DOCUMENT 00010 - TABLE OF CONTENTS

END OF DOCUMENT 00010

SECTION 01000 – SUMMARY of WORK

1.0 SCOPE of WORK

1.1 Intent of Specifications - This specification identifies all material, labor, and equipment required to perform this work. All work performed and all materials and equipment used are subject to approval by the Contracting Officer (CO) and /or the Resident Engineer (RE). This shall include but is not limited to inspection, scheduling, reporting and submittals.

1.1.2.Title - Titles to division and sections of the specifications and notes and titles on drawings referring to subcontractors, division of work by trade, or type of work, are introduced merely for convenience in reading the specifications and drawings and do not imply any separate contractual arrangements of work assignments. Such separations into titled divisions and sections shall not operate to make the Government an arbiter to establish subcontract limits between the contractor and subcontractors, or between the subcontractors themselves.

1.1.3 Contract Documents - The drawings, as shown on the "List of Drawings" in the section labeled Index, in each specification package, General, Architectural, Mechanical, Electrical, and FAA Standards, all form a part of the construction requirements for this project. The renovation of these systems shall be in accordance with the lines and grades shown on the drawings. The Contractor shall not use dimensions scaled from drawings. All dimensions shown on the drawings shall be field verified by the contractor prior to any modifications and fabrications. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Contracting Officers Technical representative, COTR, for adjustment before any work affected is performed.

1.1.4 Precedence of Contract Documents - In the event of a difference among the following contract provisions, the order of precedence to determine which provision shall govern is:

1. Contract Clauses and Provisions
2. Project Specifications
3. Project Drawings

Any discrepancies between the contract provisions, the specifications and the contract drawings shall be referred to the CO for a written determination in accordance with Contract Clause entitled Order of Precedence.

1.1.5 Contractor Superintendence - In accordance with Contract Clause entitled SUPERINTENDENCE BY THE CONTRACTOR, the Contractor shall at all times during performance of this contract and until the work is completed and accepted, directly superintend the work on site or assign and have on site a competent superintendent with the authority to act for the Contractor.

The Contractor shall submit a Project Organizational Chart with the key personnel identified and their and their qualifications for the Government's review and approval.

1.2 SPECIAL REQUIREMENTS

1.2.1 Asbestos Containing Materials. - **Materials supplied by the contractor for this construction shall not contain asbestos or lead-based products.** The contractor shall

verify that all materials, including those supplied by third parties, are asbestos free and/or lead-based free materials.

- Contractor Certification Requirements. - The contractor shall provide to the Contracting Officer (CO) a signed and notarized document stating that to the best of his/her knowledge, no asbestos containing or lead-based materials were used during the construction, renovation, and/or modernization of this facility.

1.2.2 Material Safety Data Sheets. - The contractor shall submit Material Safety Data Sheets (MSDS) with all submittals for review and approval by the Contracting Officer. New materials found to contain asbestos and/or lead-based products will be automatically disapproved. Copies of all MSDS sheets shall be provided to the facility FAA personnel for the building records. The contractor shall comply with all health and safety provisions outlined in each MSDS and shall follow all OSHA guidelines regarding personnel protection.

1.2.3 Hazardous Materials.- If the FAA RE suspects the presence of asbestos or lead- based products in the new materials, the FAA will sample the suspect material to verify that no asbestos containing material or lead-based material were used. If these materials are found to contain asbestos or lead-based products, the cost of the survey and all subsequent removal/replacement of any hazardous materials shall be at the contractors' expense.

1.2.4. Work Plan and Scheduling. – Prior to the Contracting Officer issuing the Notice to Proceed (NTP), the contractor shall submit for approval a plan and schedule of the work. This schedule shall include but is not limited to all of the requirements as defined in Section 01042 of this specification and the milestones listed in paragraph 1.2.6 - 4 below. These requirements represent the basic minimum and the contractor is strongly urged to provide as much detail as possible. The submittal of the schedule is critical and requires approval prior to issuance of the NTP.

1.2.5. Sequence of work. - The contractor shall be responsible for scheduling all aspects of the work and coordinating among the different trades and the COTR involved in or assigned to the project. The contractor shall follow the guidelines outlined in the sequence of work as described in the contract drawings and specifications. The Federal Aviation Administration has developed a list of milestones that the contractor shall be required to include at a minimum on the submitted schedule with the activities and milestones.

1.2.6. Construction Activities and Milestones. – These are required Construction Activities and Milestones for inclusion in the submitted schedule. They are provided for guidance as a rough general outline to assist with the preparation of the contract activities schedule which shall be governed by the Phasing Plan shown in Section 1000 and drawings G005 thru G014.

1. CRITICAL SUBMITTAL APPROVAL
2. ORDER LONG LEAD ITEMS
3. NOTICE TO PROCEED (ISSUED by CO)
4. MILESTONES TO BE INCLUDED IN THE WORK SCHEDULE:
   a. MOBILIZATION (100% Complete)
   b. PHASE 1: MCC-1C REPLACEMENT (100% Complete) c. PHASE 2: MCC-1B REPLACEMENT (100% Complete)
   d. PHASE 4: MCC-1A REPLACEMENT (100% Complete)
   e. PHASE 5: MISCELLANEOUS WORK (100% Complete)
   f. FINAL INSPECTION(100% Complete)
   g. CLOSOUT
   h. PROJECT COMPLETION
5. SUBMITTALS (NON CRITICAL)

6. REMOVE EQUIPMENT LOCKOUT DEVICES
7. EQUIPMENT WARRANTY (Start Date)
8. PUNCH LIST
9. CAI (Contractors Acceptance Inspection)

2.1 SCOPE OF WORK: These specifications, together with the referenced codes, specifications, standards, and drawings set fourth in these contract documents, cover the requirements of the Federal Aviation Administration, hereinafter referred to as the Government or FAA, for work associated with this project replace four (4) motor control centers (MCC) with three (3) new power distribution panels at the Boston Air Route Traffic Control Center. The work also extends to re-wiring of feeds to some downstream panels and the reconfiguration of power sources to the new panels. Work is to be completed at various locations within the Boston Air Route Traffic Control Center complex located at 35 Northeastern Boulevard, in Nashua, New Hampshire 03062. It is estimated that 60% of this project, as a minimum, will require night work. The successful Offeror will be required to furnish all labor, materials, tools, equipment, expertise, and supervision required to complete the following work:

- Replace the four (4) existing Motor Control Centers (MCCs), which are in rooms B112 and B118, with three (3) new contractor supplied and installed panelboards at the same location now occupied by the three (3) MCCs, MCC-1A, MCC-1B, and MCC-1C in room B118. New overhead feeder raceways and conductors will be routed directly from the upstream MCCs, MCC-A, MCC-B, and MCC-C, in Rm. B113 to the new panelboards. Old MCC-1A, -1B and -1C feeders are to be removed. The sequence for completion of the project is contained in the phasing plan portion of the specifications, section 1000.

- The successful offeror shall furnish and mount an electrical panel to be used as a temporary power source for circuits having to be removed from the Motor Control Center being replaced. The panel shall be securely mounted on a steel structure at the location shown on drawing ZBW-1003512 - E002. The panel shall be bottom fed, installed as per the NEC, and capable of safely supporting all of the temporary loads placed on it.

- One of the following contingency actions will be selected for each equipment subject to relocation on a case by-case basis and coordinated with Facility Operations, as required, thru the Contracting Officer's Technical Representative herein referred to as the COTR:

    1. For equipment configured with dual power sources, the affected equipment will be supplied from the alternate power source (See drawing ZBW-1003512 -G004). Alternate power source configurations shall be completed by Environmental Personnel. Contractor personnel shall not complete any such actions unless specifically directed by the COTR.

    2. For equipment having redundant counterparts supplied from other MCCs, the redundant equipment will be started and placed on line allowing the affected equipment to be removed from service.

    3. Temporary feeder conductors will be routed from another, unaffected panelboard to the affected equipment where feasible. All other circuitry shall be routed to the temporary power panel. (See **"**Phase Work" - Section 3.2)

    4. Portable lighting, supplied by the contractor, shall be used in areas where lighting may be lost during the course of the project. Lighting will be affected when providing new circuitry to the transformers.

    5. Based on a determination by FAA personnel that equipment that will be affected by activities during the various phases of work can be left de-energized and off line for

the duration of an MCC replacement phase, the equipment will be de-energized by FAA personnel and tagged as removed from service.

6. A temporary panelboard shall be established in room B112 (see drawing ZBW-1003512 - E002). All remaining MCC branch circuits not covered by the above contingency actions will be transferred to the temporary panelboard as each MCC is being replaced. Jumpers/conductors with pre-approved connection devices (submittals required) will be used to temporarily extend the branch circuit conductors to the temporary panel as necessary. Circuitry shall be extended to the temporary panelboard via the installation of temporary square duct. Upon installation of the new MCC replacement power panel, the circuits shall be re-established in that panel prior to start of work on the next phase..

- Points of connection (POC), to existing conduits that are to be reused, proposed rerouting of conduit and feeders, conduit to be abandoned in place after removal of feeder cables, and those conduits and circuits scheduled to be totally removed are identified in the drawing set. All additional conduits, wire, or other materials required to complete the installation shall be supplied and installed by the contractor.

- Three motor control circuits (for Hot Water Pumps P-2B and P-2C and for Chilled Water Pump P-1E) will be relocated to the upstream MCCs located in Rm. B113. New overhead conduit and conductors will be routed from new motor starters/controllers in the upstream MCCs to these pump motors.

- With the exception of the two boiler circuits, all other loads are panelboards fed thru MCCs-1A, 1B and-1C feeders supplied through circuit breakers. The boiler circuits and panelboard feeders will be transferred to the corresponding new panelboards. These loads will be fed from alternative power sources during the replacement process.

- To the extent possible, existing conduit and conductors shall be re-used. However, because **splicing of essential power circuits is not permitted**, when the original circuits are to be landed in the new panels some loads will require the installation of new, full length conductors. Compatible conduit and fittings shall be used to extend or re-route existing conduit to the new panelboards.

- Power panels located in the Engine Generator Building designated as DPA, DPB, and DPC will require the contractor to complete the following in accordance with the procedures outlined in the Phase Plan:

  1. Extension of the existing feeder cables to the temporary power panel.
  2. Disconnecting of feeder cable from the temporary panel and the DP panel and removing from the conduit/underground duct bank system back to the DP panel.
  3. Installation of new feeders from EB-118 panels to the White EG building panels. (see ZBW-1003512 - E013)
  4. Temporary powering the DP panel having the feeders replaced from one of the remaining energized panels.
- Cutovers to temporary and permanent power sources shall be performed off-hours (11:00 PM to 6:00 AM). Removal and installation of equipment may be performed during normal work hours, subject to facility operational constraints.

2.2 ASSOCIATED WORK

- Pull and remove all abandoned conductors terminating in the MCCs. Install pull strings in the associated conduits and identify with labels, each conduit end with the location of the terminating end.

- Construct panelboard support structures for temporary panel and replacement panels EB-118A, EB-118B, and EB-118C. Shop drawing and fabrication submittals are required for approval prior to start of work. See ZBW-1003512 - E004.

- Restore, repair, patch, and/or paint any areas damaged as a result of contractor activities associated with the completion of this project.

- Identify Panel Boards and update panelboard circuit directories affected by the project. Directories shall be typed. These shall be typed and submitted to the FAA at the end of the project in a format acceptable to the COTR. Work shall be in accordance with Section 16195, Electrical Identification.

- The coring of concrete/block walls for conduit access to various locations of the facility is a part of this project. All coring shall be completed using dust and water control measures approved by the COTR, submittal required. See Section 07270 for Fire Stopping requirements for conduit wall penetrations.

ADVISORY NOTE to OFFERORS: All equipment necessary to the support of the facilities' mission is monitored thru a Building Computer System, (I-Net), to insure continuous operations without safety concerns to the flying public. To assure this safety and insure against loss of service, the removal/replacement of operational equipment from service for the purpose of repair, replacement, or service by an agency other than the FAA must be accomplished by or in the presence of a qualified FAA Engineer or Technician. Wiring associated with breakers that interface with the I-Net system shall be relocated to the new breaker locations. See Phase 5 E of the phasing plan.

2.2 COORDINATION: In order to assure the uninterrupted operations of this facility, all work must be coordinated through the COTR on a daily basis.

2.3 CONTRACT DURATION: The total contract duration for completion of all work shall be 120 calendar days from the issuance of the "Notice to Proceed", excluding the following FAA holiday moratoriums as listed below:

2.3.1 FAA Holiday Moratorium: No work shall be scheduled or take place during the week of and the weekend preceding and following: the Thanksgiving, Christmas, and New Year's Holidays. Only emergency work to restore critical services to the facility will be considered and a moratorium waiver must be submitted and approved. The moratorium period will not be counted against the contract construction duration for the project.

3.0 PROPOSED PHASE PLAN WORK SEQUENCE. The following sequence of proposed activities have been evaluated and proposed for completion having been considered having the least impact to the operational facility. The successful Offeror's work schedule shall comply with this sequence of events and include all aspects mentioned in the contract. Request for changes to the plan most be submitted in accordance with the Section 1300, "Submittals Procedures".

3.1 PHASE WORK:

3.1.1 **Pre Phase Work: Mobilization and Critical Submittals:** For a list of critical submittals, see section 1300.

3.1.2 **Phase 1 Preliminary Work Synopses:** The removal of MCC-1C1, establishing the temporary panel, the installation of new feeders and motor starters for chilled water (CW) pump P-1E and Hot Water (HW) pumps P-2B and P-2C, the installation of new feeders for new power panels EB-118A, EB-118B and EB-118C. See phase plan for detailed sequence of work and associated drawings.

2.1.3 **Phase 2 Work Synopses:** Transfer MCC-1C branch circuits to temporary panel. Remove MCC-1C. Install new panel EB-118C. Install new MCC-C bucket for HWP P-2C and terminate new pump feeders.

2.1.4 **Phase 3 Work Synopses:** Transfer MCC-1B branch circuits to temporary panel. Remove MCC-1B. Install new panel EB-118B. Install new MCC-B bucket for HWP P-2B and terminate new pump feeders.

2.1.5 **Phase 4 Work Synopses:** Transfer MCC-1A branch circuits to temporary panel. Remove MCC-1A. Install new panel EB-118A. Install new MCC-A bucket for CWP P-1E and terminate new pump feeders.

2.1.6 **Phase 5 Work Synopses:** Panels DPA, DPB, and DPC feeder replacement and HWP P-2A disconnect switch installation. Demobilization.

Phasing Plan

PHASE NO:	TITLE			WORK SEQUENCE	DRAWINGS
1	**Preliminary Work**			**Remove MCC-1C1. Establish Temporary Panel. Install new feeders for Chilled Water (CW) Pump P-1E and Hot Water (HW) Pumps P-2B & P-2C. Install feeders for new power panels EB-118A, EB-118B, and EB-118C.**	
		A		**Site Preparations including the removal of MCC-1C1.**	
			1	Transfer PP-MOV to its alternate source.	ZBW-D-1003512-G004
			2	Switch Panels PP-GB, EPP-1, EPP-2 and BC-L-1 to their respective alternate sources.	ZBW-D-1003512-G004
			3	De-Energize MCC-1C & MCC-1C1 at MCC-C bucket, F1A. Lock-out bucket.	ZBW-D-1003512-E022
			4	To assure there is no unforeseen impact as a result of a system being de-energized, the contractor shall wait 15 minutes before proceeding with work in any particular phase.	
			5	Remove all cable and conduit from MCC-1C1 Power Box to MCC-1C1.	ZBW-D-1003512-D001
			6	Energize MCC-1C.	ZBW-D-1003512-E022
			7	Disconnect all cable, conduit, and duct from MCC-1C1. Do not remove existing cable and conduit. Remove MCC-1C1. Maintain grounding for connection to temporary panel.	ZBW-D-1003512-E005
			8	Install temporary plywood door leaf. Seal appropriately for "air quality control".	ZBW-D-1003512-E004 ZBW-D-1003512 E005
			9	Mount temporary bottom fed power panel and install ductwork from temporary panel to within room B118.	ZBW-D-1003512-E004 ZBW-D-1003512 E005
			10	Install breakers and jumpers required for supplying temporary power to the various electrical components.	ZBW-D-1003512-E004

			11	Lay, test, and connect temporary cables from the Essential Bus to the temporary panel.	ZBW-D-1003512-E002
			12	Complete the sealing of the Essential Bus cubicle door.	ZBW-D-1003512-E002
		B		**Install new feeder conductors & conduit for Panels EB118A, EB118B, and EB118C**	
	Steps 1.B.1 - 1.B.3 may be performed in any sequence		**1**	Install new feeder conductors and conduit from MCC-A area to location of future Panel EB-118A. Do not terminate. Cored holes are required to complete step.	ZBW-D-1003512-E003 ZBW-D-1003512-E005 ZBW-D-1003512 E006
			2	Install new feeder conductors and conduit from MCC-B area to location of future Panel EB-118B. Do not terminate. Cored holes are required to complete step	ZBW-D-1003512-E003 ZBW-D-1003512-E005 ZBW-D-1003512 E006
			3	Install new feeder conductors and conduit from MCC-C area to location of future Panel EB-118C. Do not terminate.	ZBW-D-1003512-E003 ZBW-D-1003512-E005 ZBW-D-1003512 E006
		C		**Install new feeder conductors & conduit for CWP and HWP pump motors.**	
	Steps 1.C.1 - 1.C.3 may be performed in any sequence		**1**	Install new conduit and conductors from HW Pump P-2C to MCC-C. Do not terminate. Cored holes are required to complete step.	ZBW-D-1003512-E005 ZBW-D-1003512-E009
			2	Install new conduit and conductors from HW Pump P-2B to MCC-B. Do not terminate. Cored holes are required to complete step.	ZBW-D-1003512-E005 ZBW-D-1003512-E009
			3	Install new conduit for CW Pump P-1E from P.O.C. at the south wall of Room B112 to MCC-A. Do not terminate. Cored holes are required to complete step.	ZBW-D-1003512-E005 ZBW-D-1003512-E008
			4	Disconnect existing CW Pump P-1E feeder at disconnect switch for Pump P-1E.	ZBW-D-1003512-E008
			5	Install new conductors from CW pump P-1E to MCC-A. Do not terminate.	ZBW-D-1003512-E008
				Preliminary Work Complete	
2	**MCC - 1C Replacement**			**Transfer MCC-1C branch circuits to temporary panel. Remove MCC-1C. Install new Panel EB-118C. Install new MCC-C "bucket" for HWP Pump P-2C and terminate new pump feeders.**	
		A		**Isolate MCC-1C. Install new MCC-C "bucket" for HWP Pump P-2C. Install new HW Pump P-2C Feeder and Disconnect Switch. Update "bucket" for Panel EB-118C.**	

	MCC-C Outage Required		**1**	De-energize & lock-out MCC-C from Essential Bus.							FAA Action
			2	To assure there is no unforeseen impact as a result of a system being de-energized, the contractor shall wait 15 minutes before proceeding with work in any particular phase.							
			3	Disconnect MCC-1C feeder at MCC- C bucket, F1A and at MCC-1C.							ZBW-D-1003512-D004 ZBW-D-1003512-E022
			4	Cut and remove MCC-1C cable splices that pass through Essential Bus Switchgear cabinet #35.							ZBW-D-1003512-E007
			5	Upon removal of splice section, remove the existing feeders between MCC-C and the essential bus cabinet and between the essential bus cabinet and MCC-1C.							ZBW-D-1003512-D001
			6	Complete and terminate new EB-118C feeder cables and conduit at MCC-C bucket, F1A. Change fuse and settings in bucket F1A. Verify bucket F1A circuit breaker is open and locked-out.							ZBW-D-1003512-E018 ZBW-D-1003512-E023
			7	Install NEMA 1 motor starter/controller in MCC-C bucket, R1B.							ZBW-D-1003512-E023
			8	Complete & terminate new HW Pump P-2C conduit & conductors, both power and INET, at MCC-C bucket, R1B. Verify starter is opened and locked-out.							ZBW-D-1003512-E023 ZBW-D-1003512-E008
	MCC-C Restored		**9**	Re-energize MCC-C from Essential Bus.							FAA Action
			10	Disconnect existing HW Pump P-2C feeder at Pump P-2C							ZBW-D-1003512-E009
			11	Install Disconnect Switch at HW Pump P-2C.							ZBW-D-1003512-E021
			12	Complete & terminate new HW Pump P-2C conduit & conductors at Disconnect Switch. Verify Disconnect Switch is opened and locked-out.							ZBW-D-1003512-E009
			13	Energize HWP P-2C starter/controller at MCC-C. Test hookup at disconnect switch for HWP P-2C.							ZBW-D-1003512-E023
			14	Energize HWP P-2C.							
		B		**Transfer MCC-1C branch circuits to temporary panel. Install new Panel EB-118C.**							
			1	Temporary Panel Circuit Breaker Assignments for MCC-1C circuits.							
				Equipment	**OCP**	**No:**		**No:**	**OCP**	**Equipment**	
						1	**A**	**2**			
				Panel DPC	**150 A**	**3**	**B**	**4**	**100 A**	**Panel AHU-C**	
						5	**C**	**6**			
						7	**A**	**8**			

				Xfmr BC-1C	**40 A**	**9**	**B**	**10**	**100 A**	**Panel Z-3**	
						11	**C**	**12**			
						13	**A**	**14**			
				5	**100 A**	**15**	**B**	**16**	**20 A**	**Boiler B-1C**	
						17	**C**	**18**			
						19	**A**	**20**		**Blank**	
				7	**40 A**	**21**	**B**	**22**		**Blank**	
						23	**C**	**24**		**Blank**	
				Blank		**25**	**A**	**26**		**Blank**	
				Blank		**27**	**B**	**28**		**Blank**	
				Blank		**29**	**C**	**30**		**Blank**	
	Steps 2.B.2 - 2.B.6 may be performed in any sequence		**2**	Transfer Panel DPC feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E013 ZBW-D-1003512-G007
			3	Transfer Panel AHU-C feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E017 ZBW-D-1003512-G007
			4	Transfer Transformer BC-1C feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E012 ZBW-D-1003512-E019 ZBW-D-1003512-G007
			5	Transfer Panel Z-3 feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E016 ZBW-D-1003512-G007
			6	Disconnect Boiler B-1C feeder circuit at MCC-1C. Do not transfer to Temporary Panel. (If connection is required, circuit breakers 14, 16, 18 are assigned to Boiler B-1C.)							ZBW-D-1003512-E015 ZBW-D-1003512-G007
			7	Energize Temporary Panel from Essential Bus.							FAA Action
			8	Remove MCC-1C. Install new Panel EB-118C.							ZBW-D-1003512-D004 ZBW-D-1003512-E018
		C		**Transfer branch circuits from Temporary Panel to Panel EB-118C**							
			1	Complete and terminate new Panel EB-118C feeder at Panel EB-118C.							ZBW-D-1003512-E006
			2	De- Energize Temporary Panel at Essential Bus.							ZBW-D-1003512-E002
			3	Circuit Breaker Assignments for Panel EB-118C circuits.							
				Equipment	**OCP**	**No:**		**No:**	**OCP**	**Equipment**	
						1	**A**	**2**			

				Panel DPC	**150 A**	**3**	**B**	**4**	**100 A**	**Panel AHU-C**	
						5	**C**	**6**			
						7	**A**	**8**			
				Boiler B-1C	**20 A**	**9**	**B**	**10**	**100 A**	**Panel Z-3**	
						11	**C**	**12**			
						13	**A**	**14**			
				Panel PP-MOV	**100 A**	**15**	**B**	**16**	**40 A**	**Xfmr BC-1C**	
						17	**C**	**18**			
				Blank		**19**	**A**	**20**		**Blank**	
				Blank		**21**	**B**	**22**		**Blank**	
				Blank		**23**	**C**	**24**		**Blank**	
				Blank		**25**	**A**	**26**		**Blank**	
				Blank		**27**	**B**	**28**		**Blank**	
				Blank		**29**	**C**	**30**		**Blank**	
	Steps 2.C.4 - 2.C.9 may be performed in any sequence		**4**	Re-terminate Panel PP-MOV feeder at Panel EB-118C.							ZBW-D-1003512-E011 ZBW-D-1003512-E025
			5	Re-terminate Panel AHU-C feeder at Panel EB-118C.							ZBW-D-1003512-E017 ZBW-D-1003512-E025
			6	Re-terminate Transformer BC-1C feeder at Panel EB-118C.							ZBW-D-1003512-E012 ZBW-D-1003512-E025
			7	Re-terminate Panel Z-3 feeder at Panel EB-118C.							ZBW-D-1003512-E016 ZBW-D-1003512-E025
			8	Re-terminate Boiler B-1C feeder at Panel EB-118C.							ZBW-D-1003512-E015 ZBW-D-1003512-E025
			9	Re-terminate Panel DPC feeder cables at Panel EB-118C.							ZBW-D-1003512-E013 ZBW-D-1003512-E025
		D		**Energize Panel EB118C**							
			1	Energize Panel EB-118C from MCC-C bucket, F1A.							FAA Action
				MCC-1C Replacement Complete.							
3	**MCC - 1B Replacement**			**Transfer MCC-1B branch circuits to temporary panel. Remove MCC-1B. Install new Panel EB-118B. Install new MCC-B "bucket" for HWP Pump P-2B and terminate new pump feeders.**							

		A		**Isolate MCC-1B. Install new MCC-B "bucket" for HWP Pump P-2B. Install new HW Pump P-2B Feeder and Disconnect Switch. Update "bucket" for Panel EB-118B.**	
			1	Switch Panels GLB, PP-GB, EPP-2 and PP-MOV to their respective alternate sources.	ZBW-D-1003512-G004
	MCC-B Outage Required		**2**	De-energize & lock-out MCC-B from Essential Bus.	FAA Action
			3	To assure there is no unforeseen impact as a result of a system being de-energized, the contractor shall wait 15 minutes before proceeding with work in any particular phase.	
			4	Disconnect MCC-1B feeder at MCC- B bucket, F1A and at MCC-1B.	ZBW-D-1003512-D004 ZBW-D-1003512-E022
			5	Cut and remove MCC-1B cable splices that pass through Essential Bus Switchgear cabinet #34.	ZBW-D-1003512-E007
			6	Upon removal of splice section, remove the existing feeders between MCC-B and the essential bus cabinet and between the essential bus cabinet and MCC-1B.	ZBW-D-1003512-D001
			7	Complete and terminate new EB118B feeder cables and conduit at MCC-B bucket, F1A. Change fuse and settings in bucket F1A. Verify bucket F1A circuit breaker is open and locked-out.	ZBW-D-1003512-E018 ZBW-D-1003512-E023
			8	Install NEMA 1 motor starter/controller in MCC-B bucket, R1B.	ZBW-D-1003512-E023
			9	Complete & terminate new HW Pump P-2B conduit & conductors, both power and INET, at MCC-B bucket, R1B. Verify starter is opened and locked-out.	ZBW-D-1003512-E023 ZBW-D-1003512-E008
	MCC-B Restored		**10**	Re-energize MCC-B from Essential Bus.	FAA Action
			11	Disconnect existing HW Pump P-2B feeder at Pump P-2B	ZBW-D-1003512-E009
			12	Install Disconnect Switch at HW Pump P-2B.	ZBW-D-1003512-E021
			13	Complete & terminate new HW Pump P-2B conduit & conductors at Disconnect Switch. Verify Disconnect Switch is opened and locked-out.	ZBW-D-1003512-E009
			14	Energize HWP P-2B starter/controller at MCC-B. Test hookup at disconnect switch for HWP P-2B.	ZBW-D-1003512-E023
			15	Energize HWP P-2B.	
		B		**Transfer MCC-1B branch circuits to temporary panel. Install new Panel EB-118B.**	
			1	Temporary Panel Circuit Breaker Assignments for MCC-1B circuits.	

				Equipment	**OCP**	**No:**		**No:**	**OCP**	**Equipment**	

						1	**A**	**2**			
				Panel DPB	**150 A**	**3**	**B**	**4**	**100 A**	**Panel AHU-B**	
						5	**C**	**6**			
						7	**A**	**8**			
				Xfmr BC	**40 A**	**9**	**B**	**10**	**100 A**	**Panel Z-2**	
						11	**C**	**12**			
						13	**A**	**14**			
				5	**100 A**	**15**	**B**	**16**	**20 A**	**6**	
						17	**C**	**18**			
						19	**A**	**20**		**Blank**	
				7	**40 A**	**21**	**B**	**22**		**Blank**	
						23	**C**	**24**		**Blank**	
				Blank		**25**	**A**	**26**		**Blank**	
				Blank		**27**	**B**	**28**		**Blank**	
				Blank		**29**	**C**	**30**		**Blank**	
	Steps 3.B.2 - 3.B.5 may be performed in any sequence		**2**	Transfer Panel AHU-B feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E017 ZBW-D-1003512-G009
			3	Transfer Transformer BC feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E012 ZBW-D-1003512-E019 ZBW-D-1003512-G009
			4	Transfer Panel Z-2 feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E016 ZBW-D-1003512-G009
			5	Transfer Panel DPB feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E013 ZBW-D-1003512-G009
			6	Energize Temporary Panel from Essential Bus.							FAA Action
			7	Remove MCC-1B. Install new Panel EB-118B.							ZBW-D-1003512-D004 ZBW-D-1003512-E018
		C		**Transfer branch circuits from Temporary Panel to Panel EB-118B**							
			1	Complete and terminate new Panel EB118B feeder at Panel EB-118B.							ZBW-D-1003512-E006
			2	De- Energize Temporary Panel at Essential Bus.							ZBW-D-1003512-E002
			3	Circuit Breaker Assignments for Panel EB-118B circuits.							
				Equipment	**OCP**	**No:**		**No:**	**OCP**	**Equipment**	

						1	**A**	**2**			
				Panel DPB	**150 A**	**3**	**B**	**4**	**100 A**	**Panel AHU-B**	
						5	**C**	**6**			
						7	**A**	**8**			
				Panel PP-MOV	**100 A**	**9**	**B**	**10**	**100 A**	**Panel Z-2**	
						11	**C**	**12**			
				Blank		**13**	**A**	**14**			
				Blank		**15**	**B**	**16**	**40 A**	**Xfmr BC**	
				Blank		**17**	**C**	**18**			
				Blank		**19**	**A**	**20**		**Blank**	
				Blank		**21**	**B**	**22**		**Blank**	
				Blank		**23**	**C**	**24**		**Blank**	
				Blank		**25**	**A**	**26**		**Blank**	
				Blank		**27**	**B**	**28**		**Blank**	
				Blank		**29**	**C**	**30**		**Blank**	
	Steps 3.C.4 - 3.C.7 may be performed in any sequence		**4**	Re-terminate Panel PP-MOV feeder at Panel EB-118B.							ZBW-D-1003512-E011 ZBW-D-1003512-E025
			5	Re-terminate Panel AHU-B feeder at Panel EB-118B.							ZBW-D-1003512-E017 ZBW-D-1003512-E025
			6	Re-terminate Transformer BC feeder at Panel EB-118B.							ZBW-D-1003512-E012 ZBW-D-1003512-E025
			7	Re-terminate Panel Z-2 feeder at Panel EB-118B.							ZBW-D-1003512-E016 ZBW-D-1003512-E025
			8	Re-terminate Panel DPB feeder at Panel EB-118B.							ZBW-D-1003512-E013 ZBW-D-1003512-E025
		D		**Energize Panel EB-118B**							
			1	Energize Panel EB-118B at MCC-B bucket, F1A.							FAA Action
				MCC-1B Replacement Complete.							
4	**MCC - 1A Replacement**			**Transfer MCC-1A branch circuits to temporary panel. Remove MCC-1A. Install new Panel EB-118A. Install new MCC-A "bucket" for CWP Pump P-1E and terminate new pump feeders.**							

		A		**Isolate MCC-1A. Install new MCC-A "bucket" for CWP Pump P-1E. Install new CW Pump P-1E Feeder. Update "bucket" for Panel EB-118A.**	
			1	Switch Panels GLB and EPP-1 to their respective alternate sources.	ZBW-D-1003512-G004
	MCC-A Outage Required		**2**	De-energize & lock-out MCC-A from Essential Bus.	FAA Action
			3	To assure there is no unforeseen impact as a result of a system being de-energized, the contractor shall wait 15 minutes before proceeding with work in any particular phase.	
			4	Disconnect MCC-1A feeder at MCC- A bucket, F1A and at MCC-1A.	ZBW-D-1003512-D004 ZBW-D-1003512-E022
			5	Cut and remove MCC-1A cable splices that pass through Essential Bus Switchgear cabinet #33.	ZBW-D-1003512-E007
			6	Upon removal of splice section, remove the existing feeders between MCC-A and the essential bus cabinet and between the essential bus cabinet and MCC-1A.	ZBW-D-1003512-D001
			7	Complete and terminate new EB118A feeder cables and conduit at MCC-A bucket, F1A. Change fuse and settings in bucket F1A. Verify bucket F1A circuit breaker is open and locked-out.	ZBW-D-1003512-E018 ZBW-D-1003512-E023
			8	Install NEMA 3 motor starter/controller in MCC-A bucket, R1D.	ZBW-D-1003512-E023
			9	Complete & terminate new CW Pump P-1E conduit & conductors, both power and INET, at MCC-A bucket, R1D. Verify starter is opened and locked-out.	ZBW-D-1003512-E023 ZBW-D-1003512-E008
	MCC-A Restored		**10**	Re-energize MCC-A from Essential Bus.	FAA Action
			11	Complete & terminate new CW Pump P-1E conductors at Disconnect Switch. Verify Disconnect Switch is opened and locked-out.	ZBW-D-1003512-E008
			12	Energize CWP P-1E starter/controller at MCC-A. Test hookup at disconnect switch for CWP P-1E.	ZBW-D-1003512-E023
			13	Energize CWP P-1E.	
		B		**Transfer MCC-1A branch circuits to temporary panel. Install new Panel EB-118A.**	
			1	Temporary Panel Circuit Breaker Assignments for MCC-1A circuits.	

				Equipment	**OCP**	**No:**		**No:**	**OCP**	**Equipment**	
						1	**A**	**2**			
				Panel DPA	**150 A**	**3**	**B**	**4**	**100 A**	**Panel AHU-A**	
						5	**C**	**6**			

						7	**A**	**8**			
				Xfmr BC-1A	**40 A**	**9**	**B**	**10**	**100 A**	**Panel Z-1**	
						11	**C**	**12**			
						13	**A**	**14**			
				5	**100 A**	**15**	**B**	**16**	**20 A**	**Boiler B-1A**	
						17	**C**	**18**			
						19	**A**	**20**		**Blank**	
				Xfmr BC-1	**40 A**	**21**	**B**	**22**		**Blank**	
						23	**C**	**24**		**Blank**	
				Blank		**25**	**A**	**26**		**Blank**	
				Blank		**27**	**B**	**28**		**Blank**	
				Blank		**29**	**C**	**30**		**Blank**	
	Steps 4.B.2 - 4.B.7 may be performed in any sequence		**2**	Transfer Panel AHU-A feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E017 ZBW-D-1003512-G011
			3	Transfer Transformer BC-1A feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E012 ZBW-D-1003512-E019 ZBW-D-1003512-G011
			4	Transfer Panel Z-1 feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E016 ZBW-D-1003512-G011
			5	Disconnect Boiler B-1A feeder circuit at MCC-1A. Do not transfer to Temporary Panel. (If connection is required, circuit breakers 14, 16, 18 are assigned to Boiler B-1A.)							ZBW-D-1003512-E015 ZBW-D-1003512-G011
			6	Transfer Transformer BC-1 feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E012 ZBW-D-1003512-E019 ZBW-D-1003512-G011
			7	Transfer Panel DPA feeder circuit to Temporary Panel using splice boxes and splice conductors as required.							ZBW-D-1003512-E013 ZBW-D-1003512-G011
			8	Energize Temporary Panel from Essential Bus.							FAA Action
			9	Remove MCC-1A. Install new Panel EB-118A.							ZBW-D-1003512-D004 ZBW-D-1003512-E018
		C		**Transfer branch circuits from Temporary Panel to Panel EB-118A**							
			1	Complete and terminate new Panel EB-118A feeder at Panel EB-118A.							ZBW-D-1003512-E006
			2	De- Energize Temporary Panel at Essential Bus.							ZBW-D-1003512-E002
			3	Circuit Breaker Assignments for Panel EB-118A circuits.							

				Equipment	OCP	No:		No:	OCP	Equipment	
						1	A	2			
				Panel DPA	150 A	3	B	4	100 A	Panel AHU-A	
						5	C	6			
						7	A	8			
				Boiler B-1A	20 A	9	B	10	100 A	Panel Z-1	
						11	C	12			
						13	A	14			
				Xfmr BC-1	40 A	15	B	16	40 A	Xfmr BC-1A	
						17	C	18			
				Blank		19	A	20		Blank	
				Blank		21	B	22		Blank	
				Blank		23	C	24		Blank	
				Blank		25	A	26		Blank	
				Blank		27	B	28		Blank	
				Blank		29	C	30		Blank	
	Steps 4.C.4 - 4.C.8 may be performed in any sequence		**4**	Re-terminate Panel AHU-A feeder at Panel EB-118A.							ZBW-D-1003512-E017 ZBW-D-1003512-E025
			5	Re-terminate Transformer BC-1A feeder at Panel EB-118A.							ZBW-D-1003512-E012 ZBW-D-1003512-E025
			6	Re-terminate Panel Z-1 feeder at Panel EB-118A.							ZBW-D-1003512-E016 ZBW-D-1003512-E025
			7	Re-terminate Boiler B-1A feeder at Panel EB-118A.							ZBW-D-1003512-E015 ZBW-D-1003512-E025
			8	Re-terminate Transformer BC-1 feeder at Panel EB-118A.							ZBW-D-1003512-E012 ZBW-D-1003512-E025
			9	Re-terminate Panel DPA feeder at Panel EB-118A.							ZBW-D-1003512-E013 ZBW-D-1003512-E025
		D		**Energize Panel EB-118A**							
			1	Energize Panel EB-118A at MCC-A bucket, F1A.							FAA Action
				MCC-1A Replacement Complete.							

5	**Miscellaneous Work**			**Panels DPA, DPB & DPC Feeder Replacements and HW Pump P-2A Disconnect Switch Installation. Install INET cables from DDCP panels to INET junction box in room B113.**	
	Steps 5.A - 5.D may be performed in any sequence	**A**		**Panel DPC Feeder Replacement**	
			1	Open and lock-out Panel DPC feeder circuit breaker at Panel EB-118C (or MCC-1C).	ZBW-D-1003512-E013
			2	Open and lock-out Panel DPA feeder circuit breaker at Panel EB-118A (or MCC-1A).	ZBW-D-1003512-E013
			3	To assure there is no unforeseen impact as a result of a system being de-energized, the contractor shall wait 15 minutes before proceeding with work in any particular phase.	
			4	Disconnect Panel DPC feeder at Panel DPC.	ZBW-D-1003512-E014
			5	Install appropriately-sized "jumper" conductor between Panels DPA and DPC. Terminate jumper at 100 A. spare circuit breaker in Panel DPA and at Panel DPC main lugs.	ZBW-D-1003512-E014
			6	Re-energize Panel DPA at Panel EB-118A (or MCC-1A).	
			7	De-energize & lock-out Panel EB-118C (or MCC-1C) at MCC-C bucket, F1A.	ZBW-D-1003512-E022 ZBW-D-1003512-E023
			8	Disconnect Panel DPC feeder at Panel EB-118C (or MCC-1C).	ZBW-D-1003512-E013
			9	Remove existing Panel DPC feeder.	ZBW-D-1003512-E013 ZBW-D-1003512-E014 ZBW-D-1003512-E020
			10	Pull-in/install new Panel DPC feeder.	ZBW-D-1003512-E013 ZBW-D-1003512-E014 ZBW-D-1003512-E020
			11	Terminate new Panel DPC feeder at Panel EB-118C (or MCC-1C).	ZBW-D-1003512-E013
			12	Verify new Panel DPC feeder circuit breaker is open and locked-out at Panel EB-118C (or MCC-1C).	ZBW-D-1003512-E013
			13	Re-energize Panel EB-118C (or MCC-1C) at MCC-C bucket, F1A.	ZBW-D-1003512-E022 ZBW-D-1003512-E023
			14	Open and lock-out Panel DPA feeder circuit breaker at Panel EB-118A (or MCC-1A).	
			15	Disconnect and remove jumper between Panels DPA and DPC.	ZBW-D-1003512-E014
			16	Terminate new Panel DPC feeder at Panel DPC.	ZBW-D-1003512-E013
			17	Re-energize Panel DPC at EB-118C (or MCC-1C).	

			18	Re-energize Panel DPA at Panel EB-118A (or MCC-1A).	
				Panel DPC Feeder Replacement Complete.	
		B		**Panel DPB Feeder Replacement**	
			1	Open and lock-out Panel DPB feeder circuit breaker at Panel EB-118B (or MCC-1B).	ZBW-D-1003512-E013
			2	Open and lock-out Panel DPA feeder circuit breaker at Panel EB-118A (or MCC-1A).	ZBW-D-1003512-E013
			3	To assure there is no unforeseen impact as a result of a system being de-energized, the contractor shall wait 15 minutes before proceeding with work in any particular phase.	
			4	Disconnect Panel DPB feeder at Panel DPB.	ZBW-D-1003512-E014
			5	Install appropriately-sized "jumper" conductor between Panels DPA and DPB. Terminate jumper at 100 A. spare circuit breaker in Panel DPA and at Panel DPB main lugs.	ZBW-D-1003512-E014
			6	Re-energize Panel DPA at Panel EB-118A (or MCC-1A).	
			7	De-energize & lock-out Panel EB-118B (or MCC-1B) at MCC-B bucket, F1A.	ZBW-D-1003512-E022 ZBW-D-1003512-E023
			8	Disconnect Panel DPB feeder at Panel EB-118B (or MCC-1B).	ZBW-D-1003512-E013
			9	Remove existing Panel DPB feeder.	ZBW-D-1003512-E013 ZBW-D-1003512-E014 ZBW-D-1003512-E020
			10	Pull-in/install new Panel DPB feeder.	ZBW-D-1003512-E013 ZBW-D-1003512-E014 ZBW-D-1003512-E020
			11	Terminate new Panel DPB feeder at Panel EB-118B (or MCC-1B).	ZBW-D-1003512-E013
			12	Verify new Panel DPB feeder circuit breaker is open and locked-out at Panel EB-118B (or MCC-1B).	ZBW-D-1003512-E013
			13	Re-energize Panel EB-118B (or MCC-1B) at MCC-B bucket, F1A.	ZBW-D-1003512-E022 ZBW-D-1003512-E023
			14	Open and lock-out Panel DPA feeder circuit breaker at Panel EB-118A (or MCC-1A).	
			15	Disconnect and remove jumper between Panels DPA and DPB.	ZBW-D-1003512-E014
			16	Disconnect Panel DPA feeder at Panel DPA.	

			18	Remove spare 100 A. circuit breaker from Panel DPA and re-install in Panel DPB.	
			19	Terminate new Panel DPB feeder at Panel DPB.	ZBW-D-1003512-E013
			20	Re-energize Panel DPB at EB-118B (or MCC-1B).	
			21	Re-energize Panel DPA at Panel EB-118A (or MCC-1A).	
				Panel DPB Feeder Replacement Complete.	
		C		**Panel DPA Feeder Replacement**	
			1	Open and lock-out Panel DPA feeder circuit breaker at Panel EB-118A (or MCC-1A).	ZBW-D-1003512-E013
			2	Open and lock-out Panel DPB feeder circuit breaker at Panel EB-118B (or MCC-1B).	ZBW-D-1003512-E013
			3	To assure there is no unforeseen impact as a result of a system being de-energized, the contractor shall wait 15 minutes before proceeding with work in any particular phase.	
			4	Disconnect Panel DPA feeder at Panel DPA.	ZBW-D-1003512-E014
			5	Install jumper conductor between Panels DPA and DPB. Terminate jumper at 100 A. spare circuit breaker in Panel DPB and at Panel DPA main lugs.	ZBW-D-1003512-E014
			6	Re-energize Panel DPB at Panel E-118B (or MCC-1B).	
			7	De-energize & lock-out Panel EB-118A (or MCC-1A) at MCC-A bucket, F1A.	ZBW-D-1003512-E022 ZBW-D-1003512-E023
			8	Disconnect Panel DPA feeder at Panel EB-118A (or MCC-1A).	ZBW-D-1003512-E013
			9	Remove existing Panel DPA feeder.	ZBW-D-1003512-E013 ZBW-D-1003512-E014 ZBW-D-1003512-E020
			10	Pull-in/install new Panel DPA feeder.	ZBW-D-1003512-E013 ZBW-D-1003512-E014 ZBW-D-1003512-E020
			11	Terminate new Panel DPA feeder at Panel EB-118A (or MCC-1A).	ZBW-D-1003512-E013
			12	Verify new Panel DPA feeder circuit breaker is open and locked-out at Panel EB-118A (or MCC-1A).	ZBW-D-1003512-E013
			13	De-energize Panel EB-118B (or MCC-1B) at MCC-1B bucket, F1A.	ZBW-D-1003512-E022 ZBW-D-1003512-E023

			14	Disconnect and remove jumper between Panels DPA and DPC.	
			15	Terminate new Panel DPA feeder at Panel DPA.	ZBW-D-1003512-E014
			16	Re-energize Panel DPA at EB-118A (or MCC-1A).	
			17	Re-energize Panel DPB at EB-118B (or MCC-1B).	
				Panel DPA Feeder Replacement Complete.	
		D		**Install HW Pump P-2A Disconnect Switch**	
			1	De-energize HW Pump P-2A at MCC-1D.	
			2	Install Disconnect Switch at HW Pump P-2A.	ZBW-D-1003512-E021
			3	Complete & terminate new HW Pump P-2A conduit & conductors at Disconnect Switch. Verify Disconnect Switch is opened and locked-out.	ZBW-D-1003512-E003
			4	Energize HW Pump P-2A starter/controller at MCC-1D. Test hookup at disconnect switch for HW Pump P-2A.	ZBW-D-1003512-E003
			5	Energize HW Pump P-2A.	
				HW Pump P-2A Disconnect Switch Installation Complete.	
		E		**Install INET cable**	
			1	Install junction box above panels DDCP-1 and DDCP-2.	ZBW-D-1003512-E008
			2	Install junction box between MCC-A and MCC-B in room B113.	ZBW-D-1003512-E008
			3	Install conduit from junction box above panels DDCP-1 and DDCP-2.and square duct above DDCP-4 thru DDCP-9 to the junction box between MCC-A and MCC-B in room B113.	ZBW-D-1003512-E008
			4	Install conduit from junction box above panels DDCP-1 and DDCP-2.and square duct above DDCP-4 thru DDCP-9 to the junction box between MCC-A and MCC-B in room B113.	ZBW-D-1003512-E008
				INET Cable Installation Complete.	

.

*** END OF SECTION 01000 ***

SECTION 01030 SITE ACCESS, CONSTRUCTION LIMITS, USE OF FACILITIES

PART 1 – GENERAL

1.1 SUMMARY

A. Existing facility operations. - Construction/demolition shall in no way interfere with Air Traffic Control Operations. The ARTCC is a 24 hour, seven day a week facility. Extreme care shall be exercised so as not to cause any interference or interruption of service from this facility. Controller functions are vital to the safety of the flying public. It is absolutely mandatory that the contractor protects FAA personnel and existing FAA communication, electrical and mechanical equipment both inside and outside buildings from damage caused by impact, water, debris, dust or odor. The contractor shall have the overall responsibility for the performance and enforcement of all forms of protection within the ARTCC premises against any damages due to work performed under this contract. Any damages incurred, as a result of construction activity during the performance of this contract will be repaired/replaced immediately by the contractor at no cost to the FAA.

Any work or activity that may impact the National Airspace System (NAS), such as work on critical equipment or circuits, will require coordination with the Contractor Office Representative (COR). The COR will prepare and submit a work or activity specific "Risk Assessment" for the facility's review and approval. This process may take one week to complete. Typically, this type of work or activity is performed from midnight to 05:00 am and/or on weekends.

B. Construction limits and access. -

1. Construction limits.- The contractor shall confine operations, activities, storage of materials and employee parking within the designated areas, as indicated on the construction staging plan, or as designated by the COTR. Additional space the contractor deems necessary shall be obtained off site, at no additional cost to the Government.

2. Access. - Access route for the contractor, subcontractors, employees, deliveries, etc., shall be through the facility main gate. Access to all, parking areas, and loading dock shall be kept unobstructed. If temporary access obstruction is unavoidable, the contractor shall advise the COR immediately. Vehicles transporting materials shall not be loaded beyond the capacity prescribed by federal, state, or local laws. Obstruction of existing roadways, driveways, to the ARTCC is strictly prohibited.

3. Damage to site. - Damage to existing paving, lawns, curbs, sidewalks, and utilities caused by the contractor's activities shall be repaired immediately. Any damage to the building, interior or exterior, that are a result of the contractor's activities shall be repaired. All costs of repairs shall be paid by the contractor. After notice to proceed and prior to the commencement of construction, the contractor and COR shall conduct joint inspections of the existing areas affected by the construction. Existing damage or defects shall be noted and will be used as the basis for determination of damages caused by the contractor's operations.

C. Inspection of site by contractor. - It is strongly urged that the contractor carefully examine the premises to determine the extent of work and the conditions under which it must be done.

D. Government use and access to premises. - The Government reserves the right to enter the construction area at any time for work inspection and for the Operation and Maintenance Activities.

E Security requirements.

1. Personnel List. - Contractor shall provide the COR with a list of contractor personnel who require access to the ARTCC. The list shall be submitted immediately after contract award. The list shall be kept current during the project and shall include the following:

   Full name, including middle initial
   Federal or State issued photo ID
   Date of Birth
   Place of Birth

2. Vehicle identification. - Vehicle identification tags will be issued for contractor's and contractor's employees' vehicles that require access into the ARTCC site. The identification tags shall be displayed in the windshield of the vehicle at all times when the vehicle is on the site. The contractor shall be responsible for the collection and return of all vehicle tags which are no longer required.

3. Escort requirement. - Contractor is responsible to provide an escort for his employees. This will required a security background investigation by the FAA. Contractor's personnel shall not violate any security regulations pertaining to the ARTCC facility. Violators may be removed from the premises with the right to reenter revocable. Contractor's day-to-day work schedules in the classified areas shall be so arranged to allow for minimum escort.

4. Right to search. - Current procedures at FAA facilities include the "right to search." If in the judgment of the FAA a cause to search a vehicle or a person exists, such search will be made.

5. Replacement of lost identification. - The FAA will provide personnel badges and vehicle identification tags as described above. It is the contractor's responsibility to return these badges and tags daily and upon completion of the project. The contractor shall be liable to pay for any FAA badge or tag not returned or replaced at the completion of the work

6. Physical Security. - At the end of each work day, the contractor shall secure all construction areas by closing and locking all doors and gates. The contractor is responsible for the security of the staging area, and shall provide the required measures at no additional expense to the government.

END OF SECTION 01030

* * * * *

SECTION 01042 CONSTRUCTION SCHEDULES

PART 1 – GENERAL

1.1 SUMMARY

1.1.1. Description: The work plan and schedule prepared by the contractor shall consist of a cost loaded Gantt styled Bar chart or Pert chart(s) following Critical Path Methodology accompanied by a logical narrative plan. The charts shall show all significant activities and shall include detailed activities when critical work is to be performed and clearly identify the critical path on the schedule. The Chart shall clearly indicate the major work efforts, including necessary material and equipment fabrications and deliveries. The schedule shall be submitted with sufficient detail to adequately determine performance within the allotted contract performance time. No single activity shall be longer than 30 days in duration, with increments on a daily basis. All off-hour (nights, weekends, etc.) activities shall have a unique symbol associated with them to allow them to be distinguished from normal working hours. Contractor training for FAA personnel shall be shown on the schedule as a stand alone activity. The activities shall be sequentially numbered so as not to confuse the same activity repeated for a different MCC. Interdependencies between critical work efforts shall be depicted on the Chart. In addition, allowances in the work schedule shall be made for shop drawing submittal, review, and approval process as well as moratoriums. In the event of failure of the Contractor to comply with the requirements stated herein for the construction schedule, the Contracting Officer may withhold approval of progress payment estimates until such time as the Contractor submits the required revised schedule.

1.2 PRODUCTS

A. Diagrams -

1. Show the logical order of the activities. Schedule logic requires that all Activities and Milestones, excluding start and finish, shall have a predecessor and a successor at a minimum

2. Include construction activities, the submittal and approval of materials, samples and shop drawings, the procurement of critical materials and equipment, fabrication of special materials and equipment along with their installation and testing, and costs associated with each activity in the bar chart. All Activities' are to be cost loaded with the total cost equal to the contract award amount.

B. Progress Schedules. - Within 30 calendar days of contract award, the contractor shall submit the schedule and work plan. **A Notice to Proceed will not be issued nor any work started until the schedule is approved.**

1.3 EXECUTION

A. Review and Evaluation. - The Contractor shall participate in a review and evaluation of the proposed schedule with the Contracting Officer and Contracting Officers Technical Representative, (COTR). Any revisions necessary as a result of the review shall be re-submitted for approval of the Contracting Officer within 14 days after the conference. The approved schedule shall then be used by the contractor for planning, organizing, and directing work, reporting progress, and requesting payment for work accomplished. If the contractor, thereafter, desires to make changes in the schedule, the Contracting Officer and COTR shall be notified in writing, stating the reasons for the change. If the Government considers the change to be of a major nature, the contractor may be required to revise the schedule and submit it for approval, without additional cost to the government.

B. Monthly Update. - The contractor shall meet with the COTR at monthly intervals to discuss the construction progress. If the project is behind schedule and requires a change in the schedule, the contractor shall submit a revised schedule with a description of the delaying factors and their impact, and an explanation of corrective actions taken or proposed.

C. Payment. - The monthly update shall show the activities completed during the reporting period, and their total value will be the basis for the contractor's periodic request for payment. Payment will be based on the total value of such activities complafter only after verification by the COTR.

D. Submission Requirements. - Schedule charts shall be on (minimum) 11" x 17" size paper. Update charts shall show the date of the latest revision. Schedule charts with revisions and monthly updates shall be submitted in three copies.

E. Requirements for Schedule Chart. -

1. Activities.- The significant activities to be included in the schedule chart shall include, but not be limited to:

   a. The milestones listed in Section 01010, paragraph 1.2 D.
   b. Any system shutdowns or cut-overs
   c. Any other significant activities the contractor or FAA feels necessary.

2. Format - Contractor submittal shall be hard copy Microsoft Project. E-Copy is only acceptable in the 2005 file format.

F. Shutdown and Cut Over.

1. Mechanical Systems. - All shutdowns when permitted and cut overs of computer air handling units shall be coordinated with the COTR. Only one air handling unit shall be off and unavailable at any given time. Equipment shutdown and lock-out shall be accomplished by FAA personnel.

2. Electrical Systems. - New construction shall have no impact on the essential electrical service at this facility. However, all electrical connections within live power panels will be scheduled with the COTR at least 14 days in advance. All electrical connections to existing panels shall be coordinated with FAA personnel. Equipment shutdown and lock-out shall be accomplished by FAA personnel. “Hot Work” is not allowed unless mandated through circumstances.

3. Startup - Initial startup testing and training will be completed by the contractor.

G. Acceptance and Warranties.

1. The Contractor shall warranty material and equipment furnished by the various manufacturers in writing for period of two (2) years (or not less than the industry standard for the material specified, nor the manufacturer’s standard warranty period, whichever is greater) on building systems finishes or equipment from the date of final project acceptance by the FAA.

H. New utility work. - Interface all existing utility work with new work as indicated in the plans and specifications.

END OF SECTION 01042

* * * * *

SECTION 01100 - GENERAL REQUIREMENTS

1.1 General

A. Project Location:

Boston Air Route Traffic Control Center (ARTCC)
35 Northeastern Blvd.
Nashua, NH 03062

B. Scope of Work: These specifications, together with the referenced specifications, standards, and drawings specified in the Contract Documents, cover the requirements of the Federal Aviation Administration (FAA) for all work associated with the Construction of the Motor Control Center Replacement. This project includes the replacement of 4 Motor Control Centers (MCC-1A, MCC-1B, MCC-1C, and MCC-1C1) with three (3) power distribution panelboards.

C. Intent of Specifications: All material, labor and equipment required to perform the work shall be furnished by the Contractor. All work performed and all materials and equipment used shall be approved by the Contracting Officer Representative (COR). This shall include, but not be limited to, testing, inspection, scheduling, reporting, and submittals.

D. Titles: Titles to divisions and sections of the specifications and notes and titles on drawings referring to subcontractors, division of work by trade, or by type of work, are introduced merely for convenience in reading the specifications and drawings and do not imply any separate contractual arrangements of work assignments. Such separations into titled divisions and sections shall not operate to make the Government an arbiter to establish subcontract limits between the Contractor and subcontractors or between the subcontractors themselves.

E. Contract Documents: The drawings for the Electrical work form a part of the construction requirements for this project.

F. The renovation of this facility shall be in accordance with the lines and grades shown on the drawings. The Contractor shall not use dimensions scaled from drawings. All dimensions shown on the drawings shall be verified by the Contractor by actual measurements in the field.

G. Precedence of Contract Documents: If any discrepancies between the contract provisions, the specifications, and the contract drawings appear, refer to contract clause portion of Contract Documents.

H. Known Acceptable Sources: The use of the term "Known Acceptable Sources" and "Brand Name or Equal" in referencing a specific product or manufacturer is not intended to indicate a preference for the products mentioned, but indicates the quality and characteristics of products that will meet the Government's requirements. Should the contractor decide to use a product other than that identified as a "Known Acceptable Source" or "Brand Name or Equal", the Contractor shall provide a submittal for this

product. This does not relieve the Contractor from providing submittals for products or materials required in other sections of this specification.

I. Supports and Bracing: All work, during all phases of construction shall be braced for Seismic Group B, Category II forces per the latest International Building Code (IBC).

1.2 Construction Limits and Access

A. The Contractor shall confine operations, activities, storage of materials, and employee parking as indicated on the drawings. Any deviation from the drawings shall be coordinated with the (COR). Additional space the Contractor deems necessary shall be obtained off site at no additional cost to the government.

B. Access route for the Contractor, Subcontractors, employees, deliveries, etc., shall be as indicated on the project drawings. Access to the construction site, parking areas and FAA loading dock area shall be kept unobstructed. Vehicles transporting materials shall not be loaded beyond the capacity prescribed by federal, state or local law. Obstruction of existing roadways, driveways, etc., to the ARTCC is strictly prohibited.

1.3 Security - Refer to the SCR and Clauses portions of Contract Documents.

1.4 Facility Protection/Precautions. Construction/demolition shall in no way interfere with Air Traffic Control Operations. The ARTCC is a 24 hour, seven day a week facility. Extreme care shall be exercised so as not to cause any interference or interruption of service from this facility. Controller functions are vital to the safety of the flying public. It is absolutely mandatory that the contractor protects FAA personnel and existing FAA communication, electrical and mechanical equipment both inside and outside buildings from damaged caused by impact, water, debris or dust. The contractor shall have the overall responsibility for the performance and enforcement of all forms of protection within the ARTCC premises against any damages due to work performed under this contract. Any damages incurred, as a result of construction activity during the performance of this contract will be repaired/replaced immediately by the contractor at no cost to the FAA.

1.5 Use of Facilities. All necessary water and power systems will be available for work within the ARTCC building for the use of the Contractor. The contractor shall verify the source of electrical power with the COR before he makes any connections. The Contractor shall be required to make any and all connections and disconnections at the completion of the project.

1.6 Project Safety: See Section 01200-1.3B & C for more details.

A. Safety Plan. The contractor shall submit to the Contracting Officer fourteen (14) days after award of contract an Accident Prevention Plan/Safety Plan/ Hazcom Plan. The plan shall be accepted by the Contracting Officer prior to start of work. The plan shall be site specific and contain as a minimum the following major elements: management commitment and employee involvement, work site analysis, hazard prevention and control, safety and health training.

B. Site Specific Activity Hazard Analysis. The contractor shall submit to the COR five (5) working days prior to start of work a Site Specific Hazard Analysis (Enclosure 1). The analysis shall identify for each phase of work the hazards for that activity and present the

procedures and safeguards necessary to reduce the risk to an acceptable level. The analysis shall include the Material Safety Data Sheets (MSDS) for materials, chemicals, solvents etc., the activity that will be performed.

C. Local exhaust ventilation shall be required to prevent migration of dust to FAA concern under consideration and submit as part of the safety requirements. See also section 01200 - OSHA Safety Requirements and Environmental Control.

D. The project work area, laydown area and other adjacent surfaces used by the contractor shall be kept in a clean, neat manner. Daily cleaning (or more if necessary) shall take place to prevent the accumulation of waste materials, rubbish, wind-blown debris, dust and odors resulting from construction operations. Contractor shall conduct cleaning and disposal operations to comply with local, state and federal codes, ordinances, regulations and anti-pollution laws. The contractor shall provide on-site containers for the collection of waste materials, debris and rubbish. FAA dumpsters/trash bins/trash cans shall not be used by the contractor.

1.7 Temporary Facilities. See drawings and specifications. No utilities are provided at the location for the temporary construction trailer or laydown area.

1.8 Project Coordination. It shall be the duty of the Contractor to prepare a detailed schedule of work and work layout to resolve conflicts and to assure coordination of the work by different trades.

A. Weekly Meeting. Coordination between the COTR and Contractor shall take place weekly at the site. Special meetings will be scheduled if requested by either the COTR or Contractor. The subjects to be discussed at the progress meetings shall include, but are not limited to, the following:

-Safety concerns/Issues
-Progress of Work
-Previous meeting action items/issues
-Field problems
-Material and Equipment delivery status
-Submittal status/schedules
-Progress planned during the upcoming week(s)
-Review of changes, and potential effects on the schedule
-Construction schedule revisions
-Schedule Revisions
-Other current business

The following persons will be expected to attend meetings; FAA COTR, Prime Contractor Superintendent, and Prime Contractor Project Manager.

B. Facility Coordination Meeting. Weekly coordination meeting shall take place between the facility managers, COTR and the Contractor's Project Superintendent.

C. The contractor shall apply, pay fees, etc., to obtain permits and inspections as required. The contractor shall perform the construction in compliance with the most current editions of the International Building code (IBC) and National Electric Code (NEC) in

addition to the specifications and drawings. If the drawings and specifications exceed code requirements, the drawings and specifications govern. If the drawings and specifications do not meet code requirements, the Contractor shall notify the COTR immediately in writing, so corrective action can be taken.

1.9 Working Hours.

A. Unless otherwise stated, work shall be performed during the hours of 10:00 PM and 6:00AM, Monday thru Friday (or as otherwise mutually agreed to at the site between the Contractor and COTR), excluding all federal holidays. Overtime, holiday and weekend work request if allowed shall be approved by the COTR. The request for approval shall be forwarded to the COTR at least 72 hours in advance.

BOSTON CENTER (Enclosure 1)

Activity Hazard Analysis

Subcontractor ____ Yes ____ No ____ N/A

Whom: _____

Activity Being Performed: _____

Proposed Dates of Work: _____ To: _____

Description of Activity: _____

_____

Location on Project: _____

MSDS on Site: ____ Yes ____ No ____ N/A

MSDS Read: ____ Yes ____ No ____ N/A

MSDS Recommendations: _____

Standard Safety Protocol: _____

_____

_____

Potential Hazards: _____

Proposed Controls Above Standard Protocols: _____

_____

_____

_____

Submitted by: _____ Print Name: _____

Reviewed by: _____ Print Name: _____

Air Traffic Representative: _____ Print Name: _____

Airway Facility Rep: _____ Print Name: _____

END OF SECTION 01100

SECTION 01300 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including the following:

1. Contractor's construction schedule (Critical); See Sections: 01042, 01300- 1.4 and 01300- 1.6.
2. Submittal schedule and Log (Critical); Section 01300- 1.5.
3. Daily construction reports.
4. Shop Drawings.
5. Product Data, including Material Safety Data Sheets (MSDS).
6. Samples.
7 Quality assurance submittals.
8. Certificates.
9. Warranty Information.
10. Operation and Maintenance Manuals.
11. Equipment Panels Disconnects (critical) Section: 16476

Note: All Critical submittals must be submitted and approved by the COTR prior to the CO issuing the NTP, the Notice to Proceed. Information to be included and required for each submittal can be found in the Submittals respective sections.

B. Administrative Submittals: Refer to other Sections of the Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:

1. Permits.
2. Applications for Payment.
3. Performance and payment bonds.
4. Insurance certificates.
5. List of subcontractors.

1.2 DEFINITIONS

A. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended.

B. Field samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.

C. Mockups are full-size assemblies for review of construction, coordination, testing, or operation; they are not Samples.

D. COTR or COR: Contracting Officer's Technical Representative.

E. RE: Resident Engineer.

F. Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships along the critical path of the project. (See G below.)

G. Network Logic Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.

H. Activity: A discrete part of a project which can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are on the critical path.
2. Predecessor activity is an activity that must be completed before a given activity can begin.

I. Event: The starting or ending point of an activity.
J. Milestone: A key or critical point in time for reference or measurement.
K. Float: The measure of leeway (time) in activity performance. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.
L. Additional Requirements:

1. The Diagram shall have no open acts or milestones.
2. The schedule shall include cost loading for each activity

1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

a. The COTR reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.

3. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for re-submittals.

    a. Allow 20 working (business, non-weekend and non-holiday) days for initial review. Allow additional time if the COTR must delay processing to permit coordination with subsequent submittals.
    b. If an intermediate submittal is necessary, process the same as the initial submittal.
    c. Allow 20 working (business, non-weekend and non-holiday) days for reprocessing each submittal.
    d. No extension of Contract Time shall be authorized because of failure to transmit submittals to the COTR sufficiently in advance of the Work to permit processing.
    e. All submittals are due 45 calendar days after contract award.

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the Contractor that prepared each submittal on the label or title block.

1. Provide a space approximately 4 by 5 inches on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
2. Include the following information on the label for processing and recording action taken.

    a. Submittal number, numbered sequentially.
    b. Project name.
    c. Date.
    d. Name and address of the Design Architect/Engineer.
    e. Name and address of the Contractor.
    f. Name and address of the subcontractor.
    g. Name and address of the supplier.
    h. Name of the manufacturer.
    i. Number and title of appropriate Specification Section.
    j. Drawing number and detail references, as appropriate.

3. Submittals that do not have Contractor’s approval stamp will be returned without processing. Affix the approval stamp to each submittal stating that is has been reviewed and includes any necessary corrections and the material contained herein is in compliance with the Construction Documents.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the COTR using a transmittal form. The COTR will not accept submittals received from sources other than the Contractor.

1. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including

variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

2. Transmittal form: Use form furnished by COTR.

1.4 CONSTRUCTION SCHEDULE – refer to Specification Section 01042

1.5 SUBMITTAL SCHEDULE

A. After development and acceptance of the Contractor's Construction Schedule, prepare a complete schedule of submittals. Submit the schedule within 10 calendar days of the date required for submittal of the Contractor's Construction Schedule.

1. Coordinate Submittal Schedule with the Contractor's Construction Schedule.
2. Prepare the schedule in chronological order. Provide the following information:

a. Scheduled date for the first submittal.
b. Related Section number.
c. Submittal category (Shop Drawings, Product Data, or Samples).
d. Name of the subcontractor.
e. Description of the part of the Work covered.
f. Scheduled date for re-submittal.
g. Scheduled date for the COTR's final release or approval.

B. Distribution: Following response to the initial submittal, print and distribute copies to the COTR, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

C. Schedule Updating: Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.6 CONSTRUCTION SCHEDULES

A. Construction Phasing Plan: Provide schedule including constraints and work restrictions indicated in the Contract Documents and as follows and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Partial occupancy before Substantial Completion.
e. Use of premises restrictions.
f. Environmental control.
g. Other information as required by COTR.

4. Milestones in the Construction Schedule:

   a. See Section 01000 – 1.2.6

B. Proposed dust and odor control measures.

C. Proposed noise-control measures.

D. Welding and Torch Cutting Plan. Prior to any welding or torch cutting activity, submit a Welding and Torch Cutting Plan for approval by the COTR. Identify the work where welding and cutting will be performed, locations of the work, types of welding and cutting being proposed, schedule for proposed welding and cutting activities and plan for protecting the facility and its occupants, operations and equipment during the welding and cutting activities.

1. Building electrical power may not be used for arc welding.
2. Building components, including structural or miscellaneous steel, may not be used as grounding return for welding activities.
3. Provide ventilation and exhaust to the outside during welding and cutting activities to keep zone clear. Do not weld or cut unless ventilation and exhaust has been deemed acceptable by the COTR or Resident Engineer.
4. Provide non-flammable shields to protect persons and properties.
5. Keep cylinders upright and chained or secured to support.
6. Remove flammable materials from welding and cutting areas prior to beginning welding and cutting activities. Keep fire extinguishers in the welding and cutting areas.
7. Follow AWS "Specification and Safety Practice Codes" as published by the American Welding Society (AWS) and OSHA Safety Requirements.

1.7 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report recording the following information concerning events at the site, and submit duplicate copies to the COTR at weekly intervals:

1. List of subcontractors at the site.
2. Count of personnel at the site by Contractor and Trades.
3. High and low temperatures, general weather conditions.
4. Accidents and unusual events.
5. Meetings and significant decisions.
6. Stoppages, delays, shortages, and losses.
7. Meter readings and similar recordings.
8. Emergency procedures.
9. Orders and requests of governing authorities.
10. Change Orders received, implemented.
11. Services connected, disconnected.
12. Equipment or system tests and startups.
13. Partial Completions, occupancies.
14. Substantial Completions authorized.
15. Activities (by number and description) worked on with brief description of daily progress.

1.8 SHOP DRAWINGS

A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or

copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:

1. Dimensions.
2. Identification of products and materials included by sheet and detail number.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.
6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.
7. Initial Submittal: Submit one correctable, translucent, reproducible print and six blue- or black-line prints for the COTR's review. The COTR will return the reproducible print and two non-reproducible prints.
8. Final Submittal: If final submittal is required, submit one correctable, translucent, reproducible print and 6 blue- or black-line prints and 2 additional prints where required for maintenance manuals, plus the number of prints needed by the COTR for distribution.

    a. One of the prints returned shall be marked up and maintained as a "Record Document."

9. Do not use Shop Drawings without an appropriate final stamp indicating action taken.

1.9 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed product data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:

    a. Manufacturer's printed recommendations.
    b. Compliance with trade association standards.
    c. Compliance with recognized testing agency standards.
    d. Application of testing agency labels and seals.
    e. Notation of dimensions verified by field measurement.
    f. Notation of coordination requirements.

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
3. Preliminary Submittal: Submit a preliminary single reproducible copy of Product Data where selection of options is required.
4. Submittals: Submit 6 copies of each required submittal; submit 8 copies where required for maintenance manuals. The COTR will retain two, and will return the others marked with action taken and corrections or modifications required.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

5. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.10 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1. Mount or display Samples in the manner to facilitate review of qualities indicated. Prepare Samples to match the COTR's sample. Include the following:

a. Specification Section number and reference.
b. Generic description of the Sample.
c. Sample source.
d. Product name or name of the manufacturer.
e. Compliance with recognized standards.
f. Availability and delivery time.
g. Associated submittal, if applicable.

2. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least 3 multiple units that show approximate limits of the variations.
b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, and details of assembly, connections, operation, and similar construction characteristics.
c. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.
d. Samples not incorporated into the Work, or otherwise designated as the FAA's property, are the property of the Contractor and shall be removed from the site after acceptance of that work, and prior to Substantial Completion.

3. Preliminary Submittals: Submit a full set of choices where Samples are submitted for selection of color, pattern, texture, or similar characteristics from a range of standard choices.

a. The COTR shall review and return preliminary submittals with the COTR's notation, indicating selection and other action.

4. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit 3 sets. The COTR shall return one set marked with the action taken.
5. Maintain sets of Samples, as returned, at the Project Site, for quality comparisons throughout the course of construction.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.

1. Field samples are full-size examples erected on-site to illustrate finishes, coatings, or finish materials and to establish the Project standard.

a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.11 QUALITY ASSURANCE SUBMITTALS

A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.

1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in individual sections of these Specifications and each written report shall include the following:

1. Date issued
2. Project title and number
3. Testing laboratory name, address, and telephone number
4. Name and signature of laboratory inspector
5. Data and time of sampling or inspection
6. Record of temperature and weather conditions
7. Date of test
8. Identification of product and specifications
9. Location of sample or test in the project
10. Type of inspection or test
11. Results of tests and compliance with Contract Documents
12. Interpretation of test results, when requested by COTR

1.12 OPERATIONS/MAINTENANCE (O&M) INSTRUCTIONS AND PARTS LIST

A. Prior to final inspection of acceptance, review contents of O&M manual with the FAA's designated operating and maintenance personnel over a period of not more than five working days, instructing them in operation, adjustments and maintenance of products, equipment, and systems. Maintain equipment and pay all costs of operation, demonstration, tests, and instruction until acceptance by the FAA.

B. Refer to Section 01782, "Operation and Maintenance Manual Data" for requirements for submitting data for manuals.

1.13 COTR'S ACTION

A. Except for submittals for the record or information, where action and return is required, the COTR shall review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The COTR shall stamp each submittal with a uniform, action stamp. The COTR shall mark the stamp appropriately to indicate the action taken, as follows:

1. Final Unrestricted Release: When the COTR marks a submittal "Approved," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
2. Final-But-Restricted Release: When the COTR marks a submittal "Approved as Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
3. Returned for Re-submittal: When the COTR marks a submittal "Not Approved, Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.

a. Do not use, or allow others to use, submittals marked "Not Approved, Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.

4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the COTR will return the submittal marked "Action Not Required."

C. Unsolicited Submittals: The COTR may return unsolicited submittals to the sender without action.

PART 2 – PRODUCTS: (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SUBMITTAL SCHEDULE

A. General: Contractor shall submit to the COTR in triplicate, a schedule listing all items that will be furnished for review and approval. The schedule shall include but not necessarily be limited

to shop drawings and manufacturer's literature, test procedures, test results, certificates of compliance, material samples, and special guarantees. The schedule shall indicate the type of item, Contract requirement reference, the Contractor's scheduled date for submitting the above items, identification of the first schedule activity and projected needs for approval answers to support procurement or installation. In preparing the schedule, allow 20 days for review, approval, and possible re-submittal. Scheduling shall be coordinated with the approved construction progress chart. The Contractor shall revise and/or update the schedule as directed. Revised schedule shall be made available to COTR for monitoring.

B. Schedule of Submittals: Submittals (Schedules, Manufacturer's Literature, Shop Drawings, Samples, Test Reports, Certificates, Design Calculations, and Installation Instructions) are required for the items listed in the specifications or on the drawings. Submittals for additional items not shown on this list, but identified in the specifications or on the drawings, are also required.

	PRE-CONSTRUCTION												POST-CONSTRUCTION			
SECTION NUMBER	Product Data	Shop Drawings	Samples	Calculation	Design Data	Test Report	Certifications	Qualifications	Coordination Drawings	Proposal	Schedule	MSDS/ Low VOC's Data	Field Report	Record Documents	O & M Data	Warranty
01100-General Requirements												X				
01200-OSHA Safety Rqmnts and Environmental Cont.												X				
01300-Submittals											X					
01310-Construction Schedule											X					
01710-Cleaning										X					X	
01731-Cutting & Patching										X						
01732-Selective Demolition								X		X				X		
01781-Project Record Documents													X	X	X	
01782-Operation and Maintenance	X										X				X	
07270-Firestopping	X	X				X	X	X								
16050-Basic Electrical Methods and Materials	X	X	X										X	X	X	
16120-Wires and Cables													X			
16190-Support Devices	X															
16195-Electrical Identification	X															
16452-Grounding	X							X					X			
16472- Grounding	X	X						X					X		X	
16476 – Disconnects and Circuit Breakers	X															
16481 – Motor Controllers																

END OF SECTION 01300

SECTION 01651 MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1-1 SUMMARY

A. General. - Material and equipment incorporated into the work shall conform to applicable specifications and standards and comply with size, make, type and quality specified, or as specifically approved in writing by the COTR. Manufactured and fabricated products shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gages and shall be interchangeable. Two or more items of the same kind shall be identical and manufactured by the same manufacturer. Products shall be suitable for service conditions. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing. Do not use material or equipment for any purpose other than for which it is designed or specified. Furnish and install products specified, under options and conditions for substitution stated in this section.

1. Manufacturer's instructions.- When contract documents require that installation of work shall comply with manufacturer's printed instructions, copies of such instructions shall be distributed to parties involved in the installation, including two copies to the COR. Maintain one set of complete instructions at the job site during installation and until completion. Products shall be handled, installed, connected, cleaned and conditioned in strict accordance with such instructions and in conformity with specified requirements. If job conditions or specified requirements conflict with manufacturer's instructions, the contractor shall consult with the COR for further instructions. All work shall be performed in accordance with manufacturer's instructions. No preparatory step or installation procedure shall be omitted unless specifically modified or exempted by contract documents.

2. Transportation and handling. - Products shall be delivered in undamaged condition, in manufacturer's original containers or packing, with identifying labels intact and legible. Shipments shall be inspected to ensure compliance with requirements of contract documents and approved submittals, and products are properly protected and undamaged immediately on delivery. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packing.

3. Storage. - Unless specified, products shall be stored in accordance with manufacturer's instructions, with seals and labels intact and legible. Products subject to damage by the elements shall be stored in weather tight enclosures.

4. Temperature. - Temperature and humidity shall be maintained within the ranges required by the manufactures instructions. Fabricated products shall be stored above the ground, on blocking or skids to prevent soiling or staining. Products which are subject to deterioration shall be covered with impervious sheet coverings and adequate ventilation shall be provided to avoid condensation.

5. Substitutions. - A separate request for each substitution shall be submitted. Each request shall be supported with complete data substantiating compliance of proposed substitution with the requirements stated in the contract documents. Each request shall include product identification, manufacturer's literature including address, product description, reference standards and performance and test data. Samples shall be submitted as applicable. An itemized comparison of the proposed substitution with the product specified shall be included. The following information shall also be included: data relating to changes in the

construction schedule; list of changes required in other work or products; and accurate cost data. Substitute products shall not be ordered or installed without written acceptance. In making a formal request for substitution, the contractor represents that he has investigated the proposed products and has determined that it is equal to or superior in all respects to that specified. The contractor ascertains that he will provide same warranties or bonds for substitutions as for product specified. That he will coordinate installation of accepted substitution into work to be complete in all respects; that he waives claims for additional costs caused by substitution which may subsequently become apparent; and that cost data is complete and includes related costs under his contract. Primarily, an "or equal" product will not be considered a substitution. If an actual substitution is accepted, it shall be done only by formal contract modification and not by a submittal approval.

6. New equipment and materials – All contractor supplied materials and equipment that will remain in the government's custody after contract completion, shall be new. Refurbished and or used equipment and materials are disallowed for construction purposes under this contract.

END OF SECTION 01651

* * * * *

SECTION 01652 PROTECTION OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements Included. - It shall be the Contractor's responsibility to provide protection of work from weather, physical damage, improper use, and other adverse natural conditions. It shall be the responsibility of the Contractor to replace any damaged work including finishes, material, and equipment.

1.2 RELATED REQUIREMENTS. - The Respective Section of the Specification covering items of work.
Section 01651: Materials and Equipment
Section 01710: Cleaning

B. Protection during Installation.

1. Sleeves. - Provide watertight closures for sleeve openings below grade.

2. Building Openings. - Provide protection of temporary openings in the building to completely protect the contents and enable work to progress, during winter and all weather conditions. The method and means shall be subject to approval by the COR.

3. Base Materials. - Provide protection of base materials to receive finishes from physical damage.

4. Protection after Installation. - Provide protection of installed products and finished surfaces to prevent damage from subsequent operations. Remove when no longer needed, prior to completion of work.

5. Floors and Stairs.- Protect finished floors and stairs from dirt and damage:

   a. In areas subject to foot traffic, secure heavy sheathing in place.
   b. For movement of heavy products, lay planking or similar materials in place.
   c. For storage of products, lay tight wood sheathing in place.

6. When some activity must take place in order to carry out the contract, obtain and abide by recommendations of installer for protection of surface. Remove upon completion of the activity.

END OF SECTION 01652

* * * *

SECTION 01710 - CLEANING

PART 1- GENERAL

1.1 SUMMARY

A. Just prior to occupancy of the building spaces by the FAA, and prior to Contract Acceptance Inspection (CAI), perform a thorough cleaning of the site and work areas.

1.2 SUBMITTALS

A. Submit in accordance with Section 01300 “Submittal Procedures” and include the following:

1. Maintenance Instructions

2. Provide a typewritten description of finish materials along with a list of the cleaning products recommended by the manufacturer. Place forms in the appropriate Section of the O & M Manual. Describe maintenance needed, including daily, weekly, and monthly maintenance instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish materials and equipment needed for cleaning and waxing purposes. Use cleaners and waxes recommended by the manufacturer for the individual material.

PART 3 - EXECUTION

3.1 SITE CLEANING

A. Maintain work areas in clean condition at all times. At the end of each workday, gather all loose trash and debris from around site and place in trash containers or remove from site. Do not stack trash or other construction debris on the ground or in the open. Place trash in closed containers. Arrange for periodic emptying of containers. Do not allow trash or debris to become airborne, blow around or blow off site.

3.2 ROUTINE CLEANING

A. Routinely clean work areas to remove all construction debris, packing crates, wrappings, packing materials, or other trash.

B. Maintain entire space of work areas in a clean condition at all times.

3.3 FINAL CLEANING

A. Thoroughly clean the entire area of work. Remove construction debris, boxes and trash. Clean entire site, removing all trash from the site. Remove construction storage sheds and field offices and restore grade to match surrounding conditions. Remove excess dirt and complete site restoration.

B. Clean floor and inspect for damage. Replace damaged flooring. Remove paint drippings and other spillage. Sweep floors clean, then mop repeatedly until thoroughly clean, including equipment rooms. Clean resilient flooring with an approved cleaner and give one coat application of liquid floor polish as recommended by the flooring manufacturer. Polish floors to buffed appearance with powered floor buffer. Remove oil, grease and other contaminants from concrete floors, then mop repeatedly until thoroughly clean.

C. Clean wall surfaces to remove dirt or scuff marks. Remove excess adhesive along top edges of wall base. Remove adhesive from surfaces of vinyl wall coverings.

H. Clean electrical and mechanical rooms. Remove shipping labels, tape, tape residue, dirt and dust from equipment and apparatus with vacuum or compressed air. Remove oil, grease and other contaminants from floors and equipment.

I. Clean and polish ceramic tile floors and wall surfaces. Remove mildew or other stains. Tuck point defective joints.

J. Inspect all exterior painted surfaces. Spot paint any damaged surfaces. Touch up damaged surfaces on factory finished equipment with special paint furnished by the equipment manufacturer.

K. Restore exterior areas to original condition, including replacement of sod and shrubs damaged during the course of construction. Clean and sweep affected parking areas.

*** End of Section 01710***

SECTION 01730 - OSHA SAFETY REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE

A. This section identifies some of the requirements of the OSHA Construction Standard.

B. Formulation of a site specific safety plan

1.2 CONTRACTOR RESPONSIBILITY

A. General Safety Provisions - The Contractor shall bear full responsibility to provide safe working conditions for its employees and Contractors. The Contractor shall not permit any employee or Subcontractor to work in surroundings or under working conditions that are unsanitary, hazardous, or dangerous to the health and safety of the employee.

B. Accident Prevention - The Contractor shall bear the responsibility of maintaining an accident prevention program such that frequent and regular inspections of the job site, materials and equipment are made by a competent person designated by the employer.

C. Use of Equipment - The Contractor shall not permit the use of any machinery, tool, material, or equipment that is not in compliance with OSHA regulations. The employer shall permit only those employees qualified by training and/or experience to operate equipment and machinery.

1.3 SUBMITTALS

A. Submittals required include, but are not necessarily limited to, the following:

1. Contractor Safety Plan

1.4 CONTRACTOR RESPONSIBILITY

A. The FAA shall not be held responsible for safety inspections to assure Contractor conformance with the OSHA safety regulations. The FAA, however, reserves the right to notify the Contractor of any deficiencies regarding worker safety.

B. The FAA will evaluate the Contractor on its safety performance, including that of its Subcontractors. The number and severity of safety and security violations will be considered in this evaluation. Contractor safety violations are cause for termination for default, may result in notification of the Contractor’s bonding company, and will affect the Contractor’s opportunity to propose on future work. Failure to correct such deficiencies may impact the Contractor’s ability to work on future FAA contracts.

1.5 OSHA REGULATIONS

A. The Contractor shall comply with the latest Occupational Safety and Heath Administration regulations (CFR 29 Part 1926) regarding safety in the work area.

B. The Contractor shall be responsible for obtaining copies of non-FAA referenced documents without additional cost to the FAA. If Contractor requests a copy of FAA directives, they may be obtained by contacting the Contracting Officer.

C. The Contractor is not relieved from adhering to other OSHA requirements not listed herein. The Contractor shall consult the latest referenced OSHA documents for safety regulations.

1. Documents:
   a. OSHA Documents:
      1) CFR 29 Part 1926 Safety and Health Regulations for Construction
      2) CFR 29 Part 1910 General Industry Standards Applicable to Construction Industry
   b. FAA Documents:
      1) FAA Order 3900.49 Control of Hazardous Energy During Maintenance, Servicing and Repair

D. Confined Space Regulations.

1. Permit Required Confined Space Entry Procedures

   - Follow OSHA Standards outlined in 28CFR 1910.146 “Permit Required Confined Spaces”.
   - ZBW ARTCC Manholes Permit Required Procedures a copy of which is available to the successful Offeror at the Work Site.
   - Only personnel trained in confined space work/ activities will be allowed entry into or do work associated with the confined space activity. Workers associated with the activity must have a confined space card on their person at all times.

2. The contractor shall be responsible for training of the workers. All equipment necessary for this work is to be supplied by the contractor. No equipment will be furnished by the FAA The contractor shall:

   - Obtain a blank Confined Space Entry Permit and fill in the form completely
   - Identify the entry team members who will be designated as the
     a. Entry Supervisor
     b. Attendant
     c. Authorized Entrants

3. The on site Government Safety Officer will verify all certifications and contractor compliance with OSHA regulations.

1.6 SAFETY PLAN

The contractor must develop and implement a site specific comprehensive Health and Safety Plan (HASP) based on the scope of work, for his or her employees as well as others in the area and the properties around. It shall cover all aspects of onsite construction operations and activities associated with the contract. This plan must comply with 29 CFR 1926, FAA Order 3900.19B, other applicable health and safety regulations and any project-specific requirements. The contractor must provide the Contracting Officer with a copy of this plan. Acceptance of the contractor's HASP only signifies that the plan generally conforms to the requirements of the contract. It does not relieve the contractor of the responsibility for providing with a safe and healthful work environment. At a minimum the HASP shall address the following:

A. Workplace address

B. Name and address of the principal contractor

C. Key Personnel, phone nos and addresses

D. Estimated duration of the work

E. Hazard assessment and identification of the hazards in the scope of work

F. Mitigation of hazards and proposed control measures for the risks

G. Hazard Communication methods

H. How the controls will be implemented

I. Personal Protective Equipment

J. Training

K. Temperature Extreme

L. Medical Surveillance

M. Exposure Monitoring and Air Sampling

N. Site Control

O. Emergency Response/Contingency Plan

P. Emergency Action Plan

Q. Confined Space Entry

R. Spill Containment

S. Documentation and Record Control

T. Arrangements for monitoring and reviewing controls

U. Lock-out and Tag-out

The plan must be written so it is easy to understand, signed and dated by the General Contractor. It must be available for the length of the project. The General Contractor cannot allow work to start unless the plan has been discussed with or a copy given to all relevant people and the plan is readily available for inspection. The plan must be amended if there are changes in how risks will be managed. The General Contractor must inform any affected person of the change.

PART 2 – MATERIAL

NOT USED

PART 3 – EXECUTION

3.1 CFR 29 PART 1926 - SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

A. This section contains a partial listing of the referenced OSHA standards. The Contractor is responsible for adhering to all applicable regulations including those not specifically referenced herein.

1. Subpart D (Occupational Health and Environmental Controls) - Contractor shall furnish adequate supply of potable water in containers clearly marked as potable water. Containers containing non-potable water shall be clearly marked. Contractor shall furnish toilet facilities based on the number of employees present on the job-site. A minimum of 1 facility is required for less than 20 employees. See CFR 29 Part 1926 Subpart D for complete requirements.
2. Subpart E (Personal Protective Equipment) - The Contractor shall provide adequate protection for the head, hearing, and eyes for all employees working in an area where hazards to the head, ear and eyes exist. See CFR 29 Part 1926 Subpart E for complete requirements.
3. Subpart I (Tools) - All hand tools and power tools and similar equipment whether furnished by the Contractor or the employee shall be maintained and operated in a safe condition. Personal protection shall be used when applicable. The use of tools shall be limited to the intended use of said tools. See CFR 29 Part 1926 Subpart I for complete requirements.
4. Subpart K (Electrical) - The Contractor shall furnish ground fault protection for all electrical equipment used on the jobsite. Extension cords shall be three wire ground in good shape. Installation of the facilities will require energizing numerous circuits. The Contractor shall protect against electrical shock by methods such as posting warning signs, supplying insulated gloves, locking out and tagging de-energized circuits, and other similar methods. See CFR 29 Part 1926 Subpart K for complete requirements.

3.2 CFR 29 PART 1910 - GENERAL INDUSTRY STANDARDS APPLICABLE TO CONSTRUCTION INDUSTRY

A. This section contains a partial listing of the referenced OSHA standards. The Contractor is responsible for adhering to all applicable regulations including those not specifically referenced herein.

1. Section 1910.147 - Contractor shall maintain a written hazardous energy control procedure in accordance with CFR 29 1910.147. The written procedure shall describe contractor's responsibilities regarding shift changes or personnel changes. A specific coordinated lockout/tagout procedure shall be recorded in writing and signed by the Contractor and Contracting Officer with copies to each party.
2. Section 1910.120 - The Contractor shall develop and implement an Emergency Response and Contingency Plan in accordance with OSHA Standard 29 CFR 1910.120. In the event of an emergency associated with remedial action, the Contractor shall, without delay, take diligent action to remove or otherwise minimize the cause of the emergency; alert the Contractor; and institute whatever measures might be necessary to prevent any repetition of the conditions of actions leading to, or resulting in, the emergency. Emergency contact names and telephone numbers shall be posted at all project phones and in site-support vehicles as well as included within the plan.

* * * END OF SECTION 01730 * * *

SECTION 01731 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Section 01732 "Selective Demolition" for demolition of selected portions of the building for alterations.
2. Section 07270 "Firestopping."
3. Division 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
    a. Requirements in this Section apply to mechanical and electrical installations. Refer to Division 16 Sections for other requirements and limitations applicable to cutting and patching electrical installations.

1.2 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated or that will be temporarily out of service. Indicate how long service will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Contracting Officer's Technical Representative (COTR) Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or in increased maintenance or decreased operational life or safety.
   1. Primary operational systems and equipment.
   2. Air or smoke barriers.
   3. Fire-protection systems.
   4. Control systems.
   5. Communication systems.
   6. Conveying systems.
   7. Electrical wiring systems.
   8. Operating Systems of Special Construction for Fire Detection and Fire Protection systems.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity or result in reducing their capacity to perform as intended, or in increased maintenance or decreased operational life or safety.
   1. Water, moisture, or vapor barriers.
   2. Membranes and flashings.
   3. Exterior curtain-wall construction.
   4. Equipment supports.
   5. Piping, ductwork, vessels, and equipment.
   6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in COTR's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
   1. If possible, retain the original Installer or fabricator to cut and patch exposed work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs on a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

*** END OF SECTION 01731 ***

SECTION 01732 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of selected portions of a building.
   2. Patching and repairs.

1.2 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled or to remain the FAA's property.

B. Remove and Save for Reuse: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.

C. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the COTR, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

D. Salvage: Detach items from existing construction and deliver them to COTR.

1.3 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain the FAA's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

1.4 SUBMITTALS

A. Qualification Data: For demolition firm and refrigerant recovery technician.

B. Proposed dust-control measures.

C. Proposed noise-control measures.

D. Air Quality Plan: Submit plan for maintaining fresh air in work areas and removal of odors from work area during construction. Include list of products that will emit an air-borne odor and MSDS for each product, including, but not limited to:

   1. Paints.
   2. Adhesives.
   3. Sealants.

E. Schedule of selective demolition activities indicating the following:

   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure FAA on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of FAA's on-site operations. Sequence to include installation of new power panel in building to minimize interruption of service.
6. Coordination of FAA's continuing occupancy of portions of existing building and of FAA's partial occupancy of completed Work.
7. Locations of temporary partitions and means of egress.

F. Welding and Torch Cutting Plan. Prior to any welding or torch cutting activity, submit a Welding and Torch Cutting Plan for approval by the COTR. Identify the work where welding and cutting will be performed, locations of the work, types of welding and cutting being proposed, schedule for proposed welding and cutting activities and plan for protecting the facility and its occupants, operations and equipment during the welding and cutting activities.

1. Building electrical power may not be used for arc welding.
2. Building components, including structural or miscellaneous steel, may not be used as grounding return for welding activities.
3. Provide ventilation and exhaust to the outside during welding and cutting activities to keep zone clear. Do not weld or cut unless ventilation and exhaust has been deemed acceptable by the COTR or Resident Engineer.
4. Provide non-flammable shields to protect persons and properties.
5. Keep cylinders upright and chained or secured to support.
6. Remove flammable materials from welding and cutting areas prior to beginning welding and cutting activities. Keep fire extinguishers in the welding and cutting areas.
7. Follow AWS "Specification and Safety Practice Codes" as published by the American Welding Society (AWS) and OSHA Safety Requirements.

G. Inventory of items to be removed.

H. Inventory of items to be removed by FAA.

I. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

J. Record drawings at Project closeout.

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.5 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Pre-demolition Conference: Conduct conference at Project site. Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Locate proposed dust proof barriers for approval prior to proceeding with Work.

1.6 PROJECT CONDITIONS

A. Conduct selective demolition so that FAA's operations will not be disrupted. Provide not less than 10 calendar days notice to COTR of activities that will affect FAA's operations.

B. FAA assumes no responsibility for actual condition of buildings to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by FAA as far as practical.

C. Hazardous Materials: Hazardous materials are present in construction to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 SCHEDULING

A. Arrange selective demolition schedule so as not to interfere with FAA's on-site operations.

1.8 WARRANTY

A. Existing Special Warranty: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing

warranties.

PART 2 – PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
2. Insure that the replacement materials performance equals or surpasses that of existing materials.

B. Use low-VOC (volatile organic compound) products as specified in technical sections. Provide newer-formulated, low-voc products in place of existing products for repairs and renovation for the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed.

D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the COTR.

E. Survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition.

1. Before selective demolition or removal of existing building elements that will be reproduced or duplication in final Work, make permanent record of measurements, materials and construction details required to make exact reproduction.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by COTR. Provide temporary services during interruptions to

existing utilities, as acceptable to COTR.

a. Provide not less than 10 calendar days notice to FAA if shutdown of service is required during changeover.

3.3 PREPARATION

A. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from COTR. Provide alternate routes and by-passes constructed to provide dust-protection around closed or obstructed traffic ways if required by governing regulations.

B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.

1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

C. Erect and maintain dust-proof partitions to limit dust and dirt migration and to separate areas from fumes and noise.

1. Construct dust-proof partitions of not less than nominal 2-inch by 4-inch fire retardant wood or metal studs with flame retardant 6 mil polyethylene sheet, with joints taped and attached to the non-public side of studs to form dust-proof partition, as shown on the drawings.
2. Seal joints and perimeter. Equip partitions with gasketed or weather-stripped doors to maintain dust-proof conditions.
3. Protect air-handling equipment.
4. Weather-strip openings.
5. Seal joints and perimeter. Equip partitions with dust-proof doors to maintain dust proof conditions.
6. Protect air-handling equipment.
7. Weather-strip openings.

D. Preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.5 SELECTIVE DEMOLITION

A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on lower levels.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations. Torch cutting or welding only permitted in staging area and other area designated by COTR.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.
10. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools. Cut existing reinforcing 1/4-inch below finish surface.

C. Break up and remove concrete slabs on grade, unless otherwise shown to remain.

D. Remove resilient floor coverings and adhesive according to recommendations of the Resilient Floor Covering Institute's (RFCI) "Recommended Work Practices for the Removal of Resilient Floor Coverings" and Addendum.

E. Air-Conditioning Equipment: Remove refrigerants according to EPA requirements.

F. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to FAA.
4. Transport items to FAA's storage area designated by COTR.
5. Protect items from damage during transport and storage.

G. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

H. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by COTR, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 PATCHING AND REPAIRS

A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.

C. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

D. Patch and repair floor and wall surfaces in the new space where demolished walls or partitions extend one finished area into another. Provide a flush and even surface of uniform color and appearance.

1. Closely match texture and finish of existing adjacent surface.
2. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
3. Where patching smooth painted surfaces, extend final paint coat over entire unbroken surface containing the patch after the surface has received primer and second coat.
4. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
5. Inspect and test patched areas to demonstrate integrity of the installation, where feasible.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. Coordinate removal from building and site with COTR.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off FAA's property and legally dispose of them.

3.8 CLEANING

A. Sweep the building broom clean on completion of selective demolition operation.

B. Change filters on air-handling equipment on completion of selective demolition operations.

*** END OF SECTION ***

SECTION 01781 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes administrative and procedural requirements for Project Record Documents. Required Project Record Documents include the following:

1. Marked-up copies of Contract Drawings.
2. Marked-up copies of Shop Drawings.
3. Newly prepared drawings.
4. Marked-up copies of Specifications, addenda, and Change Orders.
5. Marked-up Product Data submittals.
6. Record Samples.
7. Field records for variable and concealed conditions.
8. Record information on Work that is recorded only schematically.

B. Maintenance of Documents and Samples: Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and samples available at all times for the Contracting Officer's Technical Representative's (COTR) inspections.

1.2 RECORD DRAWINGS

A. Markup Procedure: During construction, maintain a set of blue- or black-line white prints of Contract Drawings and Shop Drawings for Project Record Document purposes.

1. Mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:

a. Dimensional changes to the Drawings.
b. Revisions to details shown on the Drawings.
c. Depths of foundations below the first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directives.
k. Changes made following the COTR's written orders.

2. Details not on original Contract Drawings.
3. Mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
4. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note alternate numbers, Change Order numbers, and similar identifications.

B. Responsibility for Markup: The individual, installer, subcontractor or other entity who obtained the record data shall prepare the markup on record drawings.

1. Accurately record information in an understandable drawing technique.
2. Record data as soon as possible after obtaining it. Record and check the markup prior to enclosing concealed installations.
3. Prior to Final Acceptance, submit record drawings to the Contracting Officer for the FAA's records. Organize into sets, and bind and label.

1.3 RECORD SPECIFICATIONS

A. During the construction period, maintain 3 copies of the Project Specifications, including addenda and other modifications issued, for Project Record Document purposes.

1. Mark the Specifications to indicate the actual installation where the installation varies from that indicated in Specifications. Note related project record drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.

    a. In each Specification section where products, materials or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.
    b. Record the name of the manufacturer, supplier, installer, and other information necessary to provide a record of selections made and to document coordination with record Product Data submittals and maintenance manuals.

2. Upon completion of markup, submit Record Specifications to the COTR for the FAA's records.

1.4 RECORD PRODUCT DATA

A. During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.

1. Mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation.
2. Give particular attention to information about concealed products and installations that cannot be readily identified and recorded later.
3. Note related Change Orders and markup of record Drawings, where applicable.
4. Upon completion of markup, submit a complete set of record Product Data to the COTR for the FAA's records.
5. Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.*** END OF SECTION 01781 ***

SECTION 01782 - OPERATION AND MAINTENANCE MANUAL DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for Operation and Maintenance (O&M) manuals for hard copy and electronic/record documents, including the following:

1. Prepare and submit operation and maintenance manuals for building operating systems and equipment.
2. Project record document submittal.
3. Provide O&M data to the Government for use in updating Air Route Traffic Control Center (ARTCC) O&M documents.

    a. Prior to any demolition, the Contractor shall obtain from the Contracting Officer's Representative (COTR) a copy of the electronic O&M equipment inventory for the specific part of the facility being constructed/renovated under this contract. The contractor shall annotate on the inventory list any equipment removed or taken out of service as a result of construction/renovation and return it to the COTR upon completion of demolition.
    b. An inventory of each component and piece of equipment requiring operations and maintenance documentation identified in the specification and contract drawings shall be documented and provided to the COTR in worksheet format. Use Attachment 1 to this section to identify systems and sub-systems. Attachment 2 is the format that shall be used to document O&M equipment inventory information. COTR will provide guidance on how to complete worksheets.

B. Related references for submitting information for operation and maintenance manuals:

1. Appropriate Sections of Division 16 specify special operation and maintenance data requirements for specific pieces of equipment or building operating systems.

1.2 QUALITY ASSURANCE

A. Maintenance Manual Preparation: In preparation of maintenance manuals, use competent/certified personnel thoroughly trained and experienced in operation and maintenance of equipment or systems involved.

1. Provide O&M manuals prepared in accordance with this Section.
2. Where specifications require written instructions, use personnel skilled in technical writing where necessary for communication of essential data.
3. Where specifications require drawings or diagrams, use personnel skilled in preparing drawings clearly in an understandable format.

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Unless otherwise noted, comply with the following schedule for submitting operation and maintenance manuals:

1. Draft O&M Documentation for Individual Items. Sixty days after approval of each technical submittal, submit 2 draft sets of O&M documentation for the approved item to the COTR for review. All O&M submittals shall be manufacturer's original publications. Photocopies will not be accepted. Manuals shall be organized by system, as described in Paragraph "O&M Manual Sections By Building System" of this Section. The COTR will return 1 copy of the draft with comments within 30 days of receipt.
2. Inventory Information. Submit 2 paper copies and one electronic version in MS Excel format 60 days before substantial completion.
3. Final O&M Documentation. Make corrections or modifications to comply with the COTR's comments. Submit three sets of the final O&M documentation to the COTR within 15 days of receipt of the COTR's comments.

B. Form of Submittal: Prepare operation and maintenance manuals in the form of an instructional manual for use by the Government's operating personnel. Organize into sets in sizes as indicated. Organize O&M information by system as described in Schedule at end of Part 3 of this Section.

1. Binders: For each manual, provide heavy-duty, commercial-quality, 3-ring, vinyl-covered, loose-leaf binders, maximum of 3 inches thick, sized to receive 8-1/2-by-11- inch paper. Provide a clear plastic sleeve on the spine and front cover to hold labels describing contents. Provide 3-hole punched, heavy-duty sheet protectors to hold folded oversized documents. Do not fill binders to more than 1/2 capacity.

    a. Where multiple binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.
    b. Identify each binder on front and spine, with the printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter covered. Indicate volume number for multiple volume sets of manuals.

2. Dividers: Provide heavy paper dividers with clear celluloid-covered tabs for each separate Section. Mark each tab to indicate contents. Provide a description of the Product and major parts of equipment included in the Section on each divider.
3. Text Material: Provide the manufacturer's standard printed material. If manufacturer's standard printed material is not available, provide specially prepared data, computer generated, on 8-1/2-by-11 inch, 20-lb/sq. ft. white bond paper.
4. Drawings: Provide reinforced, punched binder tabs on drawings and bind with text. Where oversize drawings are necessary, fold drawings to the same size as text pages, and inserted in a 3-hole-punched, heavy-duty plastic sheet protector.

C. Submit 2 copies of each manual, in final form, on equipment and systems to the COTR for distribution. Include information for each unit of equipment, each operating system, and each electric and electronic system.

1.4 MANUAL CONTENT

A. Include information required by the individual Specification Sections in the form of Data Packages. Data packages shall be developed for each building component, piece of equipment and system based on level of complexity and as specified in the individual Specification Sections. Data packages shall be provided in accordance with Schedule at end of Part 3 of this Section. Applicability of data packages is as follows:

1. Data Package 1: General building materials and components such as sealants, wall and ceiling finishes, door hardware, toilet partitions, wheelchair lift, etc.
2. Data Package 2: HVAC items, piping, plumbing and associated items.
3. Data Package 3: Electrical items, panelboards, light fixtures, receptacles and associated items.

B. Software: Specified program listings, interface control documents, source code listing, and copies of the operating programs on media appropriate to use as backup for the system software. Include instructions for loading the operating software onto the system.

C. Additional requirements:

1. For each system, general system or equipment description. Include size, weight, power consumption, power requirements, and outline drawings.
2. Copies of applicable Shop Drawings, Product Data, Drawings, and Schematics for the equipment systems.
3. Theory of Operation: Description of technical operating characteristics of the system and individual equipment using standard phraseology; descriptions of interface requirements including operating protocols; equipment displays and screens; make reference to installation drawings, schematics and equipment displays as required for technical understanding.

D. Identification Legends:

1. Piping and equipment: Provide a computer-generated legend to correspond with the identification of devices installed on piping and equipment. List the identifying device, its location, a brief description of the devices function, and the I.D. number.
2. Panel boards and switchboards: Provide a computer-generated legend for each panel board and switchboard installed in the project. This information shall be a duplicate of the legend placed in the panel board.
3. Valve Tags and Schedule: Provide a computer-generated schedule of all valve tags. Include valve type, manufacturer, equipment location and size for all newly installed valves.

E. Organize the manual into separate Sections, by system as described in Paragraph "O&M Manual Sections by Building System" of this Article, for each system or piece of related equipment.

1. Title Page: Provide a title page in a transparent, plastic envelope as the first sheet of each manual. Provide the following information:

a. Subject matter covered by the manual
b. Name and address of the Project
c. Date of submittal
d. Name, address, and telephone number of the Contractor
e. Name and address of the Architect
c. Cross-reference to related systems in other operation and maintenance manuals.
d. Name, address and telephone number of all sub-contractors.

2. Table of Contents: After the title page, include a computer-generated table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product incorporated, identified by product name and other appropriate

identifying symbol and indexed to the content of the volume. Each Data Package shall be tabbed and separately listed in the Table of Contents. Where multiple volumes are required to accommodate data, provide a comprehensive table of contents for all volumes in each volume of the set.

3. General Information: Provide a general information Section immediately following table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the subcontractor or installer and the maintenance contractor where applicable. Clearly delineate the extent of responsibility of each of these entities. Include a local source for replacement parts and equipment.
4. Product Data: Where the manuals include manufacturer's standard printed data, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where the Project includes more than one item in a tabular format, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.
5. Written Text: Prepare written text to provide necessary information where manufacturer's standard printed data are not available, and the information is necessary for proper operation and maintenance of equipment or systems. Prepare written text where it is necessary to provide additional information or to supplement data included in the manual. Organize text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure.
6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to ensure correct illustration of the completed installation.
7. Warranties, Bonds, and Service Contracts: Provide a copy of each warranty, bond, or service contract tabbed in a separate binder. Provide written data outlining procedures to follow in the event of product failure. List the circumstances and conditions that would affect the validity of a warranty or bond.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SCHEDULE

A. Schedule of Operation and Maintenance Data Packages. The following is a minimum of information required for Operation and Maintenance Manuals for this project. Refer to individual technical Section for any additional information, which may be specified for O&M Manuals.

SECTION	DESCRIPTION	DP 1	DP 2	DP 3
01781	Project Record Documents	X		
01782	Operation and Maintenance	X		
16050	Basic Electrical Methods and Materials			X
16452	Grounding			X

SECTION	DESCRIPTION	DP 1	DP 2	DP 3
16470	Panelboards			X
16482	Motor Control Centers			X

*** END OF SECTION 01782 ***

SECTION 01800: CONTRACT CLOSE OUT

PART 1 - GENERAL

1.1 SUMMARY

The contractor shall require each subcontractor engaged upon the work to bear full responsibility for cleaning up during and immediately upon completion of his work. All rubbish, waste, tools, equipment and other apparatus caused by or used in the execution of his work shall be removed. This shall in no way be construed to relieve the contractor of his primary responsibility for maintaining the building and the site clean and free of debris, and leaving all work in a clean and proper condition acceptable to the COR. All exposed floor surfaces shall be protected against all mechanical damage, mortar or plaster droppings, oil, grease, or other damage that will stain or soil the finish. Protection shall be maintained until all work has been completed.

A. Rubbish removal. - Immediately after unpacking, all packing material, case lumber, wrappings, or other rubbish, flammable or otherwise, shall be collected and removed from the building and the premises.

B. Overall cleaning.- Immediately before the final inspection, the entire exterior and interior of the building and the surrounding areas shall be thoroughly cleaned by the contractor, including but not limited to the following:

1. All construction facilities, debris and rubbish shall be removed from the building and the site.
2. All finished surfaces disturbed by this construction shall be swept, dusted, vacuumed, washed or polished as required.
3. All tools, scaffolding, temporary utility connections or buildings, belonging to the contractor or used under his direction shall be removed from the site.

1.2 PROJECT RECORD DOCUMENTS

A. Maintenance of documents.- The following documents shall be maintained at the project site:

1. Contract drawings
2. Contract specifications
3. Addenda
4. Reviewed shop drawings
5. Change orders
6. Field test reports
7. Project correspondence
8. Software information specific to this project
9. Other modifications to contract

B. Storage and use of documents. - Store record documents apart from documents used for construction; do not use record documents for construction purposes. Keep documents in clean, dry, legible condition; provide file cabinets and racks for storage of drawings.

C. Marking devices. - Use red colored pencil for all marking.

D. Recording and labeling. - Label each document "Project Record" in 1-inch high printed block letters. Keep record documents current. Do not conceal or cover up any item of work until the information has been recorded.

E. Submittals. - At completion of project, deliver record documents to COR. Accompany submittal with transmittal letter containing the following:

1. Date
2. Project title and number
3. Contractor's name and address.
4. Title and number of each record document
5. Certification that each document as submitted is complete and accurate.
6. Signature of contractor, or his authorized representative

1.3 CONTRACT DOCUMENTS

A. Contract drawings.- Legibly mark to record actual construction:

1. Horizontal and vertical location of underground and overhead utilities and appurtenances referenced to permanent surface improvements.
2. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
3. Field changes of dimension and detail.
4. Changes made by change order or field order.
5. Details not on originally specified drawings.

B. Contractor specifications and addenda.- Legibly mark each section to record:

1. Manufacturer, trade name, catalog number, and supplier of each item of equipment actually installed.
2. Changes made by change order or field order.
3. Other matters not originally specified.

C. Shop drawings. - Shop drawings shall be maintained as record documents; legibly annotate drawings to record changes made after review.

1.4 COMPLETION CERTIFICATE

When the contractor considers the work complete, the contractor shall submit written certification that contract documents have been reviewed; work has been inspected for compliance with contract; equipment and systems have been tested in the presence of the RE and are operational. Second, the contractor also certifies that the required operational, and maintenance manuals, data, and parts list have been submitted and approved; spare parts have been provided as required; required instruction of maintenance personnel has been accomplished; work is completed, premises cleaned and ready for inspection; and the warranty certificates from all new equipment manufacturers have been provided.

1.5 FINAL INSPECTION

A written request for a final inspection shall be sent to the Resident Engineer fourteen (14) calendar days prior to the requested inspection date. The final inspection shall be scheduled at a mutually agreed upon date, and will be acknowledged by the Resident Engineer. The contractor shall develop his own pre-final inspection and correct all deficiencies prior to requesting the final inspection. The pre-final report shall accompany the final inspection request.

If, during the final inspection, the Resident Engineer, in concurrence with the inspection team and the Contracting Officer, determines that the contractor was not ready for the final inspection, based on the contractor not meeting all of the contractual requirements, all costs incurred by the Government for

additional inspections shall be deducted from the contract (including but not limited to: travel cost, per diem, salaries of all concerned parties, consultant engineer personnel, and FAA personnel required to participate in the final inspection). This dollar amount shall be the actual cost incurred by the FAA to perform the final inspection.

1.6 PUNCH LIST

During the final inspection, the Resident Engineer, in coordination with the regional office and local FAA personnel shall develop a list (Punch List) of all deficiencies (unsatisfactory work, latent or patent defects, etc.). A copy of the punch list will be furnished to the contractor as a draft list after the final inspection, while the original copy will be forwarded to the Contracting Officer. Only one official punch list shall be generated by the inspection team.

The Contracting Officer will furnish to the contractor the official punch list within fourteen calendar days after completion of the final inspection. The contractor shall be allowed 30 calendar days to correct all deficiencies noted.

1.7 ACCEPTANCE OF WORK

The contractor shall correct discrepancies noted during the final inspection, clean the premises, and notify the Resident Engineer that the work is ready for acceptance. The Resident Engineer shall verify that the official punch list has been accomplished and initialize and date each item as it is completed.

END OF SECTION 01800

* * * * *

SECTION 07270 - FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes firestopping for the following:

1. Penetrations through fire-resistance-rated floor and ceiling construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
4. Sealant joints in fire-resistance-rated construction.
5. Non-fire-rated penetrations at column base enclosures at raised floor conditions.

1.2 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. C719-93 (2005): Standard Test Method for Adhesion and Cohesion of Elastomeric Joint. Sealants Under Cyclic Movement (Hockman Cycle).
2. C920-05: Standard Specification for Elastomeric Joint Sealants.
4. C1193-05a: Standard Guide for Use of Joint Sealants.
5. C1401-02: Standard Guide for Structural Sealant Glazing
6. E84-05: Standard Test Method for Surface Burning Characteristics of Building Materials.
7. E119-07a: Standard Test Method for Fire Tests of Building Construction and Materials.
8. E136-04: Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C.
9. E814-06: Standard Test Method for Fire Tests of Through-Penetration firestop.

B. Environmental Protection Agency (EPA)

1. 40 CFR Part 763, Subpart F: Asbestos Hazardous Emergency Response Act, Friable Asbestos-containing Materials in Schools.

C. Underwriters Laboratories (UL)

1. 2006 UL Fire Resistance Design Directory – Volumes 2A and 2B.
2. 1479: Fire Tests of Through-Penetration Firestops.
3. 2079: Tests for Fire Resistance of Building Joint Systems.

D. OSHA 29 CFR 1910.7 – Definitions and Requirements for a Nationally Recognized Testing Laboratory.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.

B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E814-06, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.

C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E814-06, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:

1. Where firestop systems protect penetrations located outside of wall cavities.
2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
4. Where firestop systems protect penetrating items larger than a 4-inch-diameter nominal pipe or 16-sq. in. in overall cross-sectional area.

D. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as per ASTM E119-07a, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

E. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

F. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E84-05.

1.4 SUBMITTALS

A. Product data and Material Safety Data Sheets [MSDS] for each individual of product specified for use.

1. Certification by firestopping manufacturer whose products comply with FAA regulations prohibiting the use of any products that contain or emit volatile organic compounds (VOCs) and are nontoxic to building occupants.

2. Provide MSDS with up-to-date contact and emergency information for all products, including:

a. Intumescent caulks.
b. Firestop sealants for moving joints.
c. Fire-stop foams.
d. Substrate primers.
e. Mortar.

f. Glazing
g. Paints
h. Catalysts

B. Shop drawings detailing materials, installation methods, relationships to adjoining construction for each through-penetration firestop system, and each kind of construction condition. Include qualified testing and inspecting agency compliance with requirements for each condition indicated. Include forced ventilation plans layouts to be coordinated with COR a minimum of 14 days prior to start of work.

1. Submit documentation with illustrations for each through-penetration firestop configuration, including all construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration approved by firestopping manufacturer's fire protection engineer with modifications marked.

C. Product certificates from firestopping manufacturers certifying that their products comply with specified requirements of the industry.

D. Product test data showing compliance with requirements based on comprehensive testing.

E. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

F. Refer to Section 01782, “Operation and Maintenance Manual Data” for submitting such data.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:

1 Product test data shall have been performed by a qualified testing and inspecting agency, under all pertinent UL, and OSHA requirements.

2 Through-penetration products must be tested per ASTM E814-06, under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide rated systems complying with the following requirements:

3. Fire-resistive joint sealant systems tested to those fire-response characteristics per ASTM E119-07a, under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with the following requirements:

a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by the 2006 UL Fire Resistance Design Directory". All products including sealants, backing materials, and items listed above in 1.4 B.1 must all bear classification marking of the qualified testing and inspection agency.

B. Information on drawings specifying areas requiring through-penetration firestopping is intended to establish requirements for performance based on the building materials and conditions as they actually exist. Submit cut sheet data showing that the performance of all proposed products and applications equals or exceeds the fire rating of the structure penetrations to be firestopped. Contractor shall have field verified all areas prior to start of this work. Any changes in these conditions must be submitted for COR's approval prior to proceeding.

C. Installer Qualifications: Work shall be performed by an experienced, factory-certified installer who has successfully installed firestopping that is similar in material, design, and configuration to that indicated for this project. Installer must hold certification(s) from the manufacturer(s) whose products are being installed. Only manufacturers' training courses for the proper applications and testing of their products, and to maintain the installation warranty are acceptable. A Certified Installer Certificate from each manufacturer must be submitted for all individuals who will be performing the work, Such certificates read:

1. Certified 3M – Trained Master Installer (for all types of through penetration systems).
2. Certified 3M – Trained Installer (for specific through penetration system).
3. Certified Hilti Installer (for specific through penetration system).
4. Certified Nelson Firestop Installer.
5. Or other nationally recognized through penetration firestop system manufacturer.

D. Single-Source Responsibility: For each individual penetration or construction condition, use firestopping products from a single manufacturer only.

E. Field-Constructed Mockup: Prior to installing firestopping, erect mockups for each different through-penetration firestop system indicated to verify appropriate UL applications, and to demonstrate qualities of materials and execution. Build a mockup appropriate to each application to comply with the following requirements, using the same products indicated for the final installations:

1. Standard system penetrations per UL Fire Resistance Design Directory.
2. Notify COR 5 business days in advance of the dates and times when completed mockups will be available.

3 Obtain COR's acceptance of mockups before start of this work. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging completed unit of Work.

4 Accepted mockups are to be preserved as they may become part of the completed unit of work at project completion.

F. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

G. Coordinating Work: Coordinate construction of openings, framing, and penetrating items to ensure that each through-penetration firestop system is installed per specified requirements and mock-ups, and are HAZMAT and VOC free.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping products to site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life [if applicable]; qualified testing and inspecting agency's classification marking, curing time; and mixing instructions for multi-component materials.

B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not install firestopping when ambient or working surfaces' temperatures are outside limits permitted by firestopping manufacturers, or when surfaces are wet or holding condensation.

B. Ventilation: Ventilate work area per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation. No portion of the building's HVAC may be used or diverted for this effort. A separate, temporary system must be provided. Plans and shop drawings must be submitted to COR for approval a minimum of 10 working days prior to start.

1.8 SEQUENCING AND SCHEDULING

A. Notify COR to schedule inspection of each firestopping installation a minimum of 2 working days prior to completion of installation. Maintain all safe access, including ladder, scaffolds, and lighting, for COR.

B. Do not cover up those firestopping installations that will become concealed behind other construction until COR has examined and approved each installation.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

A. Compatibility: Install only firestopping components that are of same manufacturer, and are compatible with each other, and are designated by the manufacturer to work with and adhere to the working surfaces forming the openings, and the conduits passing through the penetration openings.

B. Accessories: Provide only accessory components for each firestopping application that are required as fill materials and that comply with Parts 1 and 2 of this section. Use only components specified as compatible by the firestopping manufacturer, and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:

1. Permanent forming/damming/backing materials including the following:

    a. Semi-refractory fiber (mineral wool) insulation.
    b. Ceramic fiber.
    c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
    d. Fire-rated formboard.
    e. Joint fillers for joint sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

C. Materials used in firestopping shall be UL approved and shall be products of manufacturers listed in the 2006 UL Fire Resistance Design Directory.

2.2 KNOWN ACCEPTABLE SOURCES

A. Intumescent Caulks:

1. 3M Fire Barrier Caulks CP-25 Series.
2. HILTI, Inc. FS-One high performance Intumescent Firestop Sealant.

B. Firestop Sealants for moving Joints:

1. 3M Fire Barriers 2000 & 2003 Silicone Sealants.
2. HILTI, Inc. FS601/ FS604 Elastomeric Firestop Sealant

C. Firestop Foams:

1. 3M Fire Barrier 2001 Silicone RTV Foam.

D. Firestop Collars and Barriers:

1. 3M Fire Barrier RC-1 Restricting Collar.
2. HILTI, Inc. CP 642 Intumescent Firestop Collar.

E Intumescent Wrap Strips:

1. M Fire Barrier FS-195 and Wrap/strip.

F. Fire Block:

1. HILTI, Inc. FS 657 Intumescent Firestop Block

G. Mortar:

1. HILTI, Inc. FS 635 Trowelable Firestop Compound.

H. Firestop Devices (Prefabricated) for Ease of Installing Communication and Power Cables:

1. 3M Fire Barrier CS 195^{+} Composite Sheet and 3M Interam E-5 Series Mat.

I. Mineral Fiber/Ceramic Wool Non-combustible Safing Insulation:

1. Provide minimum 8 pcf Thermafiber as manufactured by US Gypsum Company, minimum 8 pcf PBX safing insulation as manufactured by Fibre or approved equal to suit conditions and to comply with fire resistance and firestop manufacturer's requirements.
2. Thermal Ceramics Firemaster Bulk Fiber.

J. Accessories: Provide sleeves, collars, wrapstrips, devices, and other items required for a complete installation meeting the indicated F ratings.

K. Dam, Packing and Void Filling Materials: Mineral fiber safing insulation.

2.3 MIXING

A. For those products requiring mixing prior to application, comply with manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing and application time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 GENERAL

A. Firestop all new electrical penetrations through fire-rated walls which are within the limits of the work, only.

3.2 EXAMINATION

A. Examine penetration work surfaces “substrates”, conduit routes, and surrounding conditions for planning this work, and compliance with all requirements for wall cutting and opening, penetrating items, framing, condition of the substrates, and any conditions that may affect the execution of this work. In the event that an adverse or potential condition is detected, COR is to be notified immediately. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSPECTION

A. Examine the areas and conditions where firestops are to be installed. Correct any conditions detrimental to the proper and timely completion of the work.

B. Verify that environmental condition is safe and suitable for all work. Monitor from start through completion of all firestopping work.

3.4 PREPARATION

A. Surface Cleaning: Clean out openings and joints prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove foreign materials from surfaces of opening and joint substrates, and from surfaces of penetrating items that could reduce adhesion of firestopping.
2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing cohesion with firestopping. Remove loose particles remaining from cleaning operation without releasing dust.
3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping manufacturer, using manufacturer's recommended product(s) and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces. Use primers that conform to “Non-VOC” only.

C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work, and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's finish and seal with surrounding surfaces/substrates.

3.5 INSTALLING THROUGH-PENETRATION FIRESTOPS

A. General: Comply with all Part 1 – General requirements, and manufacturers' installation instructions and preparations pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories to support filler materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve the appropriate matching fire ratings. After installing fill materials, remove any excess forming materials, and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes and surfaces, unless otherwise specified by manufacturer's instructions.

D. Seal penetrations at column base enclosure conditions at access floor areas with prefabricated composite firestop devices and sealants for an airtight installation.

3.6 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

A. General: Comply with the "System Performance Requirements" article in Part 1.3, with ASTM C1193-05a, and with the sealant manufacturer's installation instructions and illustrations pertaining to products and applications indicated.

B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool non-sag sealants immediately after sealant application and prior to the time skinning or curing begin. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 FIELD QUALITY CONTROL

A. All firestopping is to be inspected by the COR, who is to be notified immediately upon completion of each installation. Access, work platforms, and access equipment and lighting are to remain in place until COR has completed inspection and approved the work.

B. Where deficiencies are found, immediately repair or replace firestopping and notify COR to schedule a new inspection.

3.8 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur. Extreme care must be taken to prevent creating or emitting any dust or other airborne debris. In the event of releasing any dust or debris, cease related work and Contact COR immediately.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove damaged or deteriorated firestopping immediately, and install new materials to produce firestopping complying with specified requirements.

3.9 INSPECTION OF WORK BY COR

C. All work must be completed to the satisfaction of the COR. In the event that the COR does not approve of the firestopping work, contractor must correct this at no additional expense to the government.

*** END OF SECTION 07270 ***

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. General:

1. Materials and equipment shall comply with all requirements of the contract documents. Materials furnished by the contractor shall be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If material and equipment requirements conflict, the order of precedence for selection shall be as follows: special contract provision, the contract drawings, this specification; and then in continuing order of precedence, Military Specifications, Federal Specifications, NFPA publications, IEEE standards, UL standards and NEMA standards. Wherever standards have been established by Underwriters' Laboratories, Inc., the material shall bear the UL label.

B. This Section includes the following electrical materials and methods:

1. Supporting devices for electrical components.
2. Electrical demolition.
3. Cutting and patching for electrical construction.
4. Touchup painting.

C. Applicable provisions of this Project include the following:

1. Provide equipment, wiring devices, and electrical connections required for installation of electrical equipment.
2. Provide indoor, normal and emergency lighting system.
3. Provide raceways and wiring for power and controls.
4. Provide grounding systems.
5. Provide empty conduit system for telephone and data.
6. Provide fire alarm detection system.
7. Provide public address system.
8. Provide seismic bracing.

D. Space requirements: Electrical equipment sizes indicated on the Drawings are generally based on specified manufacturer.

1. Verify that the equipment proposed will fit in the space indicated on the Drawings. Coordinate building dimensions with architectural and structural drawings. Equipment furnished and installed under other Sections of this specification shall be coordinated with electrical equipment installed under this Section.
2. Maintain clearances required by NEC around electrical equipment. Establish the exact location of electrical equipment based on the actual field verified dimensions of equipment furnished.

1.2 REFERENCE STANDARDS

A. General: Comply with the standards in effect as of the date of the Contract Documents as applicable to the extent specified in Division 16. The rules, regulations and reference specifications enumerated in these specifications shall be considered as minimum requirements. Adherence to other standards shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship when so required by this specification. Adherence to this specification shall not relieve the Contractor from furnishing and installing higher grades of materials and workmanship when so required by the contract Drawings or special contracts provisions. This specification shall govern when conflicts occur between it and the documents referenced in Article 1.1, paragraph A, sub-paragraph 1, of this Section.

B. American National Standards Institute (ANSI)

1.	A13.1	Scheme for the Identification of Piping Systems.

C. American Society for Testing and Materials (ASTM)

1.	A36	Standard Specification for Carbon Structural Steel.
2.	A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. Federal Aviation Administration (FAA)

1.	STD-019e	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.
2.	STD-020b	Transient Protection, Grounding, Bonding and Shielding Requirements for Electronic Equipment.
3.	C1217f	Electrical Work, Interior.
4.	C1391a	Installation and Splicing of Underground Cables.

E. Institute of Electrical and Electronic Engineers (IEEE)

1.	519	Recommended Practices and Requirements for Harmonic Control and Electrical Power Systems.

F. National Electrical Contractors Association (NECA)

1.	Standard of Installation	

G. National Electrical Manufacturers Association (NEMA)

1.	WC 5	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
2.	WC7	Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

H. National Fire Protection Association (NFPA)

1.	70	National Electrical Code (NEC)

I. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 Description and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

J. Underwriters Laboratories (UL)

1. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 SUBMITTALS

A. Product Data for each type of product specified.

B. Shop Drawings detailing fabrication, installation, and location of supports, seismic bracing, and anchorage for electrical items.

C. Project Record Documents: Maintain at the job site a separate set of white prints of the Contract Documents for the purpose of recording the system and dimension changes of those portions of work in which actual construction is significantly at variance with the Contract Documents. The Contractor shall record changes for both GFE and Contractor provided equipment. Upon acceptance of the project, submit documents to the COR, with verification of data accuracy. Mark the Drawings with colored pencil. Prepare the Drawings as the work progresses. Upon completion of work submit Drawings clearly indicating the following:

1. Locations of devices, conduits, equipment and other pertinent items.
2. Schematic and interconnection wiring diagrams of the completed power and control system incorporating the data derived from the equipment shop drawings. The drawings shall be detailed to wire and terminal block numbers, conductor color coding, device designations, locations, and reflect identifications established at the site.

D. Samples of color, lettering style, and other graphic representation required for each identification product for Project.

E. Operation and Maintenance Instructions:

1. Reference Material: Provide three copies of operating and maintenance instructions, equipment service manuals, catalog cuts and illustrations as described herein. The Operations and Maintenance (O&M) data shall be placed in suitable binders for use by maintenance personnel. The material shall include equipment model and serial numbers, performance characteristics, and power and utility requirements. Final acceptance of this equipment is contingent upon submission of required documents to, and approval by, the COR prior to equipment or facility turnover.
2. Minimum Data Required: Operating and maintenance instructions shall contain the following minimum data and shall comply with submittal requirements specified in individual Sections of the Specifications. Training on the operation and maintenance of special equipment shall be conducted by a certified technician from the manufacturer.

a. Operating instructions shall include illustrations and explanations for controls, initial set points, and startup and shutdown procedures for both normal and emergency conditions.
b. Maintenance instructions shall include periodic inspection and lubrication requirements, and when applicable, equipment performance verification requirements. Include a list of required tools and equipment to maintain the system.
c. Troubleshooting and fault diagnosis data shall list trouble symptoms, instructions necessary to determine cause of trouble and the action required to restore equipment to operating condition.
d. Repair instructions shall include equipment disassembly, repair, replacement, and reassembly. Checkout or test data shall also be provided. Reprogramming instructions shall be provided for equipment having a programmable memory. Repacking instructions shall be provided for sending equipment to the manufacturer or to a repair depot for repairs.
e. A parts list shall be furnished that includes part names and part numbers that are shown on illustrations or tables. The parts list shall identify the actual manufacturer of the part, replacement cost, and shall also contain a notation of identifying products as Commercial grade for common non-special design hardware.
f. The instructions shall contain a list of spare parts recommended by the equipment manufacturer to support the operation of the equipment for a one year time period. Provide names, addresses, and telephone numbers of all service organizations that supply repair parts for the system or systems to be furnished.
g. The O&M data shall include overhaul instructions that are required to return the equipment to full operational capability in the event that the machinery stops working properly.

h. The O&M data shall contain as appropriate, the following:

1) Wiring diagrams;
2) Electrical schematics;
3) Control diagrams;
4) Wire terminal assignments;
5) Equipment layouts;
6) Record Electrical Drawings, modified to record actual conditions and modifications, including dimensions; and
7) Approved Shop Drawings.

i. After final tests and adjustments have been completed, fully instruct the COR and other personnel, as directed by the COR, in details of operation and maintenance of special equipment, including control system, and fire alarm system, as installed. Submit outline of proposed instruction course, scheduled during a 3 week period, 21 days prior to start, for approval by the COR.

F. Operating Tests: An interim operating and performance test shall be performed for each major equipment item after installation is complete and before the item is placed in service. After mechanical systems have been completely installed and balanced, test each system for proper operation. Tests shall be conducted in the presence of the COR under design conditions to ensure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of the systems. Special tests on individual systems are specified under individual sections. Tests shall be scheduled and approved in writing by COR at least 10 working

days prior to conducting tests. Contractor shall demonstrate, to the COR's satisfaction, proper operation of control devices by simulating actual operating conditions. Devices tested shall include, but not be limited to, flow and pressure controls, temperature controls, and system interlocks and alarms.

1.4 QUALITY ASSURANCE

A. All materials procured and installed under this specification shall be in accordance with FAA-C-1217f, FAA-STD-019e, and FAA-STD-020b.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

D. Summary: Submit a summary of the Electrical Test Report and Motor Test Report, noting deviations from requirements listed below:

1. Maximum plus or minus five percent variation between nominal system voltage and no load voltage and between no load and full load voltage;
2. Variation between motor average phase current and measured individual phase currents does not exceed the manufacturer's specified limits; and;
3. Maximum plus or minus ten percent variation between average phase current and measured individual phase currents for panel-boards.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

C. Coordinate installing required supporting devices and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.

E. Coordinate connecting electrical service to components furnished under other Sections.

F. Coordinate requirements for access panels and doors where electrical items requiring access are covered by finished surfaces. Access panels and doors are specified in Section 08305 "Access Doors."

G. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

H. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

I. Interruption of Power: Contractor is advised that this facility includes a fully operational Air Traffic Control Center (ARTCC). The electrical power system is comprised of the types: critical, essential, and building service. Work shall be performed on the three types as indicated on drawings. Unscheduled interruptions of the electrical service may cause aircraft accidents and loss of life. Contractor is advised that failure to establish and maintain proper means and methods during the Work, resulting in accidents or loss of life, may result in charges of criminal negligence.

1. Work requiring a temporary or permanent de-energizing of critical, essential, and building service power systems shall be scheduled and approved in writing by the COR at least 21 calendar days in advance of performance of work.
2. Work may not commence until written authorization is received from the COR.
3. Unscheduled interruptions of power shall not be allowed at any time.
4. Only Government personnel are authorized to energize or de-energize equipment, to operate circuit breakers, switches, or fuses in this facility. Only the utility company shall be authorized to turn on, or turn off, the commercial power to this facility.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Provide channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
2. Metal Items for Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.
3. Seismic Zone: All support systems shall be designed and installed to withstand the local code equivalent of UBC Seismic Zone 4 forces.

B. Provide steel channel supports with 9/16-inch diameter holes at a maximum of 8 inches on center, in at least 1 surface.

1. Fittings and accessories to mate and match with channels and from same manufacturer.

C. Raceway Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click"- type hangers.

D. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with welded spiral seams or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:

a. 3-inch and smaller: 20-gage.
b. 4-inch to 6-inch: 16-gage.

c. over 6-inch: 14-gage.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

E. Expansion Anchors: Carbon-steel wedge or sleeve type.

F. Toggle Bolts: All-steel spring head type.

G. Powder-Driven Threaded Studs: Not Allowed.

H. Fasteners for plastic-laminated and metal signs: Self-tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts and flat end lock washers.

I. Supplementary Structural Supports: ASTM A 36 steel shapes

1. Supports shall be designed and installed to withstand the local code equivalent of a minimum UBC Seismic Zone 4 force.
2. Provide the installation of supplementary structural supports required for attachment of hangers and other devices supporting electrical equipment and conduits.
3. Members welded to main structural members shall be equal to the specification for the main structural member.
4. Size support members for their actual loads without excessive deflection and with consideration for rigidity under vibration.

2.2 TOUCHUP PAINT

A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.

B. For Non-equipment Surfaces: Matching type and color of undamaged, existing adjacent finish.

C. For Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

A. All materials and equipment shall be installed in accordance with the Contract Drawings, and with FAA-C-1217f, FAA-STD-019e, and FAA-STD-020b.

B. Where manufacturers recommended installation methods conflict with contract requirements, difference shall be resolved by the COR

C. The installation shall be accomplished by skilled workers regularly engaged in this type of work. Where required by local regulation, the workers shall be properly licensed.

D. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.

E. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.

F. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

G. Give right of way to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING METHODS

A. Damp Locations: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Conform to manufacturer's recommendations for selecting supports.

3.3 INSTALLATION

A. The rules, regulations, and reference documents indicated shall be considered as minimum requirements and shall not relieve the Contractor from furnishing and installing higher grades of materials and workmanship than are specified or when required by the Contract Drawings. Equipment shall be installed in a manner to provide proper working spaces, access, and space for removal of the equipment as required by the various equipment.

B. Contract Drawings: Where the Drawings schematically indicate the work, diagrammatically or otherwise, furnish and install equipment, material, and labor for a complete and proper installation. Ensure that electrical and communications Work is coordinated and compatible with Architectural, Mechanical and Structural Work.

C. Fire-Stopping: Apply to cable and raceway penetrations of fire-rated floor and wall assemblies. Perform fire stopping as specified in Section 07270, "Fire-Stopping" to re-establish the original fire-resistance rating of the assembly at the penetration.

D. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure in accordance with Paragraph 2.1, “Supporting Devices”, and with National Electrical Code (NEC) requirements. Install hangers and supports to withstand forces for the UBC Seismic Zone indicated.

E. Install identification devices where required in accordance with the requirements of Section 16195, “Electrical Identification.” Engrave nameplates as indicated up to a maximum of three lines. Identification and name plates shall be in accordance with FAA C-1217f, paragraphs 4.16 and 4.16.1.

F. Wiring Methods.

1. General: All wiring shall consist of insulated copper conductors installed in metallic raceways, unless otherwise specified.

2. Conductor routing: Panelboards, disconnect switches, etc., shall not be used as raceway for conductor routing other than conductors that originate or terminate in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.
3. Conductor separation: Power conductors shall be routed separately from all other conductor types in separate raceways. Separation may also be achieved by use of a metallic divider between the power conductors and the other type conductors in the same raceway.

    a. Power cables of less than 600 volts may be installed in the same duct, however, 480/277V power cables shall be in separate raceways from 208/120V power cables.
    b. Power cables of less than 600 volts shall not be installed in the same duct with control, telephone, or signal type cables.

4. Neutral conductor: Shared/common neutrals shall not be permitted, i.e., each over-current device shall have its own separate neutral conductor. Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.
5. Ground conductor: Shared/common grounding conductors shall not be permitted, i.e., each over-current device shall have its own separate ground conductor.

3.4 DEMOLITION

A. Accessible Work Indicated to Be Demolished: Remove exposed electrical installation in its entirety.

B. Abandoned Work: Remove electrical conductors in their entirety. Cap and patch surface to match existing finish.

C. Removal: Remove demolished material from the Project site.

D. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.5 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.6 TOUCHUP PAINTING

A. Thoroughly clean damaged areas and provide primer, intermediate, and finish coats to suit the degree of damage at each location.

B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3.7 FIELD TESTING

A. General: Perform the tests specified and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system. Repair or replace equipment that

does not meet test requirements and retest. Tests shall be scheduled and approved in writing by COR at least 21 working days prior to conducting tests. Unless otherwise indicated, the contractor shall furnish all test instruments, materials and labor necessary to perform tests designated in Division 16 Sections. All tests shall be performed in the presence of the COR. All instruments shall have been calibrated within a period of two years preceding testing. Calibrations shall be traceable to applicable industry recognized standards.

B. An interim operating and performance test shall be performed for each major equipment item after installation is complete and before the item is placed in service. After mechanical systems have been completely installed and balanced, test each system for proper operation. Tests shall be conducted in the presence of the COR under design conditions to ensure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of the systems. Special tests on individual systems are specified under individual sections. Provide 21 days written notice to the COR for major tests. Contractor shall demonstrate, to the COR's satisfaction, proper operation of control devices by simulating actual operating conditions. Devices tested shall include, but not be limited to, flow and pressure controls, temperature controls, and system interlocks and alarms.

C. After final tests and adjustments have been completed, fully instruct the COR and other personnel as directed by the COR in details of operation and maintenance of electrical equipment, including control systems and fire alarm system as installed.

D. Motor Insulation Resistance Test: Motors shall be tested for ground or short circuits after installation, but before start up. Windings shall test free from short circuits and grounds. Minimum insulation resistance for motors, phase to phase and phase to ground shall not be less than 30 megohm measured with a 500 volt DC insulation resistance tester. Apply the test voltage for at least one minute after the reading has stabilized.

E. Load Balancing: After the Contractor Acceptance Inspection (CAI) of electrical systems, redistribute the loads where there is a greater than a twenty percent difference between readings in two or more phases, in accordance with Section 16470, "Panelboards."

F. Complete the Electrical Test Report, Form 16050-1 included as Attachment No. 1. Provide the requested information for each panelboard and its power supply conductors. Perform insulation resistance tests in compliance with Section 16120, "Wire and Cables", on wires including the neutral before connection to source and to loads.

G. Complete the Motor Test Report, Form 16050-2 included as Attachment No. 2. Provide the requested information for each motor.

*** END OF SECTION 16050 ***

BOSTON AIR ROUTE TRAFFIC CONTROL CENTER
Nashua, New Hampshire

SECTION 16100 - RACEWAYS, BOXES, AND CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical and communication wiring.

B. Raceways include the following:

1. Rigid metal conduit (RMC).
2. Intermediate metal conduit (IMC).
3. Electrical metallic tubing (EMT).
4. Flexible metal conduit.
5. Liquid-tight flexible conduit.
6. Rigid nonmetallic conduit.

C. Boxes, enclosures, and cabinets include the following:

1. Device boxes.
2. Outlet boxes.
3. Pull and junction boxes.
4. Cable access box

1.2 REFERENCE STANDARDS

Applicable only to the extent specified.

A. American National Standards Institute (ANSI)

1.	C80.1	Rigid Steel Conduit-Zinc Coated.
2.	C80.3	Electrical Metallic Tubing-Zinc Coated.
3.	C80.6	Intermediate Metal Conduit Zinc Coated.

B. Federal Aviation Administration (FAA)

1.	STD 019e	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.
2.	STD 020b	Transient Protection, Grounding and Shielding Requirements for Electronic Equipment.
3.	C-1217f	Electrical Work, Interior.

C. Federal Specifications (FS)

1. W-C-586 Conduit Outlet Boxes, Bodies, and Entrance Caps.

D. National Electrical Contractor's Association (NECA)

1. Standard of Installation.

E. National Electrical Manufacturers Association (NEMA)

1. 250 Enclosures for Electrical Equipment.
2. FB 1 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies.
3. OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

F. National Fire Protection Association (NFPA)

1. 70 National Electrical Code (NEC)

G. Occupational Safety and Health Administration (OSHA)

1. 1910.7 Nationally Recognized Testing Laboratories (NRTL)

H. Underwriters Laboratories (UL)

1. 1 Flexible metal conduit.
2. 6 Rigid Metal Conduit.
3. 50 Enclosures for Electrical Equipment.
4. 360 Liquid-tight Flexible Metal Conduit.
5. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
6. 514A Metallic Outlet Boxes.
7. 514B Fittings for Conduit and Outlet Boxes.
8. 797 Standard for Safety Electrical Metallic Tubing.
9. 870 Standard for Safety Wireways, Auxiliary Gutters and Associated Fittings.
10. 1242 Intermediate Metal Conduits.

I. Uniform Building Code (UBC)

1.3 SYSTEM DESCRIPTION

A. Conduit size is indicated on Drawings. Minimum size conduit shall be 3/4 inch diameter.

B. Each critical power circuit shall occupy one dedicated conduit or box, separated from other circuits.

1.4 SUBMITTALS

A. Shop drawings for nonstandard boxes, enclosures, and cabinets. Include layout drawings showing components, wiring, supports, and seismic bracing.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70 "National Electrical Code" for components and installation.

1. Boxes shall be sized in accordance with NEC Article 370.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

C. Comply with NECA "Standard of Installation."

D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 GENERAL

A. Enclosures shall conform to NEMA standards.

B. All materials procured under this specification shall be in accordance with FAA C-1217f, FAA STD-019e, and FAA STD-020b.

2.2 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1 and UL 6.

B. Intermediate Metal Conduit: ANSI C80.6. Use for essential power systems where permitted by Code.

C. Electrical Metallic Tubing and Fittings: ANSI C80.3 and UL 797 with compression-type fittings. (Screw type fittings are not acceptable). Use for lighting, building power, fire alarm, environmental and communication circuits in concealed areas, such as: suspended ceilings, furred walls, raised floors, and where these circuits are not subject to physical damage.

D. Flexible Metal Conduit, Zinc Coated steel: UL 1 and FS WW-C-566

1. Liquid-tight Flexible Metal Conduit: Flexible metal conduit with PVC jacket: UL 360
2. Provide flexible metal conduit in minimum 24 inches or 10 diameter lengths for connection to motors and equipment subject to vibration and movement.

2. Conduit and fittings shall be type listed for grounding.

E. Fittings: NEMA FB 1 and UL 514B, compatible with conduit/tubing materials. Conduit expansion and deflection fittings shall be watertight. Fabricate from material compatible with conduit to be used. Expansion and deflection fittings shall be equipped with bonding jumper cable to provide electrical continuity. Lock-nut and bushings inside boxes or enclosures shall be grounding type.

2.3 OUTLET AND DEVICE BOXES

A. Sheet Metal Boxes: NEMA OS 1 and UL 514A.

B. Cast Metal Boxes: NEMA FB 1, type FD, cast ferroalloy box with threaded nubs, and with gasketed cover.

C. Exposed Outlet Boxes: UL 514A steel, malleable iron or cast iron boxes with threaded conduit entry for surface mounting in areas having exposed conduit systems.

D. Flush Outlet Boxes: UL 514A hot-dip galvanized steel, square or rectangular, 2-1/8 inches deep by four inches square, with extension ring where necessary.

E. Boxes for lighting fixtures: Flush mounted or in concealed areas: octagonal, four inches by 2-1/8 inches deep, galvanized steel, with fixture stud supports and attachments to properly support ceiling and bracket type lighting fixtures. Surface mounted: malleable or cast iron boxes with threaded conduit hub.

F. Sheet Metal Boxes: UL 514B.

2.4 PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1 and UL 514A.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine raceways prior to installation. No crushed or deformed raceway shall be installed.

3.2 WIRING METHODS

A. Indoors: Use the following wiring methods:

1. Connection to Vibrating Equipment (including transformers, hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible metal conduit, except in wet or damp locations use liquid-tight flexible metal conduit.
2. Damp or Wet Locations: Rigid metal conduit.
3. Exposed: Rigid metal conduit.
4. Concealed: Electrical metallic tubing, intermediate metal conduit, rigid steel conduit (EMT shall only be used for lighting receptacles, communications, fire alarm, security, and environmental controls in concealed locations indoors).
5. Boxes and Enclosures: NEMA Type 1, except in damp or wet locations use NEMA Type 3.

B. Outdoors: Use the following wiring methods:

1. Exposed: Rigid or intermediate metal conduit.
2. Concealed: Rigid or intermediate metal conduit.
3. Underground, Single Run: PVC coated rigid galvanized steel conduit and fittings.
4. Underground, Grouped: PVC coated rigid galvanized steel conduit and fittings.
5. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquid-tight flexible metal conduit.
6. Boxes and Enclosures: NEMA Type 3R or Type 4.

C. Conduit Use:

1. Install rigid steel conduit (RMC) or intermediate metal conduit (IMC) for all distribution panel feeders, transformer feeders, motor control center feeders, and distribution switchboards.
2. Install electrical metallic tubing (EMT) for communication, lighting, and branch circuits.

3.3 INSTALLATION

A. Products shall be installed in accordance with FAA C-1217f, FAA STD-019e, and FAA STD-020b.

B. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions. Install to withstand forces for the UBC Seismic Zone indicated in Section 16050, ‘Basic Electrical Materials and Methods.”

C. Minimum size raceway shall be 3/4 inch, unless otherwise noted. Conduit for signal systems shall be as follows:

1. 1/2-inch conduit may be used for lengths not exceeding 50 feet. 3/4-inch conduit may be used for lengths not exceeding 100 feet.
2. 1-inch conduit shall be used for lengths exceeding 100 feet.
3. No run shall contain more than two (2) 90 degree bends, or the equivalent.
4. Provide pull and junction boxes required to meet the above criteria.

D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors/raised floors.

1. Raceways shall not be attached to the ceiling suspension system.
2. Raceways shall not be attached to or supported by roof decks.
3. Do not anchor or strap raceways to wall furring channels or to other raceways.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

F. Install raceways level and square and at proper elevations. Provide adequate headroom.

1. Install conduit to drain moisture to nearest outlet or pull box.

G. Complete raceway installation before starting conductor installation.

H. Support raceways and boxes as specified in Section 16050 "Basic Electrical Materials and Methods."

1. Boxes for fixtures on suspended ceilings shall be supported independently of the ceiling supports.
2. Boxes shall not be supported from sheet-metal roof decks.

I. Use temporary closures to prevent foreign matter from entering raceway.

1. Prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings, and equipment during construction. Clogged raceways shall be entirely freed of obstructions or replaced. Clean each conduit run before pulling in conductors.

J. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and keep the straight legs of offsets parallel.

1. Prevent Bends in conduit that is 1 inch and larger shall have a minimum inside radii 12 times the nominal conduit diameter.
2. No run shall contain more than four (4) 90 degree bends, or the equivalent. Provide pull and junction boxes required to meet the bends criteria.

K. Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated.

L. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.

M. Floor and Wall Penetrations:

1. Penetrations through walls or floors shall be sealed to prevent moisture and rodent entry and to deter air transfer.
2. Seal penetrations of walls which separate individually temperature or humidity controlled areas, to prevent air circulation.

N. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

1. Run parallel or banked raceways together, on common supports where practical.
2. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

O. Join raceways with fittings designed and approved for the purpose and make joints tight.

1. Use bonding locknuts and bushings at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
2. Use insulating bushings for all conduits to protect conductors.
3. Provide expansion fittings for all raceways passing through the building expansion joints and conduit runs longer than 300 feet.

P. Where knockouts are used, provide double locknuts, one on each side with a grounding bushing or grounding locknut used on the inside.

Q. Raceway Supports: Comply with NFPA 70 and the following requirements:

1. Conform to manufacturer's recommendations for selecting and installing supports.
2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
4. Spare Support Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.
5. Support individual horizontal raceways with separate, malleable iron pipe hangers or clamps.
6. Hanger Rods: 1/4-inch diameter or larger threaded steel, except as otherwise indicated.
7. Spring Steel Fasteners: Specifically designed for supporting single conduits or tubing, may be used in lieu of malleable iron hangers for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to channel and slotted angle supports.
8. In vertical runs, arrange support so that the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals. Install supports simultaneously with raceway.
9. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.

10. Space supports for raceways in accordance with Table 1 of this section. Space supports for raceway types not covered by the above in accordance with the National Electrical Code (NEC).
11. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

TABLE 1: SPACING FOR RACEWAY SUPPORTS

HORIZONTAL RUNS

Raceway Size (Inches)	No. of Conductors in Run	Location	RMC & IMC (1)	EMT (1)	RNC (1)
3/4	1 or 2	Flat ceiling or wall.	5	5	3
3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7	...
3/4	3 or more	Any location.	7	7	...
1	3 or more	Any location.			...
1 & larger	1 or 2	Flat ceiling or wall.	6	6	...
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10	
1 & larger	3 or more	Any location.	10	10	
3/4 and larger	....	Concealed.	10	10	

VERTICAL RUNS

No. of Raceway Size (Inches)	RMC & Conductors in Run	Location	IMC (1,2)	EMT (1)	RNC (1)
3/4	....	Exposed.	7	7	....
1,1-1/4	....	Exposed.	8	8	....
1-1/2 and larger	....	Exposed.	10	10	....
Up to 2	....	Shaftway.	14	10	....
2-1/2	....	Shaftway.	16	10	....
3 & larger	....	Shaftway.	20	10	....
3/4 & larger	....	Concealed.	10	10	....

NOTES:
(1) Maximum spacing of supports (feet).
(2) Maximum spacing for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

ABBREVIATIONS:
EMT Electrical metallic tubing.
IMC Intermediate metal conduit.
RMC Rigid metal conduit.
RNC Rigid Non-metallic Conduit.

R. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, and other devices except where components are mounted directly to structural features of adequate strength.

S. In open overhead spaces, cast boxes threaded to raceways need not be separately supported, except where used for fixture support; support sheet-metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

T. Sleeves: Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

U. Fire-stopping: Apply to cable and raceway penetrations of fire-rated floor and wall assemblies. Perform fire-stopping as specified in Section 07270 "Fire-Stopping" to reestablish the original fire-resistance rating of the assembly at the penetration.

V. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cabinets, panelboards, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and by machine screws, welded threaded studs, or spring-tension clamps on steel.
2. Threaded studs driven by a powder charge shall not be used.
3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.
4. In partitions of light steel construction use sheet-metal screws.
5. Drill holes in concrete beams so holes more than 1-1/2 inches deep do not cut main reinforcing bars.
6. Drill holes in concrete so holes more than 3/4 inch deep do not cut main reinforcing bars.
7. Fill and seal holes drilled in concrete and not used.
8. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load. Use vibration and shock-resistant fasteners for attachments to concrete slabs.

W. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknut, one inside and one outside the box. In addition a bushing shall be installed on the interior threaded end of the conduit to protect conductor insulation.

X. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the

raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

Y. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight. Use insulating bushings to protect conductors.

Z. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb. tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

AA Flexible Connections: Use maximum of 6 feet of flexible metallic conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible metallic conduit in wet or damp locations. Install separate ground conductor across flexible connections.

BB Metal conduits shall be mechanically and electrically continuous between outlets, junctions and pull boxes, panels, cabinets and similar equipment.

CC Conduits shall enter and be secured to enclosures so that each system is electrically continuous throughout.

DD Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

EE Provide conduit support members required for proper and secure installation. Include stud supports, stems, mounting brackets, frames, and, if applicable, plaster rings.

1. Conduit supports shall employ materials which are suitable for the purpose. Cast metal parts other than malleable iron and cast-on rolled threads shall be designed to ensure structural adequacy.

FF Field Cut Conduit: Where conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory-cut threads on conduit.

3.4 INSTALLATION - BOXES

A. Boxes: Shall be provided in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. Each box shall have the volume required by NFPA 70 for the number and size of conductors in the box.

1. Outlet boxes: Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection.
2. Mounting light fixtures: Boxes for mounting fixtures shall be not less than 4 inches square.
3. Concealed wiring: Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. The front edge of the box shall be flush or recessed not more than 1/4" from the finished wall surface (whether the finished surface is drywall, or drywall and a sound-absorbing material.
4. Boxes in masonry block or tile walls: Shall be square-cornered title-type, or standard boxes shall have square-cornered tile-type covers.
5. Wet locations: Cast metal boxes installed in wet locations and boxes installed flush with exterior surfaces shall be gasketed.

B. Fixture boxes: Attach boxes to ceilings which are not suspended in at least two places. Distribute lighting fixture load over the ceiling boxes.

C. Mounting:

1. Install switch box on the strike side of the door at mounting height of 48 inches. Unless otherwise indicated, mounting height of receptacle boxes shall be 18 inches.
2. Height of a wall mounted outlet box is defined as the height from finished floor to horizontal center line of the cover plate.
3. Where outlets are indicated adjacent to each other, mount outlets in a symmetrical pattern with tops at the same elevation. Where outlets are indicated adjacent, but with different mounting heights, line up outlets on a vertical line.
4. Verify the final location of each outlet before installation. Remove and relocate outlet boxes placed in an unacceptable position.
5. At fire rated partitions, offset boxes to prevent back-to-back installation.

D. Box openings: Provide only the openings necessary to accommodate the conduits at the individual location. When this is not practical, plug unused openings.

E. Junction, transition and pull boxes:

1. Install junction, transition and pull boxes so that covers are readily accessible. Boxes in concealed areas of ceiling or wall shall be accessible through removable panels.
2. Locate pull boxes to permit easy pulling of wire or cables.
3. Securely attach boxes to structural and framing members using compatible fasteners of adequate size.
4. Bolt wall mounted boxes to steel profiles fastened to the wall.

F. Grounding: Provide each box with a green machine screw. Screw into tapped hole in the box for ground wire or lug connection.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer.

B. Cap stubbed up raceways, including raceways in cabinets, immediately upon installation. The use of paper or rag wads is not acceptable.

C. Galvanic corrosion protection: Avoid dissimilar metals in contact anywhere in conduit runs. Where contact cannot be avoided at conduit terminations, treat the connection with joint compound that eliminates galvanic corrosion. Where dissimilar metals are in contact, such as at aluminum cable tray or enclosures and steel supports, separate the contact surfaces by using gaskets, non-absorptive tape, or coating to prevent galvanic corrosion.

3.6 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

*** END OF SECTION 16100 ***

SECTION 16120 - WIRES AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

1.2 REFERENCE STANDARDS

Applicable only to the extent specified.

A. American Society for Testing and Materials (ASTM)

1. B3 Standard Specification for Soft or Annealed Copper Wire.
2. B8 Standard Specification for concentric-lay-stranded copper conductors; hard, medium hard, or soft.
3. D1000 Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes used for electrical and electronic applications.

B. Federal Aviation Administration (FAA)

1. C-1217f Electrical Work, Interior.
2. STD-019e Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.

C. Federal Specification (FS)

1. W-S-610 Splice Connectors.
2. QQ-W-343 Wire, Electrical, Copper, Uninsulated.

D. National Electrical Contractors Association (NECA)

1. Standard of Installation.

E. National Electrical Manufacturers Association (NEMA)

1. WC3 Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
2. WC5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
3. WC8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
4. WC26 Wire and Cable Packaging.

F. International Electrical Testing Association (NETA)

1. ATS Acceptance Testing Specification for Electric Power Distribution Equipment and Systems

D. National Fire Protection Association (NFPA)

1. 70 National Electrical Code (NEC)

G. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratories (NRTL)

H. Underwriters Laboratories (UL)

1. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 SUBMITTALS

A. Field test reports indicating and interpreting test results relative to compliance with performance requirements of testing standard.

1.4 QUALITY ASSURANCE

A. Testing Firm Qualifications: An independent testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7, or shall be a full member company of the International Electrical Testing Association (NETA).

1. Testing Firm's Field Supervisor Qualifications: A person currently certified by the NETA National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Comply with NFPA 70, NEC, for components and installation.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the NEC, Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

D. Installer Qualifications: Cable splices shall be performed by experienced and qualified cable splicers. The workmen shall be licensed if required by the authority having jurisdiction.

1.5 SEQUENCING AND SCHEDULING

A. Coordination: Coordinate layout and installation of cable with other installations.

1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the COR.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials procured and installed in this Section shall be in accordance with FAA-C-1217f, FAA STD-019e, and FAA STD-020b.

2.2 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.

B. Rubber Insulation: Conform to NEMA WC 3.

C. Thermoplastic Insulation: Conform to NEMA WC 5.

D. Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG. Stranded conductors shall be tin coated, ASTM B8, Class B.

E. All wire and conduit sizes are based on copper conductors with 75 degrees C insulation.

F. Size: Minimum 12 AWG. Minimum 10 AWG for 120 volt circuits where circuit length (one way) exceeds 75 feet from source, and 10 AWG for 277 volt circuits where circuit length (one way) exceeds 150 feet from source. Communication and control systems wiring size shall be in accordance with Manufacturer's requirements or as specified elsewhere in the specifications.

1. Stranded conductors may be used with wire compression connectors or a pressure washer type lug.
2. Stranded conductors smaller than 10 AWG are allowed in applications where vibration and flexing may be encountered.

G. Conductor type: Soft drawn, annealed copper (aluminum conductors are not acceptable).

1. Power conductors shall be single conductor type.
2. Control interconnection between equipment shall be jacketed type multi-conductor.
3. Instrumentation conductor shall be twisted pair, shielded, jacketed type.
4. Conductors used for lighting and receptacle branch circuits shall be single conductor type.

H. Conductor Color Codes: Refer to Section 16195, "Electrical Identification," for conductors No. 4 AWG and larger, where factory color coding is not available.

1. Feeder conductors to panels and three phase circuits shall be factory color coded as follows:

a. 208/120 (240) Volt System

1) Phase A: Black

2) Phase B: Red
3) Phase c: Blue
4) Neutral: White
5) Ground: Green

b. 480/277 Volt System

1) Phase A: Yellow
2) Phase B: Brown
3) Phase C: Orange
4) Neutral: Grey
5) Ground: Green

2. Single-phase branch circuits shall be factory color coded as stated above, or identified in accordance with Section 16195, "Electrical Identification."
3. Switch leg conductors shall be violet insulated.
4. Control Cables shall be IAW NEMA WC5.

I. Un-insulated conductors shall be copper and comply with F.S. QQW-343.

J. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.

2.3 CONNECTORS AND SPLICES

A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3 "Applications" Article.

B. Connectors, Splice Sleeves and Terminal Lugs: Wire and cable connectors, lugs, and sleeves shall be in compliance with UL 486A, and the following:

1. For splices of 10 AWG and smaller building wires in lighting circuits, use tin plated copper compression type connector caps with nonflammable, self-extinguishing insulation grip with temperature rating equal to that of conductor insulation; and
2. Use ring tongue compression type terminators with insulated barrel on all stranded conductors used in control wiring.
3. Crimp type connectors not permitted on solid conductors.

C. Insulating Tape: ASTM D1000. As a minimum, rate equal to conductor insulation. Rubber tape shall be silicon rubber with silicon pressure sensitive adhesive.

D. Bundling Straps: Nylon straps with a locking hub or head on one end and a taper on the other.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Feeders: Type THHN/THWN, copper conductor, in raceway.

B. Indoor Branch Circuits: Type THHN/THWN, copper conductor, 90 degree C insulation in raceway, for use in dry locations only for lighting and receptacle circuits.

C. Exterior Branch Circuits: Type THWN, copper conductor, 75 degree C insulation, in raceway.

D. Fire Alarm Power Circuits: Type THHN/THWN, copper conductor, in raceway.

E. Communication System wiring (to include telephone cable, fire alarm cable, security wiring, intercommunication wiring and public address/music system) shall be as specified under applicable sections and specific requirements of the NEC. Use copper wire or fiber optics cable only. Aluminum wire is not permitted.

3.3 INSTALLATION

A. Materials procured and installed in this Section shall be in accordance with FAA-C-1217f, FAA STD-019e, and FAA STD-020b.

B. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."

C. Remove existing wire from raceway before pulling in new wire and cable.
D. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.

1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
3. Bend to radii not less than the minimum bending recommended by manufacturer or 12 times the outer diameter of cable. Do not exceed the pulling tension recommended by manufacturer.

E. Cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation or damage to the outer protective covering.

F. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

G. Conductor Splices: Keep to minimum.

1. Splices shall be made only at outlets, junction boxes, or accessible raceways.
2. Wire nuts may only be used to splice conductors sized No. 10 AWG and smaller.
3. Compression connectors shall be used to splice conductors No. 8 and larger.

4. All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.
5. Splicing of ungrounded conductors in panelboards is not permitted.
6. Splices shall be made with solderless connectors conforming to UL 486A, UL 486C, UL 486E and FS W-S-610.
7. No splices shall be allowed on critical feeders. Critical circuits are identified on drawings.
8. Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
9. Use splice and tap connectors that are compatible with conductor material.
10. Splicing methods and material shall be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced and shall be approved by the COR prior to installation

H. Wiring at Outlets: Install with at least 12 inches of slack conductor at each outlet.

I. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

J. Conductors for critical circuits, emergency lighting, security systems, and fire alarm systems shall be kept completely independent from any other system as well as each other.

K. Grounding: Materials and equipment installed at this facility shall be grounded in accordance with FAA-C-1217f.

L. Separate neutral and ground wires shall be provided for each overcurrent protection device. Each branch circuit shall have its own neutral and ground conductor. Common neutral or ground is not acceptable.

M. Neutral conductors shall extend from the neutral bus where the phase conductors originate.

N. Each raceway shall contain a grounding conductor.

O. Install conductors only after the raceway system is complete.

P. Install electrical identification devices specified in Section 16195 “Electrical Identification”, at terminations, immediately after installing wires and cables.

3.4 FIELD QUALITY CONTROL

A. Testing, General: Cables shall be tested prior to installation and again upon completion of the installation. Testing shall be accomplished before connection is made. Tests shall be performed in the presence of the COR.

1. Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

a. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.
b. Test wire and cable for continuity or circuitry, and also for short circuits.

B. Insulation Resistance Tests: Feeder and Branch Circuit insulation tests shall be performed after installation, but before connection to equipment.

1. Conductors shall test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 30 megohms when measured with a 500-volt DC insulation resistance tester. The contractor shall submit a letter type test report to the COR prior to final inspection of the Work. The report shall list the tests performed and results obtained.

   a. Apply the test voltage for at least one minute after motor reading has stabilized.

2. Where new and existing cables are to be spliced, both cables shall be tested. The resistance values for new cable shall not be less than those recommended by the cable manufacturer. Resistance values for existing cable insulations shall not be less than 80 percent of the value for a comparable new cable. Report to COR, location of existing cable installation with less than 80 percent insulation value of new cable to be spliced.

C. Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

*** END OF SECTION 16120 ***

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors and associated fastenings.

1.2 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. 70: National Electrical Code (NEC)

B. Underwriters Laboratories (UL)

1.3 SUBMITTALS

A. Product catalog cut data for each type of product specified with selection identified to show compliance with specifications.

B. Shop drawings of supports to meet seismic requirements for IBC.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70.

B. Electrical components shall be listed and labeled by UL or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

2.1 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.

2.2 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps (if needed for existing conduit).

B. Fasteners: Types, materials, and construction features as indicated.

C. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

D. Support systems shall be capable of carrying the weight of the box and its contents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Raceway Supports: Comply with the NEC and the following requirements:

1. Neither raceways nor boxes shall be fastened to suspended ceiling supports.

*** END OF SECTION 16190 ***

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components, including but not limited to the following:

1 Identification labeling for raceways, cables, and conductors.
2. Operational instruction signs.
3. Warning and caution signs.
4. Equipment labels and signs.

1.2 REFERENCE STANDARDS

A. American Standards Institute (ANSI)

1. A13.1: Scheme for the identification of piping systems.

B. National Fire Protection Association (NFPA)

1. 70 National Electrical Code (NEC)

1.3 SUBMITTALS

A. Product Data for each type of product specified.

B. Schedule of identification nomenclature to be used for identification signs and labels.

C. Samples for each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70.

B. ANSI Compliance: Comply with requirements of ANSI standard A13.1, with regard to type and size of lettering for raceway and cable labels.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

B. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Brady USA, Inc.; Industrial Products Div.
2. Cole-Flex Corp.
3. George-Ingraham Corp.
4. Ideal Industries, Inc.
5. Panduit Corp.
6. Seton Name Plate Co.
7. Standard Signs, Inc.

2.2 RACEWAY AND CABLE LABELS

A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.
2. Legend: Indicates voltage and service.

C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is laminated with a clear, weather- and chemical-resistant coating.

D. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

F. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.3 ENGRAVED NAMEPLATES AND SIGNS

A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Engraving stock, melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 sq. in. or 8 inches in length; 1/8 inch thick for larger sizes.

1. Engraved Legend: white letters on black face.
2. Punched for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for the application. 1/4-inch grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.

E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb minimum.
3. Temperature Range: Minus 40 to 185 deg F .

B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

E. Identify Raceways and Exposed Cables of Certain Systems with Color Banding and Black Lettering Appropriately Sized for Conduit: Band exposed and accessible raceways of the systems listed below for identification.

1. Bands: Pre-tensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25 feet in congested areas.
3. Colors: As follows:
   a. Fire-Alarm System: Red.
   b. Fire-Suppression Supervisory and Control System: Red and yellow.
   c. Security System: Blue and yellow banding only, no lettering.
   d. Direct Digital Control System: Green and blue.
   e. Telecommunications System: Green and yellow.

F. Install Circuit Identification Labels on Boxes: Label externally as follows:

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label, as well as "magic marker" on cover.
2. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
3. Install line marker for underground wiring, both direct buried and in raceway.

H. Color-Code Conductors: The following field-applied color-coding methods may be used in lieu of factory-coded wire listed in Section 16120 "Wires and Cables" for sizes larger than No. 4 AWG. Contractor shall demonstrate non-availability of factory colored wire before using this application

1. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
   a. Where conductors are color coded by this method, they shall be color coded in accessible raceways, panelboards, outlets, and switches, as well as at all terminations. Conductors in accessible raceways shall be color coded so that by removing or opening any cover, the coding will be visible.
   b. Phase, ground, and neutral conductors shall be color coded in accordance with Section 16120, "Wires and Cables."

2. Green insulated conductors shall not be re-identified for purposes other than grounding.
3. White or neutral grey conductors shall not be re-identified for purposes other than grounded neutrals.

I. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in pull boxes, junction boxes, handholes, and switchboard rooms.

1. Legend: 1/4-inch-steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Fasten tags with nylon cable ties; fasten bands using integral ears.

J. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
3. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.

K. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, and other emergency operations.

L. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch-high label; where 2 lines of text are required, use larger 2-inch-high label. Use white lettering on black field. Apply labels for each unit of the following categories of equipment. Provide Name or function on first line, Phase and voltage on second line. Nomenclature to be on each nameplate(Ex. E-1006A, 3 phase, 480/277volts).
   a. Panelboards, electrical cabinets, and enclosures (including MCC compartments).
   b. Access doors and panels for concealed electrical items.
   c. Motor starters.
   d. Push-button stations.
   e. Contactors.
   f. Remote-controlled switches.
   g. Dimmers.
   h. Control devices.
   i. Telephone switching equipment.
   j. Fire-alarm master station or control panel.
   k. Security-monitoring master station or control panel.

2. Apply identification labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
3. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

4. Tag cables in each handhole with not less than two tags per cable, one near each duct entrance hole.
   a. Attach tags to cable immediately after installation.
   b. Cable terminations shall be tagged as to function.
   c. Attach securely to cable using 1/8 inch nylon cord.

*** END OF SECTION 16195 ***

SECTION 16452 - GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.

1.2 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. 70: National Electrical Code (NEC).

B. Underwriters Laboratories (UL)

1. 467: Grounding and bonding equipment.
2. 486A: Wire connectors and soldering lugs for use with copper conductors.

C. Federal Aviation Administration (FAA)

1. FAA-STD-019E, Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment.
2. FAA-C-1217f – Electrical Work, Interior
3. FAA-C-1391b – Installation & Splicing Of Underground Cables

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70, National Electrical Code.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ILSCO.
2. Kearney.
3. Thomas & Betts, Electrical.

2.2 GROUNDING AND BONDING PRODUCTS

A. Products: Of types indicated and of sizes and ratings to comply with the NEC. Where types, sizes, ratings, and quantities indicated are in excess of requirements above, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 WIRE GROUNDING CONDUCTORS

A. Comply with Section 16120 "Wires and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

1. Material: Copper. Use only insulated copper wire
2. Size: Minimum allowable size shall not be less than #12 AWG, in addition to compliance with NEC.

B. Equipment Grounding Conductors: Insulated with green color insulation.

2.4 MISCELLANEOUS CONDUCTORS

A. Raceway Bonding Jumpers: Copper, minimum size #6 AWG unless otherwise noted.

B. Ground Strap: Provide a flexible ground strap, #6 AWG or braided equal, for electrical continuity at each flexible duct connection of each air handler, and fan.

C. LFMC raceway (e.g, “liquidtight”): All LFMC used in construction shall be manufactured with an internal bonding conductor, or, a separately installed exterior bonding jumper (#6 AWG, minimum) shall be installed with grounding bushings at each connector.

PART 3 - EXECUTION

3.1 APPLICATION

A. General: FAA grounding requirements often exceed those of NEC; therefore, grounding system shall be as indicated in Contract Drawings, and as specified herein.

B. Equipment Grounding Conductors: All metallic non-current carrying parts of electrical equipment shall be grounded with equipment grounding conductors whether or not shown on the drawings. Equipment grounding conductors shall be green insulated copper conductors unless otherwise indicated. When these conductors are not sized nor shown on the Contract Drawings, size them in accordance with the NEC, “Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment”. In no case, however, shall these conductors be smaller than No. 12 AWG.

1. Install green, equipment grounding conductor with all feeder and branch circuit conductors for each overcurrent device.

C. Conduit or cable shields shall not be used as the equipment grounding conductor.

3.2 INSTALLATION

A. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

3.3 CONNECTIONS

A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.

B. Terminate insulated equipment grounding conductors for feeders with pressure-type grounding lugs. Where metallic raceways terminate at non-metallic or non-conductive housings, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors .

C. Raceway Grounding: Surface metal raceways, wireways, or cable rack systems shall be installed in a manner that assures electrical continuity. Insulated copper bonding jumpers shall be installed between adjacent raceway sections to assure proper bonding. Uninsulated conductors shall not be used. Unless otherwise indicated, the minimum size for these bonding jumpers shall be No. 6 AWG. Where aluminum raceways are used, the jumpers shall be bonded with approved connectors for the dissimilar metals. All metallic raceway penetrations into a facility structure shall be bonded to the earth electrode system.

3.4 SYSTEM AND EQUIPMENT GROUNDING

A. Install a grounding conductor for each overcurrent device. The equipment grounding conductor shall be installed in the same conduit as the branch or feeder conductors. Grounding conductor shall have insulation rating equivalent to phase conductor insulation. Insulated grounding conductors shall be connected to the ground terminal at both ends and to junction, transition, pull and fixtures boxes along the route. Under no circumstances shall this conductor be omitted from the electrical system, nor shall a separate grounding system, such as the signal grounding, be used as a substitute.

B. Metallic raceway housing the equipment grounding conductor shall be mechanically and electrically continuous.

C. Where there are parallel conductors of a feeder installed in more than one raceway, install an equipment grounding conductor in each raceway.

D. Ground the ends of all conduit runs using grounding bushings.

E. Splices of grounding conductors inside conduits are not acceptable.

*** END OF SECTION 16452 ***

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.2 REFERENCE STANDARDS

Applicable only to the extent specified.

A. American Society for Testing and Materials (ASTM)

1.	B187	Standard Specification for Copper Bar, Bus Bar, Rod and Shapes.
2.	E 699	Standard Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee.

B. Federal Aviation Administration (FAA)

1.	C-1217f	Electrical Work, Interior.
2.		STD-019e Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment.
3.	STD-020b	Transient Protection, Grounding and Shielding for Electronic Equipment.

C. Federal Specification (FS)

1.	W-P-115	Panel, Power Distribution.

D. Institute for Electrical and Electronics Engineers (IEEE)

1.	C62.1	Standard for Gapped Silicon-Carbide Surge Arrestors for AC Power Circuits.
2.	C62.11	Standard for Metal-Oxide Surge Arrestors for Alternating Current Power Circuits.
3.	C62.41	Recommended Practice on Surge voltage in Low-Voltage AC Power Circuits.

E. National Electrical Testing Association (NETA)

1.	ATS	Acceptance Testing Specification for Electric Power Distribution Equipment and Systems.

F. National Electrical Manufacturers Association (NEMA)

1.	AB1	Molded Case Circuit Breakers and Molded Case Switches.
2.	PB1	Panelboards.

3. PB 1.1 General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
4. 250 Enclosures for Electrical Equipment (1000 Volts or Less)

G. National Fire Protection Association (NFPA)

1. 70 National Electrical Code (NEC).

H. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 Definitions and Requirements for A National Recognized Testing Laboratories (NRTL).

I. Underwriters Laboratories (UL)

1. 50 Enclosures for Electrical Equipment.
2. 67 Panelboards.
3. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
4. 489 Molded-Case Circuit Breakers and Circuit Breaker Enclosures.
5. 870 Wireways, Auxiliary Gutters and Associated Fittings

1.3 DEFINITIONS

A. Over current Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.4 SUBMITTALS

A. Product data for each type panelboard, accessory item, and component specified.

B. Shop drawings from manufacturers of panelboards including dimensioned plans, sections, elevations, supports, and seismic bracing. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA Type 1.
2. Bus configuration and current ratings.
3. Short-circuit current rating of panelboard.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
5. Characteristic time current curves of every type of circuit breaker.

C. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.

D. Qualification data for field-testing organization certificates, signed by the Contractor, certifying that the organization complies with the requirements specified in Quality Assurance below.

E. Report of field tests and observations certified by the testing organization.

F. Panel schedules for installation in panelboards. Submit final versions after load balancing.

G. Maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual instructions specified in Section 16050 “Basic Electrical Materials and Methods.” Include instructions for testing circuit breakers.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7, or shall be a full member company of NRTL.

1. Testing Agency’s Field Supervision: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3 of this section.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

C. Field-Testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

D. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."

E. NEMA Standard: Comply with NEMA PB1.

F. UL Standards: Comply with UL 50.

G. Over current Protective Devises (OCPD): Provide circuit breakers in accordance with NEMA AB1 and UL 489.

1.6 EXTRA MATERIALS

A. Keys: Furnish two spares of each type for panelboard cabinet locks.

B. Touch-up Paint for panelboards: One half-pint container.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, FAA STD-019e, and FAA STD-020b.

2.2 PANELBOARD FABRICATION

A. Panelboards shall be circuit breaker equipped, dead-front type, and shall conform to Federal Specification W-P-115, Type I, Class 1.

B. Enclosures: UL 50, galvanized steel, flush- or surface-mounted cabinets as indicated. Panelboards shall be listed and labeled by Underwriters Laboratories, Inc. in accordance with UL Standard 67, and shall conform to the latest requirements of the National Electric Code and of NEMA Standard PB 1, Type 1, Class 1, unless otherwise indicated to meet environmental conditions at installed locations.

C. Directory Frame: Metal with plastic cover, mounted inside each panelboard door.

D. Bus: Hard drawn copper of 98 percent conductivity meet UL 67 temperature rise limits, and have a current density of 1000 amperes per square inch. Bus bars shall be sequenced-phased, and rigidly supported by high impact resistant, insulated bus supporting assemblies to prevent vibration or short circuits. Solderless terminations shall be suitable for copper UL listed wire or cable and shall be tested and listed in conjunction with appropriate UL standards.

1. Phase bus bars shall be silver plated copper or tin plated copper.
2. Neutral bus bar shall be copper or plated copper, and insulated from panelboard.
3. Capacity as indicated on Drawings, or equal to or greater than the panelboard OCPD.
4. Ground and neutral buses provided with mechanical connectors; one connector for each pole of panel.

E. Main and Neutral Lugs: Compression type.

1. The neutral bar shall be fully rated and capable of being located in either corner of the enclosure at the line end to facilitate conductor termination and shall be insulated from panelboard. Provide 200% rated neutral for panelboards supplying power to non-Linear loads as shown on Drawings.

F. Equipment Ground Bus: Ground bus shall be copper, fully rated, and adequate for feeder and branch-circuit equipment ground conductors with 25% additional space for future conditions. Lugs shall be sized to accommodate grounding conductors shown on plans.

1. The ground bus shall be securely bonded to the cabinet and shall be separate from the neutral bus.
2. The number of terminations shall be equal to the number of poles in the panelboard.
3. The ground bus bar shall be structurally integral to the panelboard, or attached to the panelboard with a bolt, nut, and lockwasher.

a. If ground bus bar is mounted to enclosure with screw threads only, (i.e. tapped blind hole), a separate bolted ground lug shall be installed on the panelboard and bonded to the ground bus bar.

1. Bond conductor shall have same current carrying capacity as the largest equipment grounding conductor terminated to the ground bus bar.

G. Short circuit rating: Panelboards shall be fully rated in AIC, see Drawings for AIC rating. Minimum: 10,000 AIC at 208V and 14,000 AIC at 480V.

H. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the over current protective device ampere ratings indicated for future installation of devices.

I. Include the following special features for panelboards.

1. Hinged Front Door in Door Construction: Entire front trim hinged to box with standard door within hinged trim cover. (One piece front with two doors). The smaller door, when open, provides access to device handles and rating labels and shall be lockable. The larger door, when open, provides access to conductors and wiring terminals. Door hinges shall be continuous piano hinges which are welded to the door(s) and bolt on front.

    a. All door hinges shall be concealed.

2. Channel/Wiring Space: Shall be four (4) inches wide for power feeders up to and including 100 amperes, six (6) inches wide for power feeders over 100 amperes and up to and including 225 amperes, and eight (8) inches wide for power feeders over 225 amperes and up to 600 amperes.
3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and floor.
4. Sub feed: Over current protective device or lug provision.

J. Doors shall have flush type cylinder locks and catches. All locks in a project shall be keyed alike, and 2 keys shall be furnished with each lock.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, UL 489, FS W-C-375 and the following requirements.

1. Molded case
2. Bolt-on breaker type with preassembled captive screw. Stab-in and plug-in types are not acceptable.
3. Quick make, quick break connections with mechanical trip free switching mechanism
4. Inverse time, thermal over current trip;
5. Instantaneous magnetic trip;
6. Thermal trip calibrated for 40 deg C ambient temperature;
7. Provide breakers with number of poles, voltage rating, current rating, and frame size as indicated on the drawings.
8. Multiple circuit breakers shall have an internal, common trip mechanism;
9. Trip-indicating feature;
10. Single-pole breakers shall be full size modules;
11. Two and three pole breakers shall be sized in multiples of a single-pole breaker;
12. Branch circuits shall be connected to the individual circuit number, as indicated on the Drawing;
13. UL marked as suitable for use with 75 deg C wire.
14. Shunt Trip: Where indicated. 120V. 60HZ.

B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices and interrupting capacity rating to meet available fault current as indicated on the Drawings.

1. Minimum rating: 10,000 AIC.
2. Circuit breaker ratings shall be in accordance with the SCA/PDC study, FAA Order 6950.27.

C. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.

D. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

2.4 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items as required for over current protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with manufacturer's requirements in accordance with the direction of the COR. Install to withstand forces for the UBC Seismic Zone indicated in Section 16050, "Basic Electrical Materials and Methods."

3.2 INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting Heights, top of trim: Not to exceed 81 inches above finished floor.

C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.

D. Circuit Directory: Type directory to include installed circuit loads after balancing panelboard loads. The directory shall be arranged so that typed entries simulate circuit breaker positions in the panelboard. Obtain approval of the COR before installing.

E. Install filler plates in unused spaces.

F. Wiring in Panelboard Gutters: Arrange each circuit's conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in, Section 16195 "Electrical Identification."

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws, as specified in Section 16195 "Electrical Identification." Provide panelboards with nameplates indicating the panel name, system voltage, and phase.

Example: Panel B-A222-A
208 Y/120 V, 3 Phase, 4 Wire

3.4 GROUNDING

A. Make equipment grounding connections for panelboards as indicated, and in accordance with, Section 16452 “Grounding.”

B. Provide ground continuity to main electrical ground bus as indicated.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A.

3.6 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.
2. Make continuity tests of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA, ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

C. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

D. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:

1. Perform pole to pole and pole to ground and to neutral insulation resistance tests with 500 volt DC Meggar. Insulation resistance shall be a minimum of 50 megohms. Perform test with breakers mounted, in the ON position, and not connected to external circuits.
2. Ground resistance test on equipment ground connections.
3. Test main and sub feed overcurrent protective devices.

3.7 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt and debris. Touch up scratches and marred finishes to match original finish.

3.9 COMMISSIONING

A. Balancing Loads: After Substantial Completion, conduct load-balancing measurements and circuit changes as follows:

1. Perform measurements during period of normal working load as advised by the COR.
2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with COR to avoid disrupting critical 24-hour services such as FAA communications equipment and on-line data processing, computing, transmitting, and receiving equipment.
3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
4. After load balancing, modify identifications of relocated branch circuit conductors to comply with requirements of Section 16195 “Electrical Identification.” Revise record drawings to show modifications.
5. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

*** END OF SECTION 16470 ***

SECTION 16476 – DISCONNECTS AND ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes individually mounted switches and circuit breakers used for the following:

1. Feeder and equipment disconnect switches.
2. Feeder overcurrent protection.
3. Motor disconnect switches.

1.2 REFERENCE STANDARDS

A. International Electrical Testing Association (NETA)

1. ATS: Acceptance Testing Specification for Electric Power Distribution Equipment and Systems.

B. National Electrical Manufacturer Association (NEMA)

1. KS1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
2. AB1: Molded Case Circuit Breakers and Molded Case Switches.
3. FU1: Low Voltage Cartridge Fuses.

C. National Fire Protection Association (NFPA)

1. 70: National Electrical Code (NEC).

D. Occupational Safety and Health Administration (OSHA)

1. 29CFR 1910.7: Definitions and requirements for a Nationally Recognized Testing Laboratory (NRTL).

E. Underwriters Laboratories (UL)

1. 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 SUBMITTALS

A. Product data for switches, circuit breakers, and accessories specified in this Section. Include the following:

1. Descriptive data and time-current curves.
2. Let-through current curves for circuit breakers with current-limiting characteristics.
3. Coordination charts and tables and related data.

B. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Field test reports indicating and interpreting test results.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to the Quality Control requirements specified in Division 1, an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7, or shall be a full member company of the International Electrical Testing Association (NETA).

1. Testing Agency's Field Supervisor: Person currently certified by NETA or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.

C. Comply with NFPA 70 for components and installation.

D. Listing and Labeling: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

E. Single Source Responsibility: All enclosed switches and circuit breakers shall be the product of a single manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

2.2 DISCONNECT SWITCHES

A. General: Switches shall be of the voltage and current ratings indicated on the Drawings, and each shall be capable of interrupting the locked rotor current of the motor for which it is to be used. The locked rotor current will be assumed to be ten (10) times the full rated load current. Switches shall be the quick-make, quick-break type. Except for ground lugs that shall be bonded to the housing, parts shall be mounted on insulating bases to permit replacement of any part from the front of the switch. All current carrying parts shall be of high conductivity copper unless otherwise specified, and shall be designed to carry rated current without excessive heating. Switch contacts shall be silver tungsten or plated to minimize corrosion, pitting and oxidation and to assure suitable conductivity.

B. Enclosed, Non-fusible Switch: NEMA KS 1, Type HD, lockable handle, with 2 padlocks.

C. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.

1. Outdoor Locations: Type 3R.
2. Other Wet or Damp Indoor Locations: Type 4.

D. Motor Disconnect: Provide each motor with a disconnecting means and a manually operated switch as shown on the Drawings or when required by NFPA 70.

1. Single phase motors: Provide a single-pole or double pole toggle switch, rated only for AC, for motor capacities less than 30 amperes, providing that the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors. Enclosed safety switches shall conform with paragraph 2.1B above.

E. Auxiliary Contacts: Provide additional contacts for equipment with variable frequency drives: one normally open, one normally closed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions. Install to withstand forces for the UBC Seismic Zone indicated in Section 16050, “Basic Electrical Materials and Methods.”

B. Install disconnect switches and circuit breakers level and plumb.

C. Install wiring between disconnect switches, circuit breakers, control, and indication devices.

D. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

E. Identify each disconnect switch and circuit breaker according to requirements specified in Section 16195, "Electrical Identification".

3.2 FIELD QUALITY CONTROL

A. Testing: After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 ADJUSTING

A. Set field-adjustable disconnect switches and circuit-breaker trip ranges as indicated.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

*** END OF SECTION 16476 ***

SECTION 16481 – MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes AC motor control devices rated 600 V and below that are supplied as enclosed units.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturer Association (NEMA)

0. ICS2: Standard for Industrial Control Devices, Controllers and Assemblies.
1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

B. National Fire Protection Association (NFPA)

1. 70: National Electrical Code (NEC).

C. Occupational Safety and Health Administration (OSHA)

1. 29CFR 1910.7 Definitions and requirements for a Nationally Recognized Testing Laboratory (NRTL).

D. Underwriters Laboratories (UL)

1. 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
2. 508: Electrical Industrial Control Equipment.

1.3 DEFINITIONS

A. Motor Controller: A device that controls, protects, and energizes an electric motor, and where required, controls its speed or the torque or power delivered by it.

1.4 SUBMITTALS

A. Product data for products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

C. Maintenance Data: For products to include in the maintenance manuals.

D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suit actual motor nameplate full-load currents.

E. Qualification Data for Field Testing Agency: Certificates, signed by Contractor, certifying that agency complies with requirements specified in Article 1.5 “Quality Assurance”.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide controllers from manufacturers regularly engaged in the manufacture of equipment of the types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 years. Manufacturer must also maintain, within 100 miles of the project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Field Testing Agency Qualifications: An independent testing agency with experience and capability to satisfactorily conduct testing indicated without delaying the Work. Evaluation criteria shall be according to ASTM E 699.

C. Components and Installation: NFPA 70 "National Electrical Code."

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

E. NEMA Compliance: NEMA ICS 2.

F. UL Compliance: UL 508.

G. Single-Source Responsibility: Obtain similar motor-control devices from a single manufacturer.

1.6 COORDINATION

A. General: Coordinate and provide motor controllers and control devices with necessary auxiliary contacts of proper interface with requirements obtained from existing facility control systems. Field verify all existing relevant Building Management/DDC Controls prior to submitting shop drawings for MCCs to ensure compatibility.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include:

1. Siemens Energy and Automation, Inc., or equal

2.2 MOTOR CONTROLLERS, GENERAL

A. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive,

and load, and the pilot device, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled and are of the manual reset type.

B. Contacts shall open each ungrounded connection to the motor.

C. Overload Relays: Motors, 1/8 horsepower or larger, shall have overload protection in each phase, or other equally rated method in accordance with NFPA 70. Overload relays shall be ambient-compensated type with inverse time-current characteristic. Provide with heaters or sensors matched to nameplate full-load current of the specific motor to which connected with appropriate adjustment for duty cycle.

1. Provide with reset button in an accessible location.

D. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA Standard 250. Provide enclosures suitable for the environmental conditions at the controller location. Provide NEMA Type 1 oversized enclosures except as otherwise indicated.

1. Outdoor: NEMA 250, Type 4X, oversized stainless steel.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Description: Provide full-voltage, non-reversing, across-the-line, magnetic controller, horsepower rated, tested and labeled at NEMA size indicated on the drawings, with field replaceable main contacts, external manual resets, ambient compensated melting-alloy overload protection in all phases and low voltage release and the following accessories.

1. Auxiliary contacts: Two normally open and two normally closed contacts;
2. Pilot lights;
3. Start-stop pushbutton; or three position "Hand-Off-Automatic" switch.

B. Each 3-phase magnetic motor controller shall provide reversal and phase loss protection. Protective device shall cause controller to open upon loss of any one phase or reversal of phases.

C. Control Circuit: Provide control power transformer with 120 volt AC secondary holding coil with fused primary and secondary integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

D. Combination Controller: Motor circuit protector, molded-case circuit-breaker type with magnetic-only trip element calibrated to coordinate with the actual locked-rotor current of the connected motor and the controller overload relays. Provide breakers that are factory assembled with the controller, interlocked with unit cover or door, and arranged to disconnect the controller. Provide motor-circuit protectors with field-adjustable trip elements.

E. Enhanced-Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics where indicated. Select to protect motor against voltage unbalance and single phasing.

2.4 AUXILIARY CONTROL DEVICES

A. General: Factory installed in controller enclosure except as otherwise indicated. Where separately mounted, provide NEMA 1 enclosure except as otherwise indicated.

1. Outdoor location: NEMA 250, Type 4X, stainless steel.

B. Push-button Stations, Pilot Lights, and Selector Switches: Heavy- duty type.

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Current Sensors: Coordinate with controls.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with manufacturer's requirements in accordance with the direction of the COR.

3.2 APPLICATIONS

A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

D. Use combination magnetic starters/MCP for 3-phase motors and coordinate with mechanical/controls.

E. Push-button Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.3 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Section 16190, "Supporting Devices".

3.4 IDENTIFICATION

A. Identify motor-control components with laminated engraved nameplates with name, voltage and phase.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Section 16120, "Wires and Cables".

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

1. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.
2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing.

B. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Test per Section 16050, paragraph 3.6.
2. Testing Equipment: Use instruments bearing records of calibration within 3 months of testing.
3. Provide two (2) weeks advance notice to the COR prior to testing and schedule test at least one (1) week in advance of the test commencement.

C. Remove and replace malfunctioning units with new units, and retest.

3.8 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

3.9 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to demonstrate and train Government's maintenance personnel.

*** END OF SECTION 16481 ***