transient Protection:
 - a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
 - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- F. Input/Output Interface
 - 1. Hardwired inputs and outputs shall tie into the BAS through building, custom application, or application specific controllers.
 - 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.

- b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 - c. Universal-type inputs or outputs configurable between binary and analog are acceptable.
- 3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
- 4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
- 5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 Vdc, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
- 6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
- 7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 Vdc or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
- 8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - 1) VAV terminal units.
 - 2) Duct mounted heating coils.
 - 3) Zone dampers.
 - 4) Radiant devices.
 - c. Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.4 ELECTRICAL CONTROL POWER AND LOW VOLTAGE WIRING

- A. Power Wiring: Copper wiring, plenum cable, and raceways shall be as specified in the applicable section of Division 26.
- B. Power and Communication Wiring Transient Protection:
 - 1. Comply with IEEE C62.41.2.
 - 2. Communications trunk wiring shall be protected with a transient surge protection device providing the minimal protection required.
 - 3. Communication circuitry, input/output circuitry, and communication unit shall provide protection against a 1000 volt, 3 amp transient signal, directly applied to the communication or input/output terminations.
 - a. For systems not complying with this requirement, provide equivalent protection external to the automatic temperature control system controller. Protection shall be

provided for the individual communications and input/output terminations for each automatic temperature control system controller.

- b. Submittal documentation shall clearly define how this requirement will be met and how the external protection will not affect the performance of the controllers.

C. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Supplies shall be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

D. Power Line Filtering:

1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

E. Input/Output Control Wiring

1. Control wiring shall be sized to accommodate the voltage drop associated with the distance between the control device and the controller. Minimum size shall be as specified herein.
2. In all communication conduits, provide one spare twisted pair to be installed, tagged and labeled at each end.
3. Control wiring not installed in conduit shall be UL rated for plenum installation.
4. Ethernet control wiring shall be fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
5. RTD wiring shall be three-wire or four-wire twisted, shielded, minimum number 22 gauge.
6. Other analog inputs shall be a minimum of number 22 gauge, twisted, shielded.
7. Binary control function wiring shall be a minimum of number 18 gauge.
8. Analog output control functions shall be a minimum of number 22 gauge, twisted, shielded.
9. Binary input wiring shall be a minimum of number 22 gauge, twisted, shielded.
10. Thermistors shall be equipped with the manufacturer's calibrated lead wiring.
11. 120V control wiring shall be #14 THHN in 3/4 inch conduit. Provide 20% fill extra wire in each conduit.

F. Splices: Splices in shielded cables shall consist of terminations and the use of shielded cable couplers that maintain the integrity of the shielding.

G. Conduit and Fittings

1. Conduit for Control Wiring, Control Cable and Transmission Cable: EMT with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.

4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.
- H. Relays
1. Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.
 2. Solid State Relays (SSR):
 - a. Input/output isolation: Greater than 10^9 ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz.
 - b. Contact Life: 10×10^6 operations or greater.
 - c. Ambient Temperature Range: Minus 20 to +140 degrees F.
 - d. Input impedance: Not be less than 500 ohms.
 - e. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.
 3. Contactors:
 - a. Type: Single coil, electrically operated, mechanically held, double-break, silver-to-silver type protected by arcing contacts.
 - b. Positive locking shall be obtained without the use of hooks, latches, or semi permanent magnets.
 - c. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

2.5 SYSTEM SOFTWARE

- A. General:
1. Provide all necessary system software to form a complete operating system for all operator interface devices.
 2. System software shall integrate with all controller software and allow management of software applications at the operator workstation.
 3. System software display language: English.
- B. Device Profile: BACnet devices shall Conform to the following device profiles as specified in ASHRAE/ANSI 135 BACnet Annex L:
1. Operator workstation: BACnet Operator Workstation (B-OWS)
 2. Building Controller: BACnet Building Controller (B-C).
 3. Advanced Application Controller: BACnet Advanced Application Controller (B-AAC).
 4. Application Specific Controller: BACnet Application Specific Controller (B-ASC).
- C. Software Programming:
1. Provide programming for the system and adhere to the sequences of operation provided. Provide actions for all possible situations. All other system programming necessary for the operation of the system shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Provide text-based, graphic-based, and parameter-based programming where appropriate.
- D. Operating System:
1. Concurrent, multi-tasking capability.
 2. Common Software Applications Supported:
 - a. Microsoft Windows and Microsoft Office Suite.
 - b. Open platform compatible database: Microsoft Access, Oracle Database, IBM Analytics, or other SQL database software. Proprietary databases shall not be acceptable.
 3. Acceptable Operating Systems: Most recent version of operating system.

E. System Graphics:

1. Color type, saved in an industry-standard format such as BMP, JPEG, PNG, or GIF.
2. Allow simultaneous display for comparison and monitoring of system status.
3. Web based graphics shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X, Java Virtual Machine, and Adobe Flash).
4. Animate displayed objects by shifting image files of objects based on object status.
5. Functionality: Provide method for operator with password to perform the following:
 - a. Move between, change size, and change location of graphic displays.
 - b. Modify on-line.
 - c. View a summary of the most important data for each controlled zone or piece of equipment.
 - d. View a summary of the most important global data for the project, including but not limited to date, day of week, time, outdoor dry bulb temperature, and humidity.
 - e. Use point-and-click navigation between graphic screens.
 - f. Edit setpoints and other specified parameters.
 - a. Edit equipment names and numbers.
 - b. Edit room names and numbers.
 - g. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - h. Add, delete, or change dynamic objects consisting of:
 - 1) Analog and binary values.
 - 2) Dynamic text.
 - 3) Static text.
 - 4) Animation files.
 - i. Display graphic file, text, and dynamic object data together on a single graphic. Display all measured and commanded data, setpoints, calculated values, and input and output control points with appropriate engineering units associated with each system schematic.
 - j. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.
 - k. Dynamic Data Displays shall be capable of including point data from multiple ASC's.
6. Include at least one graphic for each of the following:
 - a. Each piece of equipment.
 - b. Occupied zone.
 - c. Hydronic system (chilled water, condenser water, hot water, steam, heat pump, etc.)
 - d. Floor plan displays of the building. Indicate summary conditions for each floor.
 - e. Indicate thermal comfort on floor plan using dynamic colors to represent zone temperature relative to zone setpoint.
2. Graphic Tree Structure:
 - f. Structure graphic system tree to allow access to individual graphic screens from a macro to a micro level.
 - g. Allow each level of graphic direct access to the graphic screen above and below the graphic screen in the system tree.
 - h. Allow direct access to the main summary graphic screen/map from any individual graphic screen.
7. Sequence of Operation Graphics:
 - a. Display the complete Sequence of Operation or include a link to a separate text file that contains the sequence of operation, as submitted by the Contractor and approved by the Engineer with each system schematic view. The Sequence of Operation text shall be in a separate frame above, below, or to the side of the graphic as appropriate for the graphic size and content.
8. Custom Graphics Generation Package:
 - a. Allow operator to create, delete, modify, and save custom graphic files and displays. File format of graphics shall be compatible with BAS software.

- b. Web-based Graphics: HTML graphics to support web browser compatible formats.
 - c. The BAS Contractor shall provide libraries of pre-engineered screens and symbols depicting standard components with which custom graphics may be built. Standard components include but are not limited to
 - 1) Air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.).
 - 2) Complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.).
 - 3) Hydronic system components (e.g., chillers, boilers, pumps, piping, valves, etc.).
 - 4) Electrical symbols.
 - d. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following
 - 1) Define symbols.
 - 2) Position and size symbols.
 - 3) Define background screens.
 - 4) Define connecting lines and curves.
 - 5) Locate, orient and size descriptive text.
 - 6) Define and display colors for all elements.
 - 7) Establish correlation between symbols or text and associated system points or other displays.
 - 8) Capture or convert graphics from AutoCAD.
 - e. Graphical displays shall be capable of representing a group of objects. Groups shall be capable of representing any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the building.
3. Standard HVAC Graphics Library: Furnish a complete library of standard HVAC equipment graphics and standard symbols for ancillary equipment in a file format compatible with the graphics generation package program. Graphics shall include, but not be limited to, the following:
- a. HVAC Equipment:
 - 1) Chillers.
 - 2) Boilers.
 - 3) Air Handlers.
 - 4) Terminal HVAC Units.
 - 5) Fan Coil Units.
 - b. Ancillary Equipment:
 - 1) Fans.
 - 2) Pumps.
 - 3) Coils.
 - 4) Valves.
 - 5) Piping.
 - 6) Dampers.
 - 7) Ductwork.
- F. Workstation System Applications:
- 1. General Application Functions:
 - a. All applications shall be capable of being executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization.
 - b. Allow BAS configuration and future changes or additions by operators with password protection.
 - c. Execute configured processes defined by the user to automatically perform calculations and control routines.
 - d. Process Inputs and Variables: It shall be possible to use any of the following in a configured process:
 - 1) Any system-measured point data or status
 - 2) Any calculated data

- 3) Any results from other processes
 - 4) Boolean logic operators (and, or)
 - e. Process Triggers: Configured processes may be triggered based on any combination of the following:
 - 1) Time of day
 - 2) Calendar Date
 - 3) Other processes
 - 4) Events (e.g., point alarms)
 - f. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASC's. In addition, a single process shall be able to issue commands to points in any and all other ASC's on the local network.
- 2. Network Configuration:
 - a. Allow for configuration of the BAS network.
 - b. Provide alarm when a break in communication between devices is detected.
 - c. Enable the operator to add, delete, or modify the following:
 - 1) Building controllers and ASC's.
 - 2) Points of any type, point parameters, and tuning constants.
 - d. Provide automatic reconfiguration if any station is added or lost.
- 3. Save and Restore:
 - a. Automatic System Database Save and Restore Functions:
 - 1) Store current database copy of each Building Controller on hard disk or server.
 - 2) Backup database on a user adjustable frequency basis. Default frequency shall be monthly.
 - 3) Automatically update upon change in any system panel.
 - 4) In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - b. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - 1) Save database from any system panel.
 - 2) Clear a panel database.
 - 3) Initiate a download of a specified database to any system panel.
- 4. On-line Help:
 - a. Include context-sensitive system to assist operator in operation and editing.
 - b. Include topics available for all applications.
 - c. Include relevant screen data provided for particular screen display.
 - d. Include additional help via hypertext.
- 5. Security:
 - a. Require user name and password for Operator log-on to view, edit, add, or delete data.
 - b. Include selectable system security for each operator. Support a minimum of five levels of access:
 - 1) Level 1 = Read-only data access and display.
 - 2) Level 2 = Level 1 + scheduling.
 - 3) Level 3 = Level 2 + operator overrides and commands.
 - 4) Level 4 = Level 3 + database generation and modification.
 - 5) Level 5 = Level 4 + Audit trail management.
 - 6) Operators shall be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device shall be limited to only the items defined as accessible for the user.
 - 7) Support a minimum of 4 passwords at each Building Controller.
 - c. Allow system supervisor to set passwords and security levels for all other operators.
 - d. Allow operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.

- e. Include automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
- f. Store all system security data in encrypted format.
- g. Log all user actions and store data for audit with permission access by system administrator only.
 - 1) Include the modified system.
 - 2) Include the value modified.
 - 3) Include the time of modification.
- 6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Workstations.
 - 2) Printers.
 - 3) Network connections.
 - 4) Building management panels.
 - 5) Controllers.
 - b. Device failure is annunciated to the operator.
- 7. Alarm Management:
 - a. Allow alarm prioritizing to minimize nuisance reporting and to speed operator response to critical alarms.
 - 1) Provide a minimum of three, user definable priority levels.
 - 2) Enable users to manually inhibit alarm reporting for each point.
 - 3) Enable users to manually inhibit nuisance alarm reporting for maintenance or repair work that is scheduled to be performed.
 - 4) Enable user to define conditions under which point changes need to be acknowledged by an operator, and/or logged for analysis at a later date.
 - 5) Allow alarm prioritization to lock out or circumvent other alarms that may be generated as a result of primary alarm.
 - b. Prohibit interference with the ability of the system software to report alarms by either operator activity at the local I/O device, or communications with other system controllers on the network.
 - c. Allow all system objects that are configurable to "alarm in" and "alarm out" of normal state.
 - d. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.
 - 4) Reactions for each object.
 - 5) Alarm delay.
 - e. Alarm Messages:
 - 1) Descriptor: English language. Acronyms or mnemonics for objects in alarm are not acceptable.
 - 2) Recognizable Features:
 - a) Source.
 - b) Location.
 - c) Nature.
 - d) Time and Date.
 - e) Alarm message box to more fully describe the alarm condition or direct operator response.
 - f) Each Alarm messages shall be assignable to any point in the BAS. Alarm messages shall be assignable to multiple points.
 - a) Notification of an alarm override.
 - f. Configurable Alarm Reactions by Workstation and Time of Day:
 - 1) Logging.
 - 2) Printing.
 - 3) Starting programs.
 - 4) Displaying messages.

- 5) Phone text message.
 - 6) Email.
 - 7) Providing audible annunciation.
 - 8) Displaying specific system graphics.
8. Custom Trend Logs:
- a. Maintain trend information for minimum 365 days.
 - b. Definable for any data object in the system including interval, start time, and stop time.
 - 1) Resolution: Interval periods shall be adjustable down to one minute.
 - 2) Multiple Interval Period: Each trended point shall have the ability to be trended at a different trend interval.
 - c. Trend Data:
 - 1) Sampled and stored on the building controller panel.
 - 2) Auto-Delete Period: Software shall be capable of automatically deleting stored trend data after a user-adjustable period of time. Each trended point shall have the ability to have a different auto-delete interval period.
 - 3) Archivable on hard disk or server.
 - 4) Retrievable for use in reports, spreadsheets and standard database programs.
 - 5) Protected and encrypted format to prevent manipulation or editing of historical data and event logs.
 - d. Trend Graph Display:
 - 1) Group Trend Time Series Plots:
 - a) Provide user-selectable Y-axis points.
 - b) Provide user editable titles, point names, and Y-axis titles.
 - c) Individual trended points shall be able to be grouped into groups of up to four points per plot with up to four plots per page.
 - 2) X-Y Trend Plots:
 - a) User selectable X and Y trend inputs.
 - b) User editable titles, point names, and X and Y-axis titles.
 - c) User selectable time period options:
 - i) 1-day 24-hour period.
 - ii) 1-week 7-day period.
 - iii) 1-month period with appropriate days for the month selected.
 - iv) 1-year period.
 - v) User shall be able to select the beginning and ending period for each X-Y chart, within the time domain of the database being used.
 - vi) User selectable display up to 6 plots per screen in 2 columns.
 - 3) Automatic Scaling: System shall automatically scale the axis on which trends are displayed when multiple points with different trend interval periods are selected for graphical display.
 - 4) Dynamic Update: Trends shall be able to dynamically update at operator-defined intervals.
 - 5) Zoom: Software shall allow zoom-in function for detailed examination of trends.
 - e. Numeric Value Display: Software shall display value of any sample on a trend when picked.
9. Alarm and Event Log:
- a. View all system alarms and change of states from any system location.
 - b. List events chronologically.
 - c. List alarm priority.
 - c. Allow operator with proper security to acknowledge and clear alarms. Log operator and time when alarm is acknowledged.
 - d. Archive alarms not cleared by operator to the workstation.
10. Object, Property Status, and Control:

- a. Provide a method to view, edit if applicable, the status of any object and property in the system.
 - b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.
11. Clock Synchronization:
- a. The real-time clocks in all building control panels and workstations shall be able to automatically synchronize daily from any operator-designated device in the system.
 - b. The system shall automatically adjust for daylight savings and standard time, if applicable.
12. Reports and Logs:
- a. Reporting Package:
 - 1) Allow operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.
 - 4) Provide ability to obtain real-time logs of all objects available by type or status such as alarm, lockout, normal, etc.
 - 5) Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
 - 6) Allow printing on operator command or specific time(s).
 - b. Standard Report Format Options:
 - 1) Objects with current values.
 - 2) Global modification values.
 - 3) Current alarms not locked out.
 - 4) Disabled and overridden objects, points and variables.
 - 5) Objects in manual or automatic alarm lockout.
 - 6) Objects in alarm lockout currently in alarm.
 - 7) Objects currently in override status.
 - 8) Objects in Schedules
 - a) Daily.
 - b) Weekly.
 - c) Holiday.
 - 9) Logs:
 - a) Alarm History.
 - b) System messages.
 - c) System events.
 - d) Trends.
 - c. Custom Report Format Options:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
 - 8) Point Groups.
 - a) User-selectable.
 - b) Group may be comprised of specific points, group of equipment objects, group of groups, or for the entire facility without restriction due to the hardware configuration of the BAS.
 - d. Electrical, Fuel, and Weather:
 - 1) Electrical Meter(s):
 - a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.

- b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
 - 2) Fuel Meter(s):
 - a) Monthly showing daily fuel consumption for each meter.
 - b) Annual summary showing monthly consumption for each meter.
 - 3) Weather:
 - a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.
- 13. Global Modify:
 - a. Allow global modification of all editable data. Similar data shall be grouped into logical objects based on building function, mechanical system, building layout, or any other logical grouping of points.
 - b. Allow each common type of equipment to be excluded or included within the global editing process.
 - c. Display status information on all similar points in one global report.
 - d. Allow modification of the following:
 - 1) Individual data point edited.
 - 2) List of all points within the category.
 - 3) Global change field.
 - 4) Copy feature to assist in downloading the new changes.
 - 5) Verification that all changes were completed.
 - e. Include a change-all feature to change all selections.
 - f. Prevent acceptance of changes until an accept icon is acknowledged.
- G. Workstation Applications Editors:
 - 1. Provide editing software for each system application at the PC workstation.
 - 2. Edited applications shall be automatically downloaded and executed at the controller panel.
 - 3. Programming Description: Definition of operator device characteristics, ASC's, individual points, applications and control sequences shall be performed through fill-in-the-blank templates.
 - 4. System Definition/Control Sequence Documentation: All portions of system definition shall be self-documenting to provide hard copy printouts of all configuration and application data.
 - 5. System definition and modification procedures shall not interfere with normal system operation and control.
 - 6. Provide consistent text-based displays of all system point and system applications.
 - 7. Point identification, engineering units, status indication, and application naming conventions shall be the same at all operator devices.
 - 8. Full screen editor for each application shall allow operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.
 - d. Set-points.
 - e. Schedules.
 - 9. Scheduling:
 - d. Allow scheduling down to the zone or room level.
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be grouped, scheduled, and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
 - e. Schedule expiration.
 - d. Temporary overrides of systems with user adjustable time-out.
 - f. Provide minimum three tiers of priorities for scheduling.
 - 1) Priority 1: Event, temporary, or override.
 - 2) Priority 2: Calendar.
 - 3) Priority 3: Default.

- g. Higher priority schedules shall overlay with lower priority schedules without interrupting or deleting them. Upon expiration of a higher priority schedule, schedule shall revert to next lower priority.
 - h. Expired priority 1 and priority 2 schedules shall be automatically deleted after execution.
- 10. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:
 - 1) English oriented programming language, allowing for free form programming.
 - 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
 - 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
 - 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
 - 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
 - 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
 - 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
 - 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.6 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 - 1. User access secured via user passwords and user names.
 - 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 - 3. User Log On/Log Off attempts are recorded.
 - 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
 - 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
 - 2. Exception Schedules:
 - a. Based on any day of the year.
 - b. Defined up to one year in advance.
 - c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
 - 3. Holiday or Special Schedules:

- a. Capability to define up to 99 schedules.
 - b. Repeated annually.
 - c. Length of each period is operator defined.
- D. System Coordination: Provide a standard application for equipment coordination. The application shall provide the operator with a method of grouping together equipment based on function and location. Groups shall be capable of being used for scheduling and other applications.
- E. Alarms:
 - 1. Binary object is set to alarm based on the operator specified state.
 - 2. Analog object to have high/low alarm limits.
 - 3. All alarming is capable of being automatically or manually disabled.
 - 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - 5. Reporting Action Options:
 - a. Start Programs.
 - b. Print.
 - c. Logged.
 - d. Custom messaging.
 - e. Graphical displays.
 - f. Dial out to workstation receivers via system protocol.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation on the control drawings.
- H. PID Control Characteristics:
 - 1. Provide proportional-integral algorithms.
 - 2. Direct or reverse action.
 - 3. Anti-windup.
 - 4. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
 - 5. User selectable controlled variable, set-point, and PI gains.
- I. Staggered Start Application:
 - 1. Prevents all controlled equipment from simultaneously restarting after power outage.
 - 2. Order of equipment startup is user selectable.
- J. Anti-Short Cycling:
 - 1. All binary output objects protected from short-cycling.
 - 2. Allows minimum on-time and off-time to be selected.
 - 3. Allows the number of times each piece of equipment may be cycled within any one-hour period.
- K. On-Off Control with Differential:
 - 1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
 - 2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- L. Trending: Building controllers shall allow collection and delivery of (time, value) pairs.
- M. Totalization:
 - 1. Run-Time Totalization:
 - a. Totalize run-times for all binary input objects.
 - b. Provides operator with capability to assign high run-time alarm.
 - c. Generates unique, user-specified messages when the limit is reached.
 - d. Resolution: Adjustable down to one minute.
 - 2. Pulse Totalization:
 - a. Totalize consumption for user-selected analog and binary pulse input-type objects.
 - b. Configurable for a daily, weekly, or monthly basis.

- c. Provide calculation and storage accumulations of up to 9,999,999 units (e.g. KWH, gallons, KBTU, tons, etc.).
- d. Resolution: Adjustable down to one minute.
- e. Warning Limit: User definable. Generate unique, user-specified messages when the limit is reached.
- f. The information available from the Pulse Totalization shall include, but not be limited to, the following:
 - 1) Peak Demand, with date and time stamp
 - 2) 24-hour Demand Log
 - 3) Accumulated KWH for day
 - 4) Sunday through Saturday KWH usage
 - 5) Sunday through Saturday Demand kW
 - 6) Demand kW annual history for past 12 periods
 - 7) KWH annual history for past 12 periods
- 3. Event Totalization:
 - a. Count user-selected events, such as the number of times a pump or fan system is cycled on and off.
 - b. Provide storage accumulations of up to 9,999,999 events before reset.
 - c. Warning Limit: User definable. Generate unique, user-specified messages when the limit is reached.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices and wiring are installed prior to installation proceeding.
- E. Verify the integrity of control wiring, raceways, control panels, sensors, and control devices prior to reusing for the new work.
- F. Verify wiring insulation is defect free and test wiring for continuity and ground faults.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Coordination:
 - 1. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.
 - 2. Coordinate with other contractors performing work to provide standby power to all control devices required to operate on standby power.
 - 3. Coordinate with the Owner to display additional virtual points on individual schematic graphic screens that are not directly associated with that system. Examples may include outdoor air temperature or global alarm conditions.
- B. Web Services Enabled Network:
 - 4. Provide an IP network data drop for connection of BAS into Owner's IP network. Coordinate final location of IP network data drop with the Owners' IT staff.
 - 5. If the Owner has no preference or not indicated on the drawings, locate data drop within the main BAS control panel.

6. Coordinate with the Owner's IT department to implement proper security measures, including secure access to the network data drop and firewalls at all virtual access points to the internet to protect access to the BAS.
- C. General Workmanship:
1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
 2. Install all equipment in readily accessible locations.
 3. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
 4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
 7. Control wiring routed in wall cavities shall be installed in conduit.
 8. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
 9. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- C. Controllers:
1. Install controllers in a locked control panel. Provide common keying for all controller covers.
 2. Provide a separate controller for each piece of controlled equipment, such as an AHU, FCU, VAV box, etc. A controller may control more than one piece of equipment provided that all points associated with the equipment are assigned to the same BAS controller. Global points used for control loop reset are exempt from this requirement.
 3. Select building controllers and custom application controllers to provide the required I/O point capacity required to monitor all of the hardware points listed on the control drawings.
 4. Application specific controllers may be used where factory programming is capable of executing all control functions specified in the sequences of operation. Contractor shall add supplemental controllers, devices, and programming as required to execute the specified control function if the ASC cannot.
- D. Wiring:
1. All control and interlock wiring shall comply with national and local electrical codes.
 5. Properly ground all controllers.
 6. Wire all safety devices through both hand and auto positions of motor starting device to ensure 100 percent safety shut-off.
 2. Provide interlock wiring between devices as indicated on the control drawings.
 3. Provide electrical wiring for relays (including power feed) for temperature and pressure indication.
 4. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
 5. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.
 7. Conceal all low voltage wiring in finished rooms.
 8. Conceal all low voltage wiring in unfinished rooms below the elevation of the lights. Low voltage wiring above the elevation of the lights may be exposed.
 9. Routing of low voltage wiring above working heights in equipment rooms and above accessible ceilings is acceptable subject to following criteria:
 - a. Wiring shall be plenum rated.
 - b. Do not lay wiring on ceiling tiles.
 6. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended applications.
 7. All wiring in mechanical, electrical, service rooms, or where subject to mechanical damage, shall be installed in raceway at levels below 10 feet.

8. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two wires (e.g., relays and transformers).
9. Where Class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it and neatly tied at 10 foot intervals.
10. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
11. All wire-to-device and wire-to-wire connections shall be made at a terminal block or terminal strip.
12. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
13. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, coordinate with Division 26 to provide step-down transformers.
14. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
15. Install plenum wiring in sleeves where it passes through floors and walls. Maintain fire rating at all penetrations.
16. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
17. Include one pull string in each raceway 1 inch and larger.
18. Use coded conductors throughout with conductors of different colors.
19. Control and status relays shall be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
20. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (e.g., steam pipes or flues).
21. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
22. Install insulated bushing on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
23. Terminate all control and/or interlock wiring and maintain updated (as-built) wiring diagrams with terminations identified at the job site.
24. Terminate BAS sensor input wiring cable shield by taping back at the field device and connect shield to the grounded control panel chassis or sub-panel.
25. Terminate BAS comm bus cable shield between controllers per manufacturer recommendations.
26. Terminate management level/enterprise level network wiring cable shield by wrapping the drain wire around the foil shield and connecting the ground strip to the drain wire.
27. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than 1/2 inch electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
28. Raceway shall be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations shall be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

E. Communication Wiring:

1. Adhere to the items listed in the "Wiring" article in Part 3 of this specification in addition to the requirements listed below.
2. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication wiring.

3. Do not exceed 328 feet in Ethernet wiring length between switches or repeaters.
 4. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
 5. Do not install power wiring, in excess of 30 Vac RMS, in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, use separate twisted shielded pairs with the shields grounded in accordance with the manufacturer's wiring practice.
 6. Communication conduits shall not be installed closer than six feet from high power transformers or run parallel within six feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible.
 7. Do not exceed maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer during installation.
 8. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
 9. When a cable enters or exits a building, install a lightning arrestor between the lines and ground. Install the lightning arrestor according to the manufacturer's instructions.
 10. Ground (earth ground) all shields at one point only, to eliminate ground loops.
 11. All runs of communications wiring shall be unspliced length when that length is commercially available.
 12. Terminate shielded cable splices in accessible locations. Harness cables with cable ties.
 13. Make all wire-to-device and wire-to-wire connections at a terminal block or terminal strip.
 14. Label all communications wiring to indicate origination and destination data.
 15. Ground coaxial cable in accordance with NEC regulations.
 16. Install BACnet MS/TP communications wiring in accordance with ASHRAE/ANSI Standard 135
 - a. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 17 pF per foot at 76,800 Baud.
 - b. The maximum length of an MS/TP segment shall be 3000 ft with AWG 22 or 24 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
 - c. The maximum number of nodes per segment shall be 50. Additional nodes may be accommodated by the use of repeaters.
 - d. An MS/TP EIA-485 network shall have no T connections.
- F. Identification of Hardware and Wiring:
1. Label all wiring and cabling, including that within factory-fabricated panels, at each end within 2 inch of termination with the BAS address or termination number.
 2. Permanently label or code each point of field terminal strips to show the instrument or item served.
 3. Identify control panels with minimum 1/2 inch letters on laminated plastic nameplates.
 4. Identify all other control components with permanent labels. Label all plug-in components such that removal of the component does not remove the label.
 5. Identify room sensors related to terminal box or valves with nameplates.
 6. Maintain manufacturers' nameplates and UL or CSA labels visible and legible after equipment is installed.
 7. Identifiers shall match record documents.

3.3 STARTUP AND DEMONSTRATION

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing the BAS in permanent operation.
- B. Contractor shall provide an on-site controls technician or programmer familiar with the project BAS installation and system programming to assist the Commissioning Agent as directed during all phases of system functional testing.

- C. Coordinate with Owner the setup of logins, passwords, and security level access for individuals requiring access to the BAS.
- D. BAS graphics shall be updated with final equipment names, equipment numbers, room names and room numbers to match the final construction documents and any Owner changes made prior to occupancy.
- D. BAS shall be set up and checked by factory trained technicians skilled in the setting and adjustment of the BAS equipment used in this project. Technicians shall be experienced in the type of HVAC systems associated with this project.
- E. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
- F. Test each control device to ensure that it is operating properly and is calibrated to the appropriate operating requirements. Run each control device through its range of operation and sequence. Verify all normal positions are correct. Adjust and tune PID control constants to achieve proper system operation.
 - 1. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
 - 2. Demand limiting. The Contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 - 3. Optimum start/stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 - 4. Any tests that fail to demonstrate the operation of the BAS shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.
- G. Test and verify control interfaces to other building systems integrated into the network.
- H. Verify all alarms and interlocks.
 - 1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - 2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - 3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
 - 4. Verify fire/smoke and smoke damper functionality. Verify that they respond to the proper fire alarm system general, zone, and/or detector trips.
- I. Document on system equipment schedules the final setting of controller PID constant settings, setpoints, manual reset values, maximum and minimum controller output, and ratio and bias settings in units and terminology specific to the controller. Store documentation with operator workstation.
- J. Demonstrate complete and operating system to Owner.
 - 1. Prior to acceptance, the BAS shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
 - 2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, start-up, and debugging process.
 - 3. The Contractor shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. Any test equipment required to provide the proper operation shall be provided by and operated by the Contractor.

4. Demonstrate compliance with sequences of operation through all modes of operation.
5. Demonstrate complete operation of operator interface.

K. Acceptance:

1. All tests described in this specification shall have been performed to the satisfaction of the Owner prior to the acceptance of the BAS as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the completion requirements if stated as such in writing by the Contractor and submitted for approval by the Owner. Such tests shall then be performed as part of the warranty.
2. The BAS shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved.

3.4 MAINTENANCE SERVICE

- A. Provide service and maintenance of energy management and control systems for one year from Date of Substantial Completion.

3.5 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of sixteen hours on the operation and maintenance of the equipment provided under this section.
- B. Organize the training into sessions or modules for different levels of operators. Owner designated personnel shall be trained based on the level of operator training described below.
- C. Day-to-day Operator Training:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
 2. Proficiently operate the BAS.
 3. Understand BAS architecture and configuration.
 4. Understand BAS components.
 5. Understand system operation, including BAS control and optimizing routines (algorithms).
 6. Operate the workstation and peripherals.
 7. Log on and off the system.
 8. Access graphics, point reports, and logs.
 9. Adjust and change system set points, time schedules, and holiday schedules.
 10. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
 11. Understand BAS drawings and Operation and Maintenance manual.
 12. Understand the job layout and location of control components.
 13. Access data from BAS controllers and ASCs.
 14. Operate portable operator's terminals.
 15. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
- D. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
- E. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- F. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION