National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

FAC-M5063

CONSTRUCTION SPECIFICATIONS

FOR

REVITALIZE BUILDING ELECTRICAL SYSTEMS (BUILDING 4711)

GEORGE C. MARSHALL SPACE FLIGHT CENTER

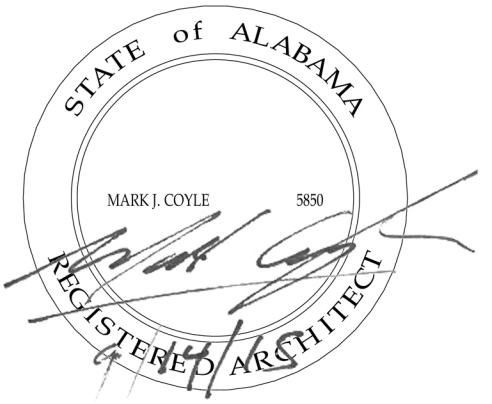
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MARSHALL SPACE FLIGHT CENTER, AL

Approval: _____ **Date:** 5 Oct 15
for **Lead, Facilities Engineering Office**

SPECIFICATIONS

PREPARED BY



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SECTION 010010 — SCOPE AND DESCRIPTION

PART 1 - GENERAL

1.1 SCOPE

A. The work to be performed under this project consists of providing the labor, equipment, and materials to perform the renovation of the office, labs and high bay area Electrical systems for building 4711 at the Marshall Space Flight Center in Huntsville, Alabama. This effort shall include the following:

1. Replacement of service entrance switchgear as noted on the drawings
2. Replacement of the bus duct system throughout the building
3. Replacement of panels as noted on the drawings
4. Replacement of circuit breakers, disconnects and transformers as noted on drawings

1.2 DESCRIPTION

A. This request for proposal (RFP) is a bid-build (BB) full and open competition contract for construction. Building 4711 is classified as a Core Capability Facility. It houses offices, labs and high bay shop space for materials analysis and development. The building has previously been used for equipment fabrication but fabrication in the facility at this time is minimal.

B. Building Operations:
1. The offices, Labs and High Bay shop will remain occupied and operational throughout this construction project.
2. The COR will determine final phasing schedule after discussion with the user. Outages shall be closely coordinated in advance with the user.
3. The general contractor shall maintain code compliant entries and exits for the building throughout the duration of the project.

C. The following are Additive Alternates for the project.
1. ADD ALTERNATIVE #1: Provide upgrades to the existing fire alarm system and install per specifications.
2. ADD ALTERNATIVE #2: Provide new Lightning Protection System and install per the specifications.
3. ADD ALTERNATIVE #3: Provide new LED fixtures to replace existing 2x2 and 2x4 light fixtures in the office spaces.
4. ADD ALTERNATIVE #4: Provide new high bay LED fixtures to replace existing high bay fluorescent light fixtures in the high bay spaces.
5. ADD ALTERNATIVE #5: Provide new wall mounted exterior LED fixtures to replace existing wall mounted exterior metal halide fixtures.

1.3 APPLICABLE DOCUMENTS

A. The publications of the issues of referenced documents in effect on the date of issuance of invitation for bids form a part of this specification and, where referred to herein by basic designation only, are applicable to the extent indicated by the references thereto. In the event of

difference between this specification or its accompanying drawings and the referenced document, this specification and its accompanying drawings shall govern to the extent of such difference.

1.4 CONTRACT DRAWINGS

A. The following drawings accompany this specification and are a part thereof. The Contractor shall check all drawings and specifications for construction interferences, detail misdescriptions, dimensional errors, and other conflicts and shall promptly notify the Contracting Officer of any discrepancies utilizing a "Request for Information." The Contracting Officer shall make a written interpretation.

Ref No.	Title	Drawing No.
G001	COVER SHEET AND INDEX OF DRAWINGS	FAC-CU-4711-G001
A002	COORDINATION PLAN – HIGH PRIORITY SPACES	FAC-CU-4711-A002
A101	PLAN, REFLECTED CEILING DEMO PLAN AND REFLECTED CEILING PLAN AND PENETRATION DETAILS	FAC-CU-4711-A101
E001	GENERAL NOTES, ABBREVIATIONS & LEGEND	FAC-CU-4711-E001
E002	FEEDER SCHEDULES & DETAILS	FAC-CU-4711-E002
E101	LIGHTING PLAN-1ST FLOOR AREA A ADD ALTERNATE #3,4,5	FAC-CU-4711-E101
E102	LIGHTING PLAN-1ST FLOOR AREA B ADD ALTERNATE #3,4	FAC-CU-4711-E102
E201	ELECTRICAL PLAN - 1ST FLOOR AREA A	FAC-CU-4711-E201
E202	ELECTRICAL PLAN - 1ST FLOOR AREA B	FAC-CU-4711-E202
E203	LARGE SCALE ELECTRICAL PLANS	FAC-CU-4711-E203
E204	BUS DUCT FLOOR PLAN - 1ST FLOOR AREA A	FAC-CU-4711-E204
E205	BUS DUCT FLOOR PLAN - 1ST FLOOR AREA B	FAC-CU-4711-E205
E301	FIRE ALARM PLAN - 1ST FLOOR AREA A ADD. ALT. #1	FAC-CU-4711-E301
E302	FIRE ALARM PLAN - 1ST FLOOR AREA B ADD. ALT. #1	FAC-CU-4711-E302
E303	FIRE ALARM PLAN – MISCELLANEOUS ADD. ALT. #1	FAC-CU-4711-E303
E401	LIGHTNING PROTECTION PLAN ADD. ALT. #2	FAC-CU-4711-E401
E501	ONE LINE DIAGRAM - MAIN DEMO & NEW WORK	FAC-CU-4711-E501
E502	ONE LINE DIAGRAM - BUSD0001 DEMO & NEW WORK	FAC-CU-4711-E502
E503	ONE LINE DIAGRAM - BUSD0002 DEMO & NEW WORK	FAC-CU-4711-E503
E504	ONE LINE DIAGRAM - BUSD0003 DEMO & NEW WORK	FAC-CU-4711-E504
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E506	ONE LINE DIAGRAM - BUSD0005 DEMO & NEW WORK	FAC-CU-4711-E506
E507	ONE LINE DIAGRAM - BUSD0006 DEMO & NEW WORK	FAC-CU-4711-E507
E508	ONE LINE DIAGRAM - BUSD0007 DEMO & NEW WORK	FAC-CU-4711-E508
E601	ELECTRICAL DETAILS	FAC-CU-4711-E601
E602	ELECTRICAL DETAILS - ADD. ALT. #2 & #5	FAC-CU-4711-E602
E701	PANEL SCHEDULES & COORDINATION	FAC-CU-4711-E701
E702	PANEL SCHEDULES	FAC-CU-4711-E702
E703	PANEL SCHEDULES	FAC-CU-4711-E703
E704	PANEL SCHEDULES	FAC-CU-4711-E704
E705	PANEL SCHEDULES	FAC-CU-4711-E705
E706	PANEL SCHEDULES	FAC-CU-4711-E706
E707	PANEL SCHEDULES	FAC-CU-4711-E707
E708	PANEL, SWITCHBOARD, & STARTER SCHEDULES	FAC-CU-4711-E708
E801	DISCONNECT SCHEDULES	FAC-CU-4711-E801
E802	DISCONNECT AND TRANSFORMER SCHEDULES	FAC-CU-4711-E802
U1	UCS FLOOR PLAN & NOTES	FAC-CU-4711-U1
U2	UCS DEMOLITION WIRING DETAILS & NEW COMM TRUNK LAYOUT	FAC-CU-4711-U2

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010010

SECTION 010590 — SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 013300, "Submittal Procedures," in sufficient detail to show full compliance with the specification.

A. Photographs of temporary structures to be brought on Center by the Contractor.

1.2 CONTRACTOR'S WORKING DRAWINGS

A. It shall be the Contractor's responsibility to develop all necessary working drawings for installation of piping, ductwork, conduit, fixtures, and equipment. Design drawings are not intended to eliminate all dimensional conflicts in routing or location of piping, ductwork, conduit, fixtures, equipment, etc. but shall show only the general arrangement. Use of design drawings for working drawings will be at the Contractor's risk, and changes required in installed work due to failure of Contractor to develop working drawings shall be accomplished at no additional cost to the Government. Prefabricated items shall have working dimensions to accommodate the actual field dimension of earlier-installed items. The Contractor shall carefully investigate all structural, mechanical, electrical, architectural, and finish conditions affecting all his work and shall coordinate and resolve all dimensional conflicts.

1.3 COOPERATION WITH OTHERS

A. During the life of this contract it is anticipated that other contractors will be performing operations in the general area where work under this contract is being performed. The Contractor shall cooperate in all respects wherever necessary for the better prosecution of the work.

1.4 EXPLOSIVE AND DISPOSAL AREA PRECAUTION

A. The possibility exists that materials of unexploded ordnance (UXO) could be encountered on NASA/MSFC property. In most areas, the potential for these occurrences is small. However, if materials resembling and suspected to be UXO are discovered in a work area immediately stop all work, cordon off or barricade suspect area, withdraw from the area, contact the Fire Department at 911, the Contracting Officer, and the Facilities Maintenance Organization (FMO) COTR and inform them of the findings. Then, post temporary barriers to prevent personnel entry into the area and remain near the site at a safe distance from the suspected UXO until the Contracting Officer or COTR takes charge of this activity. The Contracting Officer or COTR will then arrange for investigation and safe disposal of suspect material. Upon clearance from the Contracting Officer or COTR, work may then be resumed in the area.

B. Some areas are known to have formerly been utilized for ordnance related manufacturing, delivery, storage, and/or disposal activities. These areas are identified on the "Army and NASA

Site Access Control Boundaries" map. When work is to be accomplished in the areas designated on the map as "Facilities Precautionary UXO Area" or as "UXO/CWM Probability 'Occasional', 'Remote', or 'Seldom'", prior to beginning construction, contractor shall procure the services of a UXO services provider (qualified for the project-specific requirements as shown on the drawings) for initial investigation and characterization, and then a remediation recommendation, required when suspect material is detected. Upon receipt of a report that states potential UXO was detected during investigation, the Contracting Officer or COTR will then arrange for disposition of suspect material. UXO services provider shall employ personnel with skills that meet applicable minimum qualification requirements contained in the U.S. Army Corps of Engineers document, "Attachment to Chapter 20, EP 1110-1-18, Ordnance and Explosives Response, UXO Personnel Training and Experience Hierarchy", at the end of this Section. UXO services provider shall submit for approval documentation that includes the number and names of employees to be utilized for the effort and their corresponding levels of training and experience, including copies of certifications and/or other qualifying paperwork. Additionally, UXO services provider shall have a work plan and a safety plan approved by NASA MSFC prior to initiating job activities. Alternately, when working under a prime contractor, UXO investigation work and safety plan requirements may be included in the prime contractor's work and safety plans. Questions concerning UXO operations and work plans may be addressed to the Contracting Officer or the COTR. Prior to commencing UXO investigation that requires disturbing the soil, obtain a digging permit from the Contracting Officer or the COTR.

C. The Contractor shall be responsible for alerting personnel under his authority, including subcontractor personnel, when the site of work is located on a site known to have had former ordnance activity.

D. The "Army and NASA Site Access Control Boundaries" map, showing the areas at MSFC which have the potential to contain UXO, is available for reference. Contact the Contracting Officer or COTR to obtain this information.

1.5 CHEMICAL WARFARE MATERIAL PRECAUTION

A. The possibility exists that chemical warfare material (CWM) could be encountered on NASA/MSFC property. In most areas, the potential for these occurrences is small. However, if such materials are suspected in a work area, immediately stop all work, cordon off or barricade suspect area, withdraw from the area, contact the Fire Department at 911, the Contracting Officer, and the FMO COTR, and inform them of the findings. Then, remain near the site at a safe distance from the suspected CWM, and post temporary barriers to prevent personnel entry into the area until the Contracting Officer or COTR takes charge of this activity. The Contracting Officer or COTR will then arrange for investigation and safe disposal of suspect material. Upon clearance from the Contracting Officer or COTR, work may then be resumed in the area.

B. Some areas are known to have formerly been utilized for chemical warfare related manufacturing, delivery, storage, and/or disposal activities. These areas are identified on the "Army and NASA Site Access Control Boundaries" map. When work is to be accomplished in the areas designated on the map as "UXO/CWM Probability 'Occasional', 'Remote', or 'Seldom'", prior to beginning construction, contractor shall procure the services of a CWM services provider (qualified for the project-specific requirements as shown on the drawings) for initial investigation and characterization, and then a remediation recommendation, required

when suspect material is detected. Upon receipt of a report that states potential CWM was detected during investigation, the Contracting Officer or COTR will then arrange for disposition of suspect material. CWM services provider shall meet applicable minimum qualification requirements for the work to be performed. CWM services provider shall submit for approval documentation that includes the number and names of employees to be utilized for the effort and their corresponding levels of training and experience, including copies of certifications and/or other qualifying paperwork. Additionally, CWM provider shall have a work plan and a safety plan approved by NASA MSFC prior to initiating job activities. Alternately, when working under a prime contractor, CWM work and safety plan requirements may be included in the prime contractor's work and safety plans. Questions concerning CWM operations and work plans may be addressed to the Contracting Officer or COTR. Prior to commencing CWM investigation that requires disturbing the soil, obtain a digging permit from the Contracting Officer or COTR.

C. The Contractor shall be responsible for alerting personnel, including subcontractor personnel, when the site of work is located on a site known to have had former CWM activity.

D. The "Army and NASA Site Access Control Boundaries" map, showing the areas at MSFC which have the potential to contain CWM, is available for reference. Contact the Contracting Officer or COTR to obtain this information.

1.6 SECURITY

A. The Contractor shall conform to security procedures as directed by the Contracting Officer. Additional information will be provided at the preconstruction meeting and as changes occur during the contract period. Status of Center access is available by calling (256)544-HELP.

B. Center Entry and Vehicles: Entry security at the Center is critical to effect a safe environment. All personnel, vehicles, equipment, and materials are subject to search, investigation, and authorization at each entry and while on Center. Construction vehicles and trucks delivering large equipment and materials, including concrete trucks, shall enter the Center via Gate 1 or 10 or as directed by the Contracting Officer. Significant entry delays should be expected, particularly at higher security levels, so the Contractor is responsible for keeping himself apprised of security conditions and entry requirements at the Center and notifying his contract personnel of changes in order to prosecute contract work in a timely manner without delay. All vehicles must have proof of valid registration and insurance residing in the vehicle at all times and shall show such proof to security personnel on demand and in order to obtain a vehicle pass or decal. All decals must be returned to Center security when access is no longer required and when the contract period ends.

C. Personnel Identification and Badging: All personnel shall be able to show proof of United States citizenship and have on their person, valid Government-issued picture identification such as a driver's license. All Contractor personnel, including subcontractor and visitor personnel, shall have and display on their person a badge issued by Center security at all times. Center security has the right to not issue, confiscate, or change any badge. The Contractor is responsible for assuring each individual working under this contract is immediately badged in the first instance, continually wears and displays a valid badge, has only the necessary access permissions, and returns the badge to Center security upon completion of their work just prior to leaving the Center. All personnel requiring access to the Center by the Contractor shall possess either a visitor's badge or picture badge issued by Center security at Building 4312.

All Contractor personnel requiring access to the east or west test areas must receive test area access training provided by MSFC.

D. Any person on Center failing to have in their possession a valid badge or operating a vehicle without a valid pass or decal is ultimately subject to arrest and further legal action.

1.7 SPECIAL CONSIDERATIONS FOR SPECIAL HOURS OF WORK

A. Reference contract Section H attached to Standard Form 1442 – "Solicitation, Offer, and Award" – regarding "Hours of Work" therein. The following are clarifications and additional requirements necessary to perform work at the Marshall Space Flight Center (MSFC).

1. "Duty Hours" shall be considered to be 7:00 a.m. to 5:00 p.m., Monday through Friday, excluding Government holidays. All other times shall be considered "Non-Duty Hours."

2. The Contractor shall only schedule and plan contract performance during "Duty Hours," with exclusion of Safety Day, unless specific allowances are made elsewhere herein for specific activities that may be required to be performed during "Non-Duty Hours."

3. The Contractor shall make all requests to work during "Non-Duty Hours" by 9 AM of the day before the requested work period begins. The Contracting Officer must approve any work activities during "Non-Duty Hours" prior to the start of work for the period requested." These requests will typically be denied unless justifiable by outages, road crossings, hazardous operations, coordination with Government operations, and/or facility or subsystem need date.

4. All items above as well as all other Special Conditions of Section 010590 shall be factored into the Contractor's scheduling of work to meet the contract's performance period at no additional cost to the Government after contract award.

5. The Contractor may be prohibited from working in the east and west test areas approximately two days per week during hazardous testing operations. The Government typically issues a tentative weekly schedule on the Friday preceding a week which has scheduled testing. The Contractor is responsible for monitoring this schedule, making regular contact with the test point of contact, closely coordinating their specific activities, and adjusting/delaying construction activities to accommodate testing operations without additional cost to the Government after contract award.

1.8 TEMPORARY UTILITIES

A. Contractor shall provide temporary utilities required for construction. Materials may be new or used, shall be adequate for the required usage, shall not create unsafe conditions, and shall not violate applicable codes and standards.

B. Water: All reasonably required amounts of water will be available to the Contractor by the Government from such existing water systems, outlets, and supplies, without cost to the Contractor for the water he consumes. The Contractor shall be responsible for approved disposal of wastewater. The Contractor shall install and maintain at his own expense any necessary supply connections, safety measures, and facilities in a workmanlike manner as

approved by the Contracting Officer. All water shall be carefully conserved. Before final acceptance, temporary connections and piping installed by the Contractor shall be removed in a manner satisfactory to the Contracting Officer.

C. Electricity: Electric power will be made available to the Contractor by the Government in the form of single phase 208V/120V or 240V/120V, depending on availability, 60 Hz, 100A service without cost to the Contractor for temporary power purposes. Other electrical service may be provided, if available and accessible to the construction site, upon request by the Contractor and approved by the Contracting Officer. The Contractor shall install and maintain at his own expense any necessary supply connections, safety measures as required by 29 CFR 1926 Subpart K, 1926-402-408 or NEC ANSI/NFPA 70 plus formal interpretations and tentative interim amendments, and facilities in a workmanlike manner as approved by the Contracting Officer. All electricity shall be carefully conserved. When Government-provided temporary power is not available, is not of sufficient capacity, or is not of sufficient power quality, the Contractor is responsible for providing his own temporary power at his own expense. The Contractor is responsible for protecting his own electrical equipment and devices as necessary at his own expense from damage due to electrical events such as lightning, loss of power, power surges and sags, single phasing, and poor power quality.

D. Compressed Air: The Contractor is responsible for providing compressed air as needed at his own expense.

E. Breathing Air: The Contractor is responsible for providing breathing air as needed at his own expense.

F. Telephone Service: Contractor shall provide his own telephone service at his own expense.

G. Sanitary Facilities: Contractor shall provide temporary sanitary facilities in accordance with 29 CFR 1926.51 and shall service, clean, and maintain these facilities and enclosures at least once per week. Temporary facilities shall be removed from the site at the completion of the work. Sanitary facilities in existing facilities are unavailable for Contractor use.

H. Removal of Temporary Utilities: Before final project acceptance, temporary connections and facilities installed by the Contractor shall be removed and all removal locations painted, graded, etc. as necessary to match surrounding conditions in a workmanlike manner and hazard-free condition to the satisfaction of the Contracting Officer.

1.9 TRAFFIC PROVISIONS

A. Maintenance of Traffic: Contractor shall conduct his operations in a manner that will not close any thoroughfare or interfere in any way with traffic on roadways except with written permission of the Contracting Officer. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met. Work shall be conducted so as to minimize obstruction of traffic, and traffic shall be maintained on at least half of the roadway width at all times. If the entire roadway width requires blocking, the Contractor shall submit a traffic control plan to the Contracting Officer's Technical Representative for approval prior to blocking the roadway. Approval shall be obtained from the Contracting Officer prior to starting any activity that will obstruct traffic in any manner (one half of the roadway or the entire width of the roadway). Contractor shall provide, erect,

and maintain, at his own expense, lights, barriers, signals, passageways, detours, etc., that may be required.

B. Rush Hour Restrictions: Contractor shall not interfere with the peak traffic flows preceding and during normal operations without notification to and approval by the Contracting Officer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION OF FACILITIES, MATERIAL, AND WORK

A. The Contractor shall at all times protect and preserve all facilities, materials, supplies, and equipment of every description (including property which may be Government-furnished or owned) and all work performed. All reasonable requests of the Contracting Officer to enclose or especially protect such property shall be complied with. If, as determined by the Contracting Officer, material, equipment, supplies and work performed are not adequately protected by the Contractor such property may be protected by the Government and the cost thereof may be charged to the Contractor or deducted from any payments due him.

3.2 PROTECTION OF UNDERGROUND UTILITIES/DIGGING PERMITS

A. Prior to performing any excavation work or any surface penetrations 6 inches or deeper (such as driving stakes more than 6 inches in the ground) on any ground surface, this includes both outside and inside of buildings, structures, tents, or gazebos, etc., the Contractor shall obtain from the Facilities Office a digging permit and the current subsurface utility drawing of the particular area to be worked on. Contractor shall stake out subsurface high voltage cables, communication cables, and pipelines indicated within the scope of the work contemplated. After exposure, the Contractor shall obtain agreement from the Contracting Officer on how much closer to cable or pipe the excavations can be permitted. Contractor shall notify the Contracting Officer, 48 hours prior to the start of excavation work or surface penetration, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and possible damage to subsurface utilities. Where emergency conditions preclude the 48 hours advance notification, the Contractor shall immediately inform the Contracting Officer. After obtaining clearance from the Contracting Officer, the Contractor shall proceed with excavating work, or other surface penetration work. Contractor, however, shall temporarily halt any machine excavation work or other surface penetration when approaching within 3 feet of the staked-out cable or pipeline until the Contractor has exposed the cable or pipe by hand excavation to fix its location.

B. Trenching machines and augers shall not be used unless approved in advance by the Contracting Officer.

C. Prior to commencing any operations which include digging, excavations, or soil borings, etc. where there is considerable doubt of the location of concealed utilities, the Contractor shall de-energize or turn off all hazardous utilities to the building and surrounding areas.

D. When de-energizing is not possible, a waiver shall be required to allow work to continue. The waiver shall provide rationale detailing how the safety of the workers will be maintained. The waiver shall be approved by the Facilities Management Office project manager and the MSFC Industrial Safety Office.

3.3 LAYOUT OF WORK

A. The Contractor shall lay out his work from the Government-established base lines and bench marks and shall be responsible for all measurements in connection therewith. The Contractor shall furnish, at his own expense, all stakes, templates, equipment, range markers, and labor as may be required in laying out any part of the work from the base lines and bench marks established by the Government. The Contractor will be held responsible for the execution of the work to such lines and grades as may be established or indicated by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through his negligence prior to their authorized removal, they may be replaced by the Contracting Officer at his discretion. The expense of replacement will be deducted from any amount due, or to become due, the Contractor.

3.4 TEMPORARY STRUCTURES AND LAYDOWN AREA

A. All temporary structures and equipment such as construction office trailers, storage trailers, boom trucks, dump trucks, backhoes, etc. are to be in good and fully operable condition, with no broken windows, rusted areas, boarded-up openings, loose insulation, bent doors, paint in poor condition, leaks, exposed wiring, code or safety violations, or other similar defects when brought on site and are to be maintained in good and fully operable condition while they are on site. Contractor shall submit photographs of all trailers, storage units, or other temporary structures and equipment for review and initial approval prior to bringing them on Center. Regardless, trailers and equipment are to be inspected for final approval for lay down by the Government when they are brought on site prior to detaching them from the truck that delivers them so they can be immediately removed if they are found to be in unacceptable condition.

B. At least 7 days prior to arrival, the Contractor shall request the need for and extent of an all-inclusive lay down area for temporary structures, equipment, material, vehicle parking, fencing, fence gates, hazardous material storage, and the like for the duration of the work. The lay down area shall be marked up in detail on the site plan drawing and submitted for approval by the Government. Once approved, all office trailers shall be installed per the International Building Code, the Alabama Manufactured Housing Commission, and NASA safety requirements, whichever is most stringent. Any type of structure used in whole or part as office space or otherwise occupied on a regular basis shall be tied down. Utility connections shall be installed according to applicable codes/standards and in a neat and acceptable manner.

C. Housekeeping in the structures and about the lay down area shall be very well kept on a daily basis and the grass, weeds, and the like shall be kept below 6 inches in height at all times; all other areas within the construction site boundaries shall be kept below 12 inches in height. Open storage of material both singularly and collectively shall be kept and in a manner continuously acceptable to the Government.

D. Only equipment and material necessary for the work shall be kept on site, and equipment shall not be repaired on site without prior approval from the Government for more than very minor repairs.

E. All structures and equipment requiring certification, licensure, etc. shall be kept current at all times or immediately removed from the Center. Any changes to the lay down area use, arrangement, boundaries, or egress must be pre-approved by the Government.

3.5 SIGNS

A. Construction Identification Sign: Within 30 days after Notice to Proceed, the Contractor shall install the Government-furnished construction identification sign at the location designated by the Contracting Officer. This sign shall be securely installed in an acceptable manner approved by the Contracting Officer and shall be maintained in good condition and returned to the Government at project completion.

B. Other Signs and Advertisements: Only signs necessary to expedite deliveries, maintain traffic flow, promote safety (e.g. caution, danger, blasting, hardhat area), and prevent interference with Government operations shall be erected.

3.6 NASA MISSION NON-INTERFERENCE

A. The Center conducts special tests and experiments, as well as unique operations that cannot be interrupted. Certain operations such as Space Shuttle flights have predetermined periods of non-interference where the Contractor can plan ahead with little or no impact to the project Schedule. During such flights, a Dig Moratorium will be issued where the Contractor cannot dig more than 6 inches below the surface.

B. Other non-interferences are utility related and require extensive coordination and precise planning and timing.

C. Non-interference periods shall be shown on the project Schedule to the extent they potentially impact the project Schedule.

3.7 INTERRUPTION OF UTILITIES

A. Interruption to utility services, such as (but not limited to) water, sanitary sewer, steam, electricity, communications, air, high-pressure systems, heating, and air conditioning systems, shall occur at such times as permitted by the Contracting Officer so that interruption of such services will not interfere with the operation of the Center. Generally, such outages to utility services shall be scheduled in advance and caused by the Contractor on Saturdays, Sundays, or other nonworking days or periods at no additional cost to the Government. The existing steam distribution system shall not be altered nor service to existing buildings be interrupted without prior written approval of the Contracting Officer. Such interruption to the steam distribution system insofar as is practicable shall be accomplished in the summer season. All interruptions shall be held to the minimum practicable. Interruption to high-pressure systems must be pre-planned 90 days in advance, with date certain and duration certain.

B. Notice of Interruptions: The Contractor shall submit each and every request for each individual utility outage in writing seven calendar days in advance of the actual need date for approval by the Contracting Officer. Each required interruption anticipated by the Contractor shall be indicated on the project Schedule for pre-planning purposes by the Government to support the work; lack of such indication, or lack of date accuracy where the date changes from the previously approved project Schedule may result in delays and any such delay will be at the sole expense of the Contractor.

3.8 LEAKAGE PREVENTION

A. Capping of Piping Systems: All piping installed by the Contractor that is connected to a pressurized piping system, and not connected immediately to equipment, shall be terminated with a properly rated cap, blind flange, or capped valve and not left open-ended when Contractor personnel are not at the jobsite.

B. Construction Surveillance: At such time when new or modified piping systems are activated, the Contractor shall provide adequate personnel to monitor the initial start-up and operation of that system to insure that no damaging leak occurs. A monitor shall be present at each separate site of piping installation or modification at the instant of system activation. These Contractor personnel shall be authorized to immediately deactivate the system and qualified to make emergency repairs in the event of system failures. The Contractor shall notify Contracting Officer's Technical Representative a minimum of 2 days prior to activation.

3.9 GOVERNMENT FURNISHED PROPERTY

A. The Government will furnish to the Contractor the following property to be incorporated or installed in the work, or used in its performance. Salvage property to be removed and reused that is in the general work area shall be handled as a Contractor Service and not listed here.

B. Property shall be furnished on the ground at a location within the MSFC boundaries as designated by the Contracting Officer. The Contractor shall be responsible for paying any demurrage or detention charges incurred loading, unloading, and transporting the property to the job site at his own expense.

C. All such property shall be installed or incorporated into the work at the expense of the Contractor, unless otherwise indicated herein.

D. The Contractor in conjunction with an authorized Government representative shall verify the quantity and condition of such Government-furnished property when delivered to him, acknowledge receipt thereof in writing to the Contracting Officer, and in case of damage to or shortage/overage of such property, he shall within 24 hours report in writing such damage or shortage/overage to the Contracting Officer.

E. Quantities indicated for the above-listed items marked with an asterisk are estimates. It is the intention of the Government to furnish all of these items required to complete the work as specified and the various quantities will be adjusted when necessary. Quantities stated for the above items not marked with an asterisk are all that will be furnished by the Government. These quantities are not to be considered as indications or warranties that the amounts stated

will either be sufficient or insufficient. The Contractor shall be required to furnish any additional quantities required.

3.10 SALVAGE MATERIALS AND EQUIPMENT

A. The Contractor shall maintain adequate property control records for all materials or equipment specified to be salvaged. These records may be in accordance with the Contractor's system of property control, if approved by the Contracting Officer. The Contractor shall be responsible for the adequate storage and protection of all salvaged materials and equipment and shall replace, at no cost to the Government, all salvage materials and equipment broken or damaged during salvage operations as the result of his negligence, or while in his care. Any salvaged materials and equipment that are excess upon the completion of the work shall remain the property of the Government. All such excess material and equipment shall be loaded, transported, and unloaded by the Contractor in a location specified by the Contracting Officer within the boundaries of the Marshall Space Flight Center.

3.11 CONSTRUCTION PROCEDURES

A. The Contractor shall use the following procedures and methods. Only the most current Government approved forms shall be used.

B. Request for Information (RFI) S.O.P. 7321.6: The purpose of this procedure establishes the system for initiating, dispositioning the clarification of technical or quality assurance requirements specified in the contract documents, and engineering direction to the Contractor for no-cost changes to the specifications or drawings.

C. Design Change Requests (DCR's) S.O.P. 7321.1: The purpose of this procedure establishes the system for documenting and approving changes to the contract documents if on-site work must be performed prior to the contract modifications.

D. Construction Deficiency Reports (CDR's) S.O.P. 7321.3: The purpose of this procedure establishes the system for initiating, processing, distributing, and controlling any item, condition, or material which deviates from engineering drawings, specifications, or procedures which require a disposition from NASA Engineering to resolve.

E. Quality Verification System (QVS) S.O.P. 7321.2: The purpose of this procedure is to plan and perform inspections, tests, and reviews to determine compliance with engineering and quality requirements or procedural methods for data gathering. It provides for planning of activities, establishment of hold points, and documentation of the performance and results of the verification.

F. Preparation, Review, Approval & Control of Submittals S.O.P. 7321.8: The purpose of this procedure establishes the system for initiating, approving, and controlling submittal documents.

G. Field Drawing Changes (FDC) S.O.P. 7321.5: The purpose of this procedure is to establish a method of resolving and documenting same-day, no-cost field adjustments by the COTR.

3.12 ELECTRONIC CAPABILITY

A. The Contractor shall have in-house computer capability to perform daily electronic mail, word processing, Internet connectivity, virus protection, and project scheduling.

B. Contractor management and administration personnel shall be competent in the electronic capability and able to create, print, save, and electronically transfer documents, files, and messages.

C. The Contractor's site superintendent shall have an active cell phone in his possession at all times for emergency and Government representative communication.

D. The Contractor shall submit his e-mail address and emergency contact information, including cell phone numbers, home phone numbers, and pager numbers, for all key personnel as well as the business owner.

3.13 COMMUNICATION RADIOS

A. To insure safety to Government personnel on nearby test stands and to prevent dangerous radio interference from damaging space vehicle test programs underway near site, the Contractor shall not use any radio communication on or near site without coordinating same with Contracting Officer. Radio use is also restricted in certain laboratories, operation centers, and communication and computer rooms as directed by signage and the Contracting Officer. All frequencies used must be submitted for approval by the Contracting Officer prior to use.

3.14 HOUSEKEEPING

A. The Contractor shall comply with the requirements of 29 CFR 1926.25 and assure cleanliness of facilities, equipment, and protection against damage before, during, and after installation. Generally, all working and storage areas will be cleaned regularly. The Contractor shall maintain such conditions insofar as good working practices will permit. It is essential to the proper conduct of the work and to the safety of workers and others that good housekeeping be practiced at all times. Equipment shall be kept clean and shall be protected against damage before, during, and after installation. All working and storage areas shall be cleaned regularly and all scrap materials and refuse properly and promptly disposed of. Accumulations of such materials and, in particular, accumulations of flammable crates, packing, plastic coverings, and other scrap materials in working or storage areas will not be tolerated. All areas shall be left neat, clean, and free from obstructions and hazards at the end of each working day or shift.

3.15 WEATHERTIGHT INTEGRITY OF BUILDING DURING CONSTRUCTION PERIOD

A. Contractor shall not remove or penetrate any portion of the roof that he cannot replace with the specified roofing system by the end of the workday or protect by other approved methods in the event of rain or other inclement weather that might occur during the workday. The connection of the installed specified roofing system to an existing roofing system shall be made watertight at the end of each workday and/or in the event of inclement weather that might occur during the workday. The details for said connection and the manner that the Contractor plans to maintain a watertight roof throughout the entire period of performance shall be

submitted for review and approval by the Contracting Officer's Technical Representative; this shall be approved before work can commence. For 24 hours a day, 7 days per week, throughout the period of the contract, the Contractor will be responsible for keeping moisture outside of the building interior.

B. In the event that there is water penetration, the Contractor shall take immediate action to provide all materials, equipment, and labor to capture the moisture, dispose of the moisture, and protect all contents of the building.

C. The Contractor shall make repairs to stop any water penetration in a timely manner. The Contracting Officer reserves the right to stop the work when he determines the Contractor is not executing the work in a responsible manner and is causing any water penetration of the building. Work will resume once the Contractor has shown evidence that he has prepared an adequate plan for the remainder of the work; said plan shall include preventive measures to assure watertight conditions throughout the remainder of the contract.

D. When the Contractor fails to respond in time to prevent damage from occurring, MSFC maintenance personnel will respond to clean up and protect as best possible until Contractor personnel arrive. Costs incurred by the Government and maintenance operations associated with such response shall be deducted from any of the Contractor’s pay requests and the contract value reduced accordingly by the Contracting Officer.

E. When the Contractor fails to adequately protect equipment and materials, the Contractor shall pay all expenses to replace or repair any and all damages and in a manner acceptable to the Contracting Officer. Such payments shall be made within 30 days of invoice date, and proof of such payments shall be submitted to the Contracting Officer within 15 days of payment date.

3.16 CONSTRUCTION SITE DUST AND MUD CONTROL

A. The Contractor is responsible for establishing effective and mandatory controls to prevent dust and mud from leaving the construction site boundary. These controls shall be communicated to all personnel and enforced at all times. All resulting additional environmental controls required shall be in place, functional, and inspected daily.

B. The Contractor is responsible for preventing wind-blown dust from going outside the construction site boundary including civil works during normal business hours and during other hours the Contractor is present on the site.

C. The Contractor is responsible for preventing vehicles from tracking and depositing mud and other similar debris and materials outside the construction site boundary. Any such tracking or depositing on roadways, parking lots, sidewalks, equipment, building walls, and any other man-made surface shall be cleaned up immediately without delays to the satisfaction of the Contracting Officer. Rainfall is not an acceptable method.

D. The Contractor shall provide at his expense all the necessary labor, equipment, and material.

3.17 CONSERVATION

A. All energy consumption and resources shall be conserved to the greatest extent possible by the Contractor. The Contractor is responsible for communicating this requirement to all on-site personnel and for compliance. Energy and resource utilization shall be proactively managed and conservation measures and methods developed and promoted by the Contractor's management and supervision.

B. Temporary lighting shall be divided into switchable areas of relatively small size to promote and achieve energy conservation to the satisfaction of the Government. Lighting shall be off unless absolutely necessary to accomplish the work at hand. Lighting for security purposes only shall be minimized and other non-energy consuming methods employed to the greatest extent.

C. Recyclable materials (e.g. aluminum cans, white paper, cardboard, metals, etc.) shall be diverted from the waste stream and delivered to the appropriate off-site, off-Center recycle center by the Contractor as indicated. For Leadership in Energy and Environmental Design (LEED) projects, see other specification sections for more stringent requirements.

D. All cardboard materials shall be flattened, consolidated, and recycled. Cardboard may be delivered to the Center's cardboard recycling location.

3.18 JOBSITE TRAILER (FOR GOVERNMENT)

A. Contractor shall provide an approximately 500 square foot trailer at the jobsite for use solely by the Government and government representatives. Contractor shall provide the original and four copies of the keys to the trailer; no one else shall have a key to this trailer. Trailer shall be heated and cooled and custodial services shall be provided at least once per week. Trailer is to be located adjacent to the superintendent's trailer. A refrigerator with at least 14 cubic feet and -potable water shall be provided for sole use by the Government. Trailer shall be divided into four (4) rooms: an office at each end, a restroom equipped with sanitary sewer services including running water, and a common area in the middle for drawings, files, and small meetings. Submit layout drawing for COTR's review and approval.

3.19 FEDERAL AVIATION ADMINISTRATION (FAA) REQUIREMENTS

A. The Contractor shall comply with all applicable FAA regulations, particularly FAA AC 70/7460-1.

B. The Contractor shall provide all notices to the COTR in writing in order for the Government to assist the Contractor in meeting the applicable FAA regulations. The FAA requires multiple notifications and submission of forms then approval for any work including cranes above the ground over a certain height from ground level at the construction site (height limit). The Contractor shall know the current regulations and provide the notifications to meet these regulations using the 100 to 1 slope from the Redstone Army Airfield. The Contractor shall determine the requirements and any potential project impacts (both schedule and cost) prior to bidding. The Contractor shall assist the Government in completing all required forms and provide all the necessary information for accurate form completion.

C. The Contractor shall notify the COTR in writing as follows to facilitate timely form completion and submission:

1. 35 calendar days prior to anticipated breach of height limit;
2. 72 hours prior to actual breach of height limit;
3. The same day when the construction or alteration of the structure reaches its greatest height;
4. Any supplemental notices required by the FAA or the Contracting Officer.

D. Aviation lighting shall be provided by the Contractor at his own expense as indicated on the approved FAA forms but will be as typically defined under the TEMPORARY UTILITIES paragraph herein. Contractor shall typically provide a minimum of 2 aviation lights of red or high intensity white obstruction lights on temporary structures (including cranes) over the "height limit" determined by the FAA Requirements. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer or FAA

3.20 TRENCHING/EXCAVATIONS

A. Prior to beginning any excavations, this includes both outside and inside of buildings, structures, tents, or gazebos, etc., an excavation permit shall be obtained from the FMO. Trenching machines and augers shall not be used unless approved in advance by the COTR and it shall be so annotated on the issued excavation permit. Before starting any earth work, the location of underground utilities shall be carefully verified. Utilities to be left in place shall be protected from damage. Trench excavations over 5' in depth shall be shored braced or sloped to the angle of repose of the material. Excavated or other materials shall be shored and retained at least 2' from the edge of the excavation to prevent it from falling or sliding back into the excavated area and to prevent excessive pressure upon the side of the excavation.

B. Excavations, trenching and shoring requirements for the protection of employees in OSHA Regulation, CFR 29 part 1926.650 shall be employed and enforced. Side and slopes of excavations shall be maintained in a safe condition by scaling, benching or barricading. Where employees are required to be in trenches, a ladder extending from the floor of trench/excavation to at least 3' above top of excavation, located as to provide means of exit without more than 25' of lateral travel. Excavations will be barricaded and posted with warning signs for the safety of personnel. Warning lights will be provided during hours of darkness.

C. The Contractor shall ensure employees working in or around excavation projects are trained and familiar with the safety requirements in 29 CFR 1926. 650 – 652 (Subpart P).

D. Prior to commencing any operations which include digging, excavations, or soil borings, etc. where there is considerable doubt of the location of concealed utilities, the Contractor shall de-energize or turn off all hazardous utilities to the building and surrounding areas.

E. When de-energizing is not possible, a waiver shall be required to allow work to continue. The waiver shall provide rationale detailing how the safety of the workers will be maintained. The waiver shall be approved by the Facilities Management Office project manager and the MSFC Industrial Safety Office.

Attachment to Chapter 20, EP 1110-1-18, Ordnance and Explosives Response
UXO Personnel Training and Experience Hierarchy

Position Description	Training Required (Notes 1, 2, & 3)	Minimum Years of EOD/UXO Experience (Note 4)	Special Requirements
UXO Safety Officer	1, 2, or 3	10 years	Experience in all phases of UXO remediation and applicable safety standards
UXO Quality Control Specialist	1, 2, or 3	10 years	Experience in all phases of UXO remediation and the transportation, handling, and storage of ordnance and explosives materials
Senior UXO Supervisor	1, 2, or 3	15 years	Significant experience in all aspects of UXO remediation. Five years experience in supervisory positions
UXO Technician III	1, 2, or 3	10 years	Prior military EOD and/or commercial UXO experience
UXO Technician II	1, 2 --- Or 3	N/A --- 5 years	Prior military EOD experience --- Experience in UXO remediation/range clearance operations. Plus specific project/ordnance training
UXO Technician I	1, 2, or 3	0	Successfully completed DOD certified course of instruction appropriate to this skill level
UXO Sweep Personnel	Equipment and site specific training	N/A	Equipment and site specific training. (Experience at this position is not required for UXO Technician I certification.)

Notes:

1. Graduate of the Army Bomb Disposal School at Aberdeen, MD.
2. Graduate of the Naval EOD School.
3. Graduate of a Department of Defense certified UXO Training Program.
4. This is the minimum experience requirement for designation. This is not an automatic designation, but reserved for those who have demonstrated the requisite knowledge, maturity, judgment, and are recommended by the contractor for recognition at the specified skill level.

END OF SECTION

SECTION 010610 — GENERAL SAFETY AND ENVIRONMENTAL HEALTH REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The requirements of this section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES

A. The publications listed below form a part of this contract as required by law or as referenced:

B. CODE OF FEDERAL REGULATIONS (CFR)

1. Executive Order 13423 Strengthening Federal Environmental, Energy, and Transportation
2. 29 CFR 1910 Occupational Safety and Health Standards
3. 29 CFR 1925 Safety and Health Standards for Federal Service Contracts
4. 29 CFR 1926 Safety and Health Regulations for Construction
5. 40 CFR Parts 1 – 1068 Protection of the Environment

C. NASA/MSFC PUBLICATIONS

1. NPR 3792.1 Plan for a Drug-Free Workplace
2. NPR 8715.1 NASA Occupational Safety and Health Programs
3. NPR 8715.3 NASA General Safety Program Requirements
4. NASA-STD-8719.11 Safety Standard for Fire Protection
5. MPR 1040.3 MSFC Emergency Plan
6. MPD 1800.1 MSFC Smoking Policy
7. MPR 1800.1 Bloodborne Pathogens
8. MPR 1800.2 MSFC Ergonomics Program
9. MPR 1800.3 MSFC Sanitation Program
10. MPR 1810.1 MSFC Occupational Medicine
11. MPR 1840.1 MSFC Confined Space Entry Program
12. MPD 1840.1 MSFC Environmental Health Program
13. MPD 1840.2 MSFC Hearing Conservation Program
14. MPD 1840.3 MSFC Respiratory Protection Program
15. MPR 1840.2 MSFC Hazard Communication Program
16. MPR 1840.3 MSFC Hazardous Chemicals in Laboratories Protection Program
17. MPR 1840.4 MSFC Asbestos Program
18. MPR 1860.1 MSFC Radiation Safety Procedural Requirements
19. MPR 1860.2 Nonionizing Radiation Safety
20. MPD 1860.2 Radiation Safety Program
21. MPD 8500.1 MSFC Environmental Management Policy
22. MPR 8570.1 MSFC Energy and Water Management Program
23. MPR 8500.1 MSFC Environmental Management Policy

24. MPR 8500.2 MSFC Environmental Management System Manual
25. MPR 8823.2 Pressure System Safety and Certification
26. MWI 1810.1 Automated External Defibrillator (AED) Program
27. MWI 3410.1 Personnel Certification Program
28. MWI 8540.2 Green Purchasing Program
29. MWI 8550.1 Waste Management
30. MWI 8550.2 Storm Water Management
31. MWI 8550.3 Wastewater Compliance
32. MWI 8550.4 Air Emissions Compliance
33. MWI 8550.5 Chemical Management
34. MWI 8621.1 Mishap and Close Call Reporting and Investigation
35. MPR 8715.1 Marshall Safety, Health, and Environmental (SHE) Program
36. MWI 8715.1 Electrical Safety
37. MWI 8715.2 Lockout/Tagout Program
38. MWI 8715.3 Hazard Identification and Warning System
39. MWI 8715.4 Personal Protective Equipment (PPE) and Systems
40. MWI 8715.9 Occupational Safety Requirements for MSFC Contractors
41. MWI 8715.10 Explosives, Propellant, and Pyrotechnics Program
42. MWI 8715.11 Fire Safety Program
43. MWI 8715.12 Safety, Health & Environmental Finding Tracking System (SHEtrak)
44. MWI 8715.13 Safety Concerns Reporting System (SCRS)
45. MWI 8715.15 Operational Safety Assessment Program
46. MWI 8715.16 Supervisor Safety, Health, and Environmental (SHE) Visits
47. MWI 8715.17 Hazardous Operations Readiness Review Program

D. Fire Protection - National Fire Protection Association

1. NFPA 241 Construction, Alteration, and Demolition Operations
2. NFPA 1 Fire Code
3. NFPA 70E Standard for Electrical Safety in the Workplace
4. NFPA 101 Life Safety Code

1.3 SUBMITTALS

A. The following shall be submitted in accordance with Section 013300 “Submittals,” in sufficient detail to shown full compliance with the contract documents. Safety, Health and Environmental (SHE) Plan: The Contractor shall submit a Contractor SHE Plan that establishes the Contractor’s approach for implementing an industrial safety, occupational health, and environmental program that provides a workplace that is incident and injury free by (1) preventing employee fatalities, (2) reducing the number and severity of employee injuries and illnesses, and (3) protecting the environment through the ongoing planning, implementation, and management control of these programs. The Contractor SHE Plan shall be written specific for the work being conducted during the course of this contracted effort at MSFC and shall be submitted to the Facilities Management Office (FMO) Contracting Officer (CO) for approval prior to the start of work. The Contractor’s SHE Plan shall provide a clear description of the Contractor’s approach to implementing their SHE Program at MSFC and their methods for ensuring their SHE Program is implemented and maintained compliant with the following five (5) MSFC SHE Core Program Requirements (CPR) and the applicable documents listed in 1.02 to the extent specified as applicable to this contracted effort.

1. The SHE Plan shall address each of the following MSFC SHE CPR elements and sub-elements in sufficient detail to indicate the Contractor has a full understanding of the requirements. The Contractor's SHE Plan shall be approved by the Government prior to the issuance of the Notice to Proceed with construction. Contractor format is acceptable, but it is recommended that the Contractor's SHE Plan follow the order of the MSFC SHE CPR elements and sub-elements as they are shown below or provide a matrix that clearly identifies where each MSFC SHE CPR sub-element is addressed in the Contractor's SHE Plan. The Contractor's SHE Plan shall be submitted in accordance with this specification division. To assist the Contractor in the development and submittal of an acceptable SHE Plan, an Alternate SHE Plan has been developed which the Contractor can elect to use for the awarded contract. If the Contractor elects to use the Alternate SHE Plan it shall be updated to contain the required information specific to this contracted effort, approval signatures, and maintained up-to-date by the Contractor. **NOTE 1**: Contractor corporate SHE plans that are not written specific for the work being conducted at MSFC during the course of the contracted effort shall be prohibited from being submitted and not approved for use. **NOTE 2**: Documentation of any required training and/or supporting documentation can be requested by the Government prior to the start of any work for this contracted effort.

   a. <u>CPR 1 - Management Leadership and Employee Involvement</u>:

      - A description of the Contractor's safety, health and environmental policy and their management's commitment to (1) initiate a visible and proactive culture in the workplace that values the safety and health of their employees, (2) provide a safe and healthful workplace for their employees, customers, and public that is free from incidents and injuries, (3) evaluate the safety performance of subcontractors or teammates, when applicable, and (4) protect property and the environment over the duration of this contracted effort.
      - A description of methods the Contractor will use to ensure compliance with EPA, OSHA, NASA, MPR 8715.1 and all MSFC SHE documents listed in 1.02B that contain requirements applicable to this contracted effort.
      - A description of the methods the Contractor will use to ensure employees are encouraged and allowed to participate and be involved in their SHE Program (e.g., participate in safety committees, worksite inspections, accident investigations, the development of job hazard analysis, provide suggestion for improvements to their SHE program, and report hazardous working conditions).
      - A description of the methods the Contractor will use to ensure managers and employees are (1) encouraged to take responsibility for their safety and health and that of other employees, (2) encouraged to make safety a priority in the performance of their work processes, (3) held accountable to perform their jobs/tasks in a safe and healthful manner while also protecting property and the environment, and (4) fully understand their roles and responsibilities in their SHE Program.
      - A description of the methods the Contractor will use to ensure the accountabilities, roles and responsibilities listed above and required by their SHE Program are also flowed-down to subcontractors or teammates, when applicable.
      - A description of the methods the Contractor will use to conduct and document monthly SHE meetings and awareness training for employees. (**NOTE**:

Contractors shall document their monthly SHE awareness training/meetings and maintain a record of these meetings. This meeting can be included as part of a weekly pre-work meeting.)

- A description of the methods the Contractor will use to conduct and document self-evaluations of their SHE Program in order to determine its effectiveness. Provide the frequency of these self-evaluations.
- A description of the methods the Contractor will use to obtain feedback from employees for their perception about the effectiveness of the Contractor's SHE Program. Provide the frequency of this feedback.
- A description of the methods the Contractor will use to ensure their SHE plan is maintained current with contract, NASA and MSFC requirements, and is reviewed and updated as necessary. Provide the frequency of this review.
- Provide the identification, by title, of the individual assigned by the Contractor to be responsible to implement the Contractor's SHE program elements and designated to serve as the day-to-day SHE Point of Contact (POC) for this contracted effort.

b. <u>CPR 2- Worksite Analysis</u>:

- A description of the methods the Contractor will use to identify and document concerns/hazards discovered in the work area that have the potential or probability to cause (1) injury/illness to or death to personnel or the public, (2) damage to or loss of facilities/equipment, (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability, or (4) detrimental impact to the environment and the surrounding community and to evaluate these concerns/hazards in order to determine their probability of occurrence and potential severity so that adequate control measures can be recommended to eliminate or reduce these concerns/hazards to an acceptable safe working level. (**NOTE 1**: This also includes the identification, evaluation and control of health conditions in order to prevent an occupational disease.) (**NOTE 2**: Safety Checklists are provided on the SHE web page to assist in conducting this analysis.) (**NOTE 3**: Contractors shall maintain a record of this analysis and provide documentation of this evaluation to the Government, when requested.)
- A description of the methods the Contractor will use to reevaluate existing operations/processes when significant changes are made to that operation/process that can have the potential or probability to affect the existing control measures that were implemented as a result of a prior worksite analysis above.
- A description of the methods the Contractor will use to ensure each Contractor supervisor conducts and documents weekly worksite safety visits to ensure employees are performing their jobs/tasks/operations in a safe and healthful manner in accordance with MPR 8715.1 and MWI 8715.16. (**NOTE**: Weekly safety visits shall be performed once a week by the supervisor on construction sites.)
- A description of the methods the Contractor will use to ensure formal worksite inspections are conducted and documented to ensure (1) employees are provided with safe and healthful working environment and (2) unsafe and unhealthful conditions are corrected when they are discovered in accordance with MWI 8715.12. (**NOTE**: These worksite inspections can be conducted in

conjunction with the worksite safety visits above. Provide the frequency these safety inspections if they are conducted other than on a weekly basis.)

- A description of the methods the Contractor will use to ensure employees (1) are encouraged to report any concern/condition that they feel has the potential or probability to cause (1) injury/illness to or death to personnel or the public, (2) damage to or loss of facilities/equipment, (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability, or (4) detrimental impact to the environment and the surrounding community without the fear of reprisal from management and how these reports are documented and receive a timely response from management to investigate and eliminate the concern/condition. (**NOTE**: Contractors can use the provisions of MWI 8715.13 as their employee safety concern reporting system. Construction workers can also call the Industrial Safety Branch at 544-HELP (4-4357) and select safety or the Safety Hotline at 544-0046)
- A description of the methods the Contractor will use to ensure all Contractor incidents/mishaps and close calls are reported, documented, and investigated to the extent necessary to determine the proximate or root cause(s) in accordance with MWI 8621.1. Contact the CO, FMO Project Manager, or MSFC Industrial Safety Branch for assistance if needed. (**NOTE**: If an accident occurs at the worksite, describe the process for securing the site of the accident so that it is not disturbed and remains secure until the arrival of a security officer and/or safety investigator. The site of the accident shall remain secured until released by the CO, FMO Project Manager, or MSFC Industrial Safety Branch.)
- A description of the Contractor's policy for conducting post-mishap drug and alcohol testing when the initial mishap investigation provides reason to believe an employee's actions or failure to perform a required action is reasonably suspected of having caused or contributed to causing the mishap in accordance with NPR 3792.1, "Plan for Drug-Free Workplace." (**NOTE**: In the event a mishap results in a fatality or serious injury requiring immediate hospitalization, or substantial damage to property estimated to exceed $10,000, post-mishap drug and alcohol testing can be required by the Government and the results of these tests shall be provided to the MSFC FMO.)

c. <u>CPR 3 - Hazard Prevention and Control</u>:

- A description of the methods the Contractor will use to (1) review, (2) approve, and (3) verify the effectiveness of the control measures that were recommended and implemented to eliminate, reduce or control the concerns/hazards identified in a worksite analysis required above by CPR 2. (**NOTE**: A concurrence from the MSFC Industrial Safety Branch is required if an operating procedure is developed as a method to control concerns/hazards onsite at MSFC. MSFC require these procedures to be reviewed annually and updated as necessary.)
- A description of the methods the Contractor will use to ensure they fully comply with the MSFC SHE documented programs listed in 1.02B that contain requirements that are applicable to this contracted effort while working onsite at MSFC (e.g., Personal Protective Equipment (PPE), Respiratory Protection, Hazard Communication, Confined Space Entry, Lockout/Tagout, Bloodborne Pathogens).

- A description of the methods the Contractor will use to ensure their disciplinary policy/program is (1) clearly communicated and understood by all employees, (2) equitably enforced to all employees when they are discovered to be violating the disciplinary policy/program requirements, and (3) flowed-down to subcontractors or teammates, when applicable.
- A description of the methods the Contractor will use to ensure (1) an emergency management program is implemented that will respond to all types of emergencies that can occur at their worksite during this contracted effort (e.g., fire, chemical spill, accidents, natural disasters) and (2) all employees are informed and aware of what they are to do and who they are to contact in the event an emergency occurs. (**NOTE**: Contractors can use MPR 1040.3 as their emergency management program. Post a list of emergency phone numbers and points-of contacts at the worksite for employee reference.)
- A description of the methods the Contractor will use to ensure safety, health, and environmental services that are applicable to this contracted effort are provided (i.e., hazardous waste disposal, industrial hygiene monitoring, emergency medical support, hearing conservation program, respiratory protection, and hazard communication, etc.). Provide a list of environmental and health services that are provided by the Contractor when these environmental services are not to be provided by MSFC.
- A description of the methods the Contractor will use to ensure the worksite is easily identified, clearly separated from other ongoing activities in the same general area, and effectively barricaded to prevent accidental entry into the worksite by unauthorized employees.
- A description of the methods the Contractor will use to ensure structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations are protected against damage.
- A description of the methods the Contractor will use to ensure all employees are provided with a fall protection system and protected from potential fall hazards when they are on walking/working surfaces with unprotected sides or edges where the potential exists for them to fall to the next lower level in accordance with 29 CFR 1926.501, 29 CFR 1926.502, 29 CFR 1910.23, and MWI 8715.4. (**NOTE 1**: In cases where it can be demonstrated that the use of conventional fall protection systems are infeasible or greater hazards can be created by using conventional fall protection system, an additional "Site Specific Fall Protection Plan" is required and shall be submitted for Government approval.) (**NOTE 2**: Safety nets are not allowed to be used as a fall protection system at MSFC, unless approval is received from the FMO CO, FMO Project Manager, and ISB.)

d. <u>CPR 4 - Safety, Health and Environmental Training</u>

- (**NOTE**: The preferred method for documenting an employee's training is to provide a certificate of training that contains (1) the name of the training, (2) date the training was provided, (3) name of the company that provided the training, and (4) the employee's name that indicates the employee attended the training and met all training requirements. In cases where a certificate of training is unavailable for an employee the Contractor can elect to provide an alternate documentation of employee training. The alternate documentation shall (1) be written on a document that contains the company letterhead, (2)

contain rationale that clearly states why the employee is considered as trained, knowledgeable, experienced, and qualified to perform the job/task, and (3) be signed and dated by a company official or supervisor. In either case the Contractor is assuming the responsibility that the employee is trained, knowledgeable, experienced, and qualified to perform the job/task in a safe and healthful manner.)

- A description of the methods the Contractor will use to ensure each contractor employee is informed and trained to recognize conditions in the workplace that have the potential or probability to cause (1) injury/illness to or death to personnel or the public, (2) damage to or loss of facilities/equipment, (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability, or (4) detrimental impact to the environment and the surrounding community, and (5) be able to recognize signs and symptoms of workplace-related illnesses. (**NOTE**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.)
- A description of the methods the Contractor will use to ensure each Contractor employee is informed and trained to (1) fully understand they are empowered and authorized to "stop or halt" an activity that is unsafe and has the potential or probability to cause (1) injury/illness to or death to personnel or the public, (2) damage to or loss of facilities/equipment, (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability, or (4) detrimental impact to the environment and the surrounding community. (**NOTE 1**: When an activity is "stopped or halted" the activity cannot resume until the condition has been corrected. At MSFC the FMO CO, FMO Project Manager, FMO Inspector, and the MSFC Industrial Safety Branch shall be notified.) (**NOTE 2**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.)
- A description of the methods the Contractor will use to ensure each Contractor employee is trained and fully understands the Contractor's disciplinary policy/program and the actions that can be taken by the Contractor when an employee is discovered not following safety and environmental policies, procedures, and rules, and the disciplinary actions are warranted. (**NOTE**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.)
- A description of the methods the Contractor will use to evaluate each job/task performed by Contractor employees in support of this contracted effort to (1) identify the specific training required by the applicable parts of 29 CFR 1910 and 29 CFR 1926 and (2) ensure the employees have received the training in order to perform the job/task in a safety and healthful manner. Examples of OSHA required training include, but are not limited to, the following: (1) Use of fall protection systems; (2) operating lifting equipment, heavy equipment, and machinery; (3) rigging and hoisting; (4) erecting and use of scaffolds; (5) handling harmful substances; and (6) confined space entry. (**NOTE**: Contractors shall maintain a record of this evaluation and provide documentation of this evaluation to the Government, when requested.)
- A description of the methods the Contractor will use to ensure Contractor employees receive training and are designated as "qualified" to operate equipment and machinery and perform the jobs that they have been assigned in accordance with the applicable parts of 29 CFR 1910 and 29 CFR 1926.

(**NOTE**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.)

- A description of the methods the Contractor will use to ensure any employee(s) identified to serve in the role of the "competent person" for any operation identified in 29 CFR 1910 or 29 CFR 1926 that require a "competent person" (1) has received the necessary training and experience, (2) is capable of identifying the hazards associated with the operation, (3) has the authority to take the necessary corrective actions, and (4) is knowledgeable of and understands the mandatory and applicable regulations and standards associated with the equipment or operation. (**NOTE 1**: Examples of operations that require a "competent person" in accordance with OSHA include, but are not limited to, the following: (1) all protection systems; (2) erection and use of scaffolds; and (3) excavations.) (**NOTE 2**: Contractor shall maintain a record of this training and make available to the Government upon request.) (**NOTE 3**: Certificate or letter from company providing rationale why the employee is considered a "competent person" or is trained and qualified to perform selected jobs or operate selected equipment.)
- A description of the methods the Contractor will use to ensure each Contractor employee receives the initial MSFC SHE Program Awareness Training within 60 days of the Authority to Proceed (ATP) or their arrival at the worksite. (**NOTE 1**: Construction Contractors shall receive, at a minimum, the following training: SHE 101C, "MSFC SHE Program Construction Awareness Training." A copy of this training will be provided to the Contractor by the MSFC ISB at the Pre-Construction Conference. The Contractor shall provide this training within the time limits specified to all Contractor employees that will be working onsite in support of this contracted effort. It is recommended that this training be provided during a weekly pre-work meeting. A signed attendance sheet of employees attending this training shall be provided to the FMO Project Manager as a record of this training being conducted.) (**NOTE 2**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.)
- A description of the methods the Contractor will use to ensure Contractor employees receive a MSFC Safety Certification when required by the Industrial Safety Branch or Environmental Engineering and Occupational Health Office. (**NOTE**: At the present time if the Contractor is expected to operate MSFC owned lifting equipment in accordance with MWI 3410.1, a MSFC Safety Certification is required.)
- A description of the methods the Contractor will use to ensure a copy of any Contractor developed training that is intended to be used in lieu of MSFC provided training for a MSFC Safety Certification is provided to the MSFC Industrial Safety Branch for approval prior to its use when applicable.

e. <u>CPR 5 - Environmental Management System</u>

- A description of the methods the Contractor will use to ensure compliance with environmental laws and regulations CFR Title 40 Parts 1-1068, Alabama Department of Environmental Management (ADEM), Executive Order 13423 and 13514, and MPR 8500.1 and 8500.2 by:

    - Complying with MWI 8550.5 for reporting and management of chemicals.

- Implementing and reporting green procurements in accordance with MWI 8540.2.
- Reducing, reusing, and recycling of hazardous and toxic substances prior to disposal in accordance with MPR 8500.1.
- Managing storm water pollution in accordance with MWI 8550.2.
- Ensuring equipment and processes are permitted by applicable Clean Air Act Title V permit and in accordance with MWI 8550.4.
- Managing solid and hazardous waste as permitted by applicable laws in accordance with MWI 8550.1.
- Managing wastewater discharges in accordance with MWI 8550.3.

2. Control of Hazardous Energy, Lockout/Tagout System (29 CFR 1910.147, 29 CFR 1926.417, and MWI 8715.2). At MSFC, maintenance and service activities on equipment and systems that have the potential to release energy and injure employees or damage equipment shall be locked and tagged in accordance with MWI 8715.2. At MSFC **ONLY**, locks with a red case and tags with red diagonal strips containing the word "lockout" are allowed to be used for Lockout/Tagout during construction, maintenance and servicing activities. All construction employees that are expected to place a lock and/or tag or perform Lockout/Tagout activities at MSFC are required to attend and complete the MSFC Lockout/Tagout Training. Contact the Facilities Management Office (FMO) or the MSFC Industrial Safety Branch (ISB) for more information on obtaining this training. Contractors are responsible for maintaining records of the completion of this training. The Contractor shall provide documentation of this training to the Government, when requested. **NOTE**: Work on energized equipment shall only be allowed under special situation in accordance with MWI 8715.1.

3. Hazard Communication (29 CFR 1910.1200 and MPR 1840.2). During the Pre-Construction Conference, to be arranged by the FMO, ISB and/or the Environmental Engineering & Occupational Health (EEOH) Office may discuss common safety and health requirements at MSFC and distribute handouts addressing these requirements.

B. **Reports**. In addition to documentation and reports required elsewhere in this section, the following reports shall also be submitted:

1. Monthly Report: The Contractor shall complete each month MSFC Form 4371, MSFC Contractor Accident and Safety Statistics, and submit to the CO by the 15th day of the month following the report month. The form shall be complete and accurate in every detail.
2. General: a) Safety meetings and training shall be documented and retained at the construction site. Safety meeting sign-in sheets and a general description of the items covered shall be submitted to the CO. b) All job hazard analyses (JHA's) and Hazardous Operations Checklists (HOC's) shall be in writing and communicated to all affected workers. c) All safety, health, and environmental related documents (plans, forms, reports, supervisor safety visits, inspections, correspondence, JHA's MSDS, logs, certifications, etc.) shall be retained in an orderly fashion at the construction site and readily available for review by the Government when requested. (Safety Checklists are located on the SHE web page under the "News and Information" pull down menu.)
3. MSFC SHE 101 "MSFC SHE Program Construction Awareness Training" will be provided to the Contractor by the ISB during the Pre-construction Conference. The Contractor shall provide this training within the time limits specified to all Contractor employees that will be working onsite in support of this contracted effort. It is

recommended that this training be provided during a weekly safety meeting. A signed attendance sheet of employees attending this training shall be provided to the COTR or FMO Project Manager as a record of this training being conducted.

1.4 GENERAL SAFETY PROVISIONS

A. Contractor is subject to applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this contract.

B. During the performance of work under this contract, the Contractor is responsible for control and safety of persons working on and visiting the project site. Contractor is responsible for ensuring their employees and all subcontractor employees supporting them comply with all SHE requirements while working at MSFC. Contractor shall advise the CO or FMO Project Manager of any special safety restriction he has established so that Government personnel can be notified of these restrictions.

C. For any operation identified in 29 CFR 1910 or 29 CFR 1926 that requires a “competent” person, the Contractor shall identify that person(s) by name, post the name of this person(s) at the project site or designated meeting area where the workers gather prior to commencing work, and they shall be on the project site during any operation for which they have been identified as the “competent person.” Use the “MSFC Emergency Telephone List” provided by FMO or ISB or a similar format to post these names at the project site or designated meeting area.

1.5 ACCIDENT TREATMENT AND RECORDS

A. Contractor shall post emergency first aid, ambulance information, and a list of key personnel to be contacted in times of emergency at the project site.

B. Contractor employees may utilize Government dispensary facilities located in building 4249 for injury and emergency medical treatment. Contact occupational medicine services (telephone 256-544-2390).

C. Contractor shall report all accidents and mishaps that can lead to employee injury or illness to FMO Project Manager and ISB in accordance with the process described in MWI 8621.1, “Mishap and Close Call Reporting and Investigation Program.”

1.6 FIRE PREVENTION AND PROTECTION

A. Open-flame heating devices are not permitted except by approval of a hot work permit by ISB in accordance with MWI 8715.11, Fire Safety Program. Approval for the use of open-flame heating devices or open-fires does not relieve the Contractor from the responsibility for any damage incurred as a result of a fire.

B. Hot Work Permits are issued by ISB in accordance with MWI 8715.11, Fire Safety Program. Details for requesting a hot work permit will be provided by the ISB representative during the Pre-Construction Conference.

C. Burning trash, brush, or wood on the project site shall not be permitted.

1.7 ELECTRICAL

A. Contractor shall appoint an employee to serve as the "competent employee" for electrical safety. This employee shall have received training in the hazards of electricity and familiar with the safety requirements in 29 CFR 1926. 400 – 449 (Subpart K) to be responsible for the electrical safety of the contracted effort and to restrict entry to dangerous locations to only those authorized by him and the FMO. The contractor shall provide documentation of this training to the Government, when requested.

1.8 CONFINED SPACE ENTRY

A. At least 10 days prior to commencing activities, the Contractor or sub-contractor shall submit to EEOH and ISB the following for review:

1. Training records showing personnel that have been trained in confined space entry in accordance with OSHA standard 29 CFR 1910.146.

2. Communication of company letterhead and signed by an officer or supervisor of the company stating that all personnel who are to work in the confined space entry have had appropriate training, physicals, and are fit to safely perform the role they are assigned. The letter shall call out who are to act as entrants, attendants, and entry supervisors. At no time shall the person performing the task of entry supervisor also be an entrant unless another designated entry supervisor is present and duties are transferred.

3. A copy of the company's written confined space entry program.

4. Submission of this information earlier than 10 day is encouraged since failing to comply with this section can lead to delays and completion penalties.

B. Contractor shall be responsible for removing water and debris before commencement and during execution of work in manholes.

C. Contractor shall furnish their own atmospheric testing equipment and have one or more employees properly trained in operation of the testing equipment and formally qualified as Confined Space Entry Supervisors who shall be on duty during times workers are in confined spaces in accordance with 29 CFR 1910.146(g) and (i). Their primary functions shall be to perform the duties of Confined Space Entry Supervisor and to test for atmospheric hazards and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, atmospheric tests shall be made at least every 30 minutes or more often when character of ground or experience indicates gas may be encountered. An atmospheric test shall be made before workers are permitted to enter the space after an idle period exceeding one-half hour, or more frequently at the discretion of the Contractor's Entry Supervisor or by direction of EEOH or ISB. A duly designated Confined Space Entry Supervisor may borrow atmospheric testing equipment from NASA's Environmental Engineering and Occupational Health (EEOH) Office, if the equipment is available.

D. Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. Consultation with and approval by EEOH and ISB is required prior to entering these types of confined spaces.

1.9 RADIATION SAFETY REQUIREMENTS

A. The Contractor shall comply with 29 CFR1926.53, MPR 1860.1 and MPD 1860.2 for use of all radioactive material. The Contractor shall notify the MSFC Radiation Safety Officer (RSO) at least 48 hours in advance of any planned radiography. However, if planned during a weekend, notice shall be provided by Thursday. The Contractor shall report to the RSO once on-site and prior to starting work.

B. Loss of radioactive material shall be reported immediately to the CO and RSO.

C. Actual exposure of the radiographic film or unshielding the source shall not be initiated until after 5:00 p.m. on weekdays, unless prior approval is obtained from the COTR and RSO to accomplish such activities prior to 5:00 p.m.

D. In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, no assumptions shall be made as to building occupancy. Where necessary the CO will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot be accomplished and it is otherwise safe to proceed with the radiography, a fully instructed employee shall be positioned inside such building or area to prevent exiting while external radiographic operations are in process.

E. Contractor shall perform a hazard analysis (HA) when lasers are used or are in the work area. The HA shall be approved by the CO and communicated to all personnel and all necessary protective measures taken.

1.10 ROOFING AND COATING

A. At the beginning of each work day the Contractor shall check with the Government Inspector before proceeding to work on the roof to ensure safe work conditions. Roofing and coating work shall adhere to NFPA-241.

B. Barricades or covers shall be provided for all roof openings which present a hazard.

C. Any employees designated to serve as a “Fire Watch” during roofing and coating operations where a tar kettle or similar fired equipment is used shall be trained in the use of fire-extinguishing equipment, familiar with the procedures for sounding an alarm in the event of a fire, and monitor the area where the hot work operation was conducted for at least 30 minutes after completion of the hot work operation to detect and extinguish any smoldering fires. Documentation of this training shall be provided to the Government, when requested.

1.11 TEMPORARY HANDRAILS AND GUARDRAILS (29 CFR 1910.23 AND 29 CFR 1926 SUBPART M – FALL PROTECTION)

A. Temporary handrails shall be provided on all stair wells until permanent handrails are installed. All floor and wall openings from which there is a drop of more than 4 feet or there is a potential for employees to fall to a lower level shall guarded by rail. Where there is exposure below of falling materials, a removable toe board or equivalent shall also be provided. In places where

people are required to access an area close to or underneath walkways, handrails, and toe boards, approved netting shall be used.

1.12 TOOLS, HAND AND POWER (29 CFR 1910.241-244 (SUBPART P), 29 CFR1926.300-307 (SUBPART I)

A. Hand and power tools shall be in a safe operating condition and operators shall be familiar with their safe operations.

B. All portable electrically-powered tools used on this work shall be grounded by means of a 3-wire polarity type grounding system via ground fault interrupter unless the tool is UL-listed as double insulated. Operators of power-operated tools shall be familiar with their safe operation in accordance with 29 CFR 1910.241 -244 (Subpart P) and 29 CFR 1926.300 – 307 (Subpart I).

C. Operators of explosive activated tools shall be trained to operate such tools in accordance with 29 CFR 1926.302(e) and provide documentation of this training to the Government, when requested.

1.13 WELDING, FLAME CUTTING, AND MELTING

A. Contractor shall clear welding and cutting operations with the ISB before operations begin.

B. Contractor shall ensure welding and cutting operators are familiar with the safe operation of welding and cutting equipment requirements in 29 CFR 1926.350 -354 (Subpart J).

C. Contractor shall discontinue burning, welding, or cutting operations 1 hour prior to the end of the normal work day. A workman shall remain at the site for 1 hour, or as required by the Hot Work Permit (MSFC Form 1155), after discontinuing these operations to make a thorough inspection of the area for possible sources of latent combustion. He shall be equipped with two full 15-pound (6.8 kilogram) carbon dioxide fire extinguishers. Details for reporting fires will be provided by the ISB representative during the Pre-Construction Conference.

D. During operations involving possible fire hazard, the Contractor shall notify the CO and/or Government Inspector and not proceed until clearance is obtained in writing. CO and/or Government Inspector may request a standby from the Fire Station. This requirement does not relieve the Contractor of his responsibility for welding and cutting safety.

E. Roofing/Tar Melting/Handling Devices shall comply with the requirements of NFPA 241. Tar melting kettles and handling devices shall be used in a safe manner to eliminate any chance of an employee being burned or starting a fire. Melting kettles shall be placed on a level, firm foundation and protected against traffic, accidental tipping or similar hazard. An approved type of fire extinguishers shall be available at all locations where melting kettles or heating devices are in use. Melting kettles or heating devices, when in use, shall be provided with a lid and thermometer.

F. Any employees designated to serve as a “Fire Watch” during welding, flame cutting and melting shall be trained in the use of fire extinguishing equipment, familiar with the procedures for sounding an alarm in the event of a fire, and monitor the area where the hot work operation was conducted for at least 30 minutes after completion of the hot work operation to detect and

extinguish any smoldering fires. Documentation of this training shall be provided to the Government when requested.

1.14 HIGH NOISE LEVEL PROTECTION

A. Contractor shall ensure employees required to wear Personal Protective Equipment (PPE) have been trained in PPE usage in accordance with 29 CFR 1910.132(f) and MWI 8715.4. Documentation of this training shall be provided to the Government when requested.

B. Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive device activated tools) shall be scheduled for weekends or after duty working hours as directed at the pre-construction conference. Use of any such equipment shall be approved in writing by the CO prior to commencement of work.

C. When the sound pressure level in any working area exceeds 85 dBA, personnel shall be required to wear hearing protective devices in accordance with 29 CFR 1926.101.

D. When the sound pressure level in any work area exceeds 120 dBA, hearing protection equivalent to the combination of ear plugs and ear muffs shall be required.

1.15 SEVERE STORM PLAN

A. In the event of a severe storm warning, the Contractor shall:

1. Secure outside equipment and materials and place materials possible to damage in protected locations.
2. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
3. Ensure that temporary erosion controls are adequate.
4. Vacate temporary construction trailers.

1.16 SCAFFOLDS AND LADDERS (29 CFR 1926 Subpart L, 29 CFR 1926.454, 29 CFR 1910.66, 29 CFR 1910.28-29 and 29 CFR 1910.24-27)

A. The Contractor shall comply with the requirements of 29 CFR 1926 Subpart L and 29 CFR 1910.66 for use of scaffolds. All scaffolds, ladders, platforms, and runways shall be erected, inspected and maintained in accordance with the applicable sections listed above.

B. An adequate number of ladders shall be furnished at all times. Job constructed ladders shall be of select materials. All fixed ladders above 20 feet in height shall be staggered or caged. All ladders placed on concrete floors or slippery surfaces shall be equipped with an approved type no-skid shoe or adequately made to prevent slipping.

1.17 ROPES/SLINGS/CHAINS

A. No loads shall pass over workmen and other personnel at any time. Slings, their fittings and fastenings, when in use, shall be inspected daily by a qualified craft person for evidence of

overloading, excessive wear or damage. Defective slings shall be removed from service. Proper storage shall be provided for qualified slings when not in use. Wire rope shall be inspected by a competent person at the time of installation and at scheduled intervals thereafter. Drums, sheaves, or pulleys having eccentric bores or cracked hubs, spokes, or flanges shall be removed from service. To eliminate rope damage: drums, sheaves, and pulleys shall be smooth and free of surface defects.

B. Connections, fittings, fasteners, parts, etc., used in connection with ropes shall be of good quality and of proper size and strength, and shall be installed in accordance with recommendations of the manufacturer. Chains used for lifting loads shall be inspected before each use. After the initial inspection, the chains shall be inspected each week. Chains shall be removed from service when showing evidence of cracks, nicks, or other damage. All hooks, used to support human loads (on approved lifting devices) or any loads, shall be closed or equipped with a safety latch.

C. Hooks, shackles, rings, pad eyes, and other fittings that show excessive wear or that have been bent, twisted or otherwise damaged shall be removed from service. Frozen fiber rope shall not be used. Fiber rope that has been subjected to acids or excessive heat shall not be used. Fiber rope shall be protected from abrasion by padding where it is fastened. The same protection applies for fiber rope drawn over square corners, sharp or rough surfaces.

D. The Contractor shall ensure employees performing rigging and hoisting operations are trained and familiar with the safety requirements in 1926.753 and 761. Documentation of this training shall be provided to the Government when requested.

1.18 OPERATIONS ADJACENT TO POWER LINES

A. Equipment or any part thereof shall not have the capability of coming within the following minimum clearances from energized power lines. Positioning and blocking of equipment to assure that no part thereof, including cables, can come within the following minimum clearances will be considered an acceptable alternate.

Power Lines Nominal System KV	Minimum Required Clearance (Feet)
5	3
15	8
44	10
69	12
115-161	15

B. A notice of the minimum required clearance shall be posted at the operator’s position.

C. The Contractor shall ensure employees performing operations adjacent to power lines are trained and familiar with the safety requirements in 29 CFR 1926. 950 – 960 (Subpart V). Documentation of this training shall be provided to the Government when requested.

1.19 CONSTRUCTION EQUIPMENT

A. All construction equipment and machinery, including required guards, brakes, cable, etc., shall be inspected by qualified personnel before use for safe and serviceable mechanical condition. All inspections shall be done daily before each shift and will be properly maintained by qualified personnel. A warning device or service of a signal-man shall be provided where there is danger to personnel from moving equipment, swinging loads, buckets, booms, etc. All equipment capable of hauling 5 tons of material is considered to be heavy duty and shall be equipped with an emergency brake system. The State Commercial Drivers License, (CDL) requirement and regulation applies on Redstone Arsenal. Documentation of this training shall be provided to the Government when requested.

B. Before any machinery or mechanized equipment is placed in use, it shall be inspected and tested by a competent mechanic and certified to be in safe operating condition. Records of tests and inspections will be maintained at the site and will be available upon request. All machinery or equipment found to be unsafe shall be tagged out and its use prohibited until unsafe conditions have been corrected. Machinery or equipment requiring an operator shall not be permitted to run unattended. Equipment shall be locked or secured to prevent operation by unauthorized personnel. All guards and devices shall be replaced immediately after completion of repairs and adjustments.

C. The Contractor shall ensure employees working with construction equipment are trained in its safe operation and are familiar with the safety requirements in 29 CFR 1926. 600 – 606 (Subpart O). Documentation of this training shall be provided to the Government when requested.

D. Self-propelled construction equipment (except light service vehicles), crawler-type equipment, such as cranes, power shovels and draglines, whether moving alone or in combination shall be equipped with a reverse signal alarm in accordance with 29 CFR 1926.601.

1. The alarm shall be mounted on the rear of the equipment and shall withstand severe wear and tear, adverse weather, and unfavorable environmental working conditions and shall be certified by the manufacturer as fully meeting the following performance standards.
2. The alarm shall produce a relatively pure tone which shall peak within the United Standard Association standard octave passband of 600 to 2,400 cycles per second and shall produce a 0.2 to 0.5 second audible warning within the initial 3 feet of backward movement of the vehicle on which it is mounted and at regular intervals, not to exceed 3 seconds, throughout the backward movement. The alarm shall automatically cut out when the backward movement ceases. The sound intensity of the alarm shall range from and not exceed 100 dB at a horizontal distance of 5 feet from the alarm.
3. Actuation of the alarm shall be automatic by direct connection to any part of the equipment that moves or acts in a manner distinctive only to the rearward movement of the vehicle with no manual controls of any kind between the source of actuation and the alarm. Where application of this requirement to specific types of equipment has impractical application, other means of actuation may be used upon written approval of the CO.

1.20 TEMPORARY ELECTRICITY AND LIGHTNG

A. All temporary wiring shall be in accordance with the National Electric Codes, OSHA standards, and installed by competent personnel. Adequate, safe lighting shall be provided in advance for any work requiring artificial light. Grounding of all electrical portable equipment and hand tools

shall be accomplished by installing three-wire plug systems. All 120 volt, single-phase, 15 and 20 ampere receptacle outlets on construction sites which are not part of the permanent wiring of the building or structure and which are in use by employees shall have approved ground fault circuit interrupters (GFCI) for personnel protection.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

Alternate Safety, Health and Environmental (SHE) Plan for Construction

Company Name:	
Contract Number:	**Date:**
MSFC Organization supported:	
MSFC Contracting Officer:	
MSFC Contracting Officer Technical Representative:	
Contract begin date:	**Contract End date:**

Marshall Space Flight Center (MSFC) is committed to providing a workplace that is incident and injury free by (1) preventing employee fatalities, (2) reducing the number and severity of employee injuries and illnesses, and (3) protecting the MSFC environment and property by implementing the five (5) MSFC SHE Program Core Program Requirements (CPRs). During the construction, alteration, demolition and/or repair during the duration of this contracted effort ____(company name)_____shall:

CPR 1 – Management Leadership and Employee Involvement

1. Ensure a workplace is provided that (1) values the safety and health of their employees, (2) is free from incidents and injuries is provided for company employees and customers and (3) protects the MSFC environment and property during the performance of work under this contracted effort.

2. Ensure compliance with all regulations and requirements that are applicable to this contracted effort (i.e., Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), National Aeronautics Space Administration (NASA), Marshall Space Flight Center (MSFC), etc.

3. Ensure employees are encouraged and allowed to participate and be involved in their SHE Program (e.g., participate in safety committees, worksite inspections, accident investigations, the development of job hazard analysis, provide suggestion for improvements to their SHE program and report hazardous working conditions).

4. Ensure managers and employees are (1) encouraged to take responsibility for their safety and health and that of other employees, (2) encouraged to make safety a priority in the performance of their work processes, (3) held accountable to perform their jobs/tasks in a safe and healthful manner while also protecting property and the environment and (4) fully understand their roles and responsibilities in their SHE Program.

5. Ensure the accountabilities, roles and responsibilities listed in 4 above and required by their SHE Program are also flowed-down to subcontractors or teammates, when applicable.

6. Ensure monthly SHE meetings and awareness training for employees is conducted to continually inform employees to perform their tasks in a safe and healthful manner while also protecting the MSFC environment. [NOTE: This meeting can be included as part of a weekly toolbox meeting. Meeting topic and sign-in sheets of these meetings shall be documented and made available to the Government upon request.]

7. Ensure the signed Alternate SHE Plan for Construction is reviewed at least annually and updated as necessary. [**NOTE**: This review shall be documented and made available to the Government upon request.]

8. Ensure all MSFC SHE Program requirements applicable to this contracted effort are flowed down through all company levels located onsite and when applicable to any subcontractors and team-mates supporting this contracted effort.

9. Ensure company employees are assigned to serve as the company SHE Point of Contact (POC) and an alternate SHE POC. They will serve as the POC of any SHE related issue and ensure all MSFC SHE Program requirements are implemented by the contractor while working on MSFC. [**NOTE:** The names of these employees shall be posted on the attached Emergency Phone listing.]

CPR 2 – Worksite Analysis

10. Ensure a safety assessment of some level is conducted for each operation to be performed under this contracted to identify and document operations that have the potential or probability to cause (1) injury/illness to or death personnel or the public; (2) damage to or lose of facilities/equipment; (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability; or (4) detrimental impact to the environment and the surrounding community, (5) evaluate these conditions to determine the probability of their occurrence and the severity if the these conditions did occur, and (6) recommend adequate control measures to eliminate or reduce the concerns/hazards to an acceptable safe working level. [**NOTE**: This also includes the identification, evaluation and control of health concerns/hazards for the prevention of occupational disease.]

    The safety assessment can be conducted by performing a Hazard Analysis (HA), Job Hazard Analysis (JHA) or an equivalent method, or completing a MSFC Hazard Identification Checklist (HIC) specific to the worksite and operations.
    [**NOTE**: The assessments or checklists shall be documented and made available to the Government upon request. The HIC are located on the SHE web page. The Facility Management Office (FMO) inspector or FMO Contracting Officer Technical Representative (COTR) can assist in obtaining the HIC.]

11. Ensure existing operations/processes are reevaluated when significant changes are made that have the potential or probability to affect existing control measures that were previously recommended by a worksite analysis in 10 above.

12. Ensure weekly worksite safety visits to ensure employees are not performing their jobs/tasks/operations in an unsafe manner in accordance with MPR 8715.1 and MWI 8715.16.

13. Ensure worksite inspections are conducted at least weekly of the worksite, materials, and equipment by a competent employee in accordance with 29 CFR 1926.20 (a)(2) & 25. [**NOTE**: The inspection shall be documented and made available to the Government upon request.]

14. Ensure employees (1) are encouraged to and feel comfortable to report any concern/condition that they feel has the potential or probability to cause (1) injury/illness to or death personnel or the public; (2) damage to or lose of facilities/equipment; (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability; or (4) detrimental impact to the environment and the surrounding community without the fear of reprisal from management, (2) receive a timely response from management to investigate and eliminate the concern/condition and (3) how these reports are documented and tracked by management to closure. [**NOTE**: Contractors can use provisions in MWI 8715.13 as their employee safety concern reporting system. Construction workers can also call the Industrial Safety Branch at 544-HELP (4-4357) and select safety or the Safety Hotline at 544-0046.]

15. Ensure all contractor incidents/mishaps and close calls are reported, documented, and investigated to the extent necessary to determine the proximate or root cause(s) in accordance with MWI 8621.1. Contact the CO, FMO Project Manager or MSFC Industrial Safety Branch for assistance if needed. [**NOTE**: If an accident occurs at the worksite, describe the process for securing the site of the accident so that it is not disturbed and remains secure until the arrival of a security officer and/or safety investigator. The site of the accident shall remain secured until released by the CO, FMO Project Manager or MSFC Industrial Safety Branch.]

16. Ensure post-mishap drug and alcohol testing is conducted when the initial mishap investigation provides reason to believe an employee's actions or failure to perform a required action is reasonably suspected of having caused or contributed to causing the mishap in accordance with NPR 3792.1, "Plan for Drug-Free Workplace." [**NOTE**: In the event a mishap results in a fatality or serious injury requiring immediate hospitalization, or substantial damage to property estimated to exceed $10,000, post-mishap drug and alcohol testing can be required by the government and the results of these tests shall be provided to the MSFC FMO CO.]

CPR 3 – Hazard Prevention and Control

17. Ensure a (1) review, (2) approval, and (3) verification of the effectiveness of the control measures recommended to eliminate, reduce or control the concerns/hazards identified in a worksite analysis required by CPR 2 is conducted. [**NOTE**: If an operating procedure is developed as a method to control concerns/hazards onsite at MSFC, concurrence from the MSFC Industrial Safety Branch is required. MSFC requires these procedures to be reviewed annually and updated as necessary.]

18. Ensure all work is performed in full compliance with the MSFC SHE documented programs identified as applicable to this contracted effort (e.g., Personal Protective Equipment (PPE), Respiratory Protection, Hazard Communication, Confined Space Entry, Lockout/Tagout, Bloodborne Pathogens).

19. Ensure the contactor's disciplinary policy/program is (1) clearly communicated and understood by all employees, (2) equitably enforced to all employees and (3) flowed-down to subcontractors or teammates, when applicable.

20. Enforce the contractor's disciplinary policy/program is enforced when management or employees are discovered (1) not performing their jobs/tasks in a safe and healthful manner, (2) not protecting property or the environment, or (3) not complying with MSFC SHE Program requirements.

21. Ensure all employees working on MSFC are made aware of the MSFC Emergency Management Plan in accordance with 29 CFR 1926.35 and MPR 1040.3.
[**NOTE**: Each employee shall be made aware of the location of the nearest protective areas within MSFC building adjacent to the worksite and what they are to do and who they are to contact in the event an emergency occurs. The FMO inspector or FMO Contracting Officer Technical Representative (COTR) can assist in identifying these protective areas adjacent to the work site.]

22. Ensure safety, health, and environmental services that are applicable to this contracted effort are provided by the contractor or by MSFC (i.e., hazardous waste disposal, industrial hygiene monitoring, emergency medical support, hearing conservation program, respiratory protection, and hazard communication, etc.).

23. Ensure all employees are provided with fall protection and protected from potential fall hazards when they are on walking/working surfaces with unprotected sides or edges where the potential exists for them to fall to the next lower level in accordance with 29 CFR 1926.501, 29 CFR 1926.502, 29 CFR 1910.23, and MWI 8715.4. [**NOTE**: Safety nets are not allowed to be used as a fall protection system at MSFC, unless approval is received from the FMO CO, FMO Project Manager, and ISB.]

24. Ensure guardrails or other effective barriers are provided where there are open sides or openings where the walking/working surface is 4 foot or more above the next lower level in accordance with 29 CFR 1910.23(c)(1).

25. Ensure a fall protection system (guardrails or personnel fall arrest system) is provided at the worksite for any activity performed on a walking/working surface with unprotected sides or edges which is 6 foot or more above the next lower level in accordance with 29 CFR 1926.501. [**NOTE**: Safety nets are not allowed to be used as a fall protection system at MSFC, unless approval is received from the FMO CO, FMO Project Manager, and ISB.]

26. Ensure when a conventional fall protection system cannot be used to provide fall protection at the worksite a "site specific (building) fall protection plan" is generated and submitted for approval by the COTR and MSFC Industrial Safety Branch (ISB) in accordance with 29 CFR 1926.501(k).

27. Ensure all fall protection systems provided at the worksite are in compliance with the requirements listed in 29 CFR 1926 502.

28. Ensure plans or operating procedures are generated when determined necessary to control conditions or operations identified to have the potential or probability to be hazardous and result in the occurrence of any item listed in paragraph 10.
[**NOTE**: The plans or operating procedures shall be documented, clearly identify the potentially hazardous situations, the mitigation techniques necessary to control the concern/hazard, and made available to the Government upon request.]

CPR 4 – Safety, Health and Environmental Training

[NOTE: The preferred method documenting an employee's training is to provide a certificate of training that contains (1) the name of the training, (2) date the training was provided, (3) name of the company that provided the training, and (4) the employee's name that indicates the employee attended the training and met all training requirements. In cases where a certificate of training is unavailable for an employee the Contractor can elect to provide an alternate documentation of employee training. The alternation documentation shall (1) be written on a document that contains the company letterhead, (2) rationale that clearly states why the employee is considered as trained, knowledgeable, experienced, and qualified to perform the job/task, and (3) signed and dated by an a company official or supervisor. In either case the Contractor is assuming the responsibility that the employee is trained, knowledgeable, experienced, and qualified to perform the job/task in a safe and healthful manner.

29. Ensure each contractor employee is informed and trained to (1) recognize conditions in the workplace that have the potential or probability to cause (1) injury/illness to or death personnel or the public; (2) damage to or lose of facilities/equipment; (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability; or (4) detrimental impact to the environment and the surrounding community and (2) recognize signs and symptoms of workplace-related illnesses in accordance with 29 CFR Part 1926.21(b)(2). [**NOTE**: This training can be ac-

complished during a safety (toolbox) meeting and evidence of this training made available to the Government upon request.]

30. Ensure each contractor employee is informed and trained to (1) fully understand they are empowered and authorized to "stop or halt" an activity is unsafe and has the potential or probability to cause (1) injury/illness to or death personnel or the public; (2) damage to or lose of facilities/equipment; (3) an undesired outcome that could result in a serious adverse impact on mission capability or operability; or (4) detrimental impact to the environment and the surrounding community. [**NOTE** 1: When an activity is "stopped or halted" the activity cannot resume until the condition has been corrected. At MSFC the FMO CO, FMO Project Manager, FMO Inspector and the MSFC Industrial Safety Branch shall be notified.) (**NOTE** 2: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.]

31. Ensure each contractor employee is trained and fully understands the contractor's disciplinary policy/program and the actions that can be taken by the contractor when safety and health policies, procedures and rules are discovered not being followed and such actions are warranted. [**NOTE**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.]

32. Ensure each job/task performed by contractor is evaluated to (1) identify the specific training required by the applicable parts of 29 CFR 1910 and 29 CFR 1926 and (2) ensure the employees have received the training in order to perform the job/task in a safe and healthful manner. Examples of OSHA required training include, but are not limited to the following: 1) Use of fall protection systems; 2) operating lifting equipment, heavy equipment and machinery; 3) rigging and hoisting; 4) erecting and use of scaffolds; 5) handling harmful substances; and 5) confined space entry. [**NOTE**: Contractors shall maintain a record of this evaluation and provide documentation of this evaluation to the Government, when requested.]

33. Ensure contractor employees receive training and are designated as "qualified" to perform jobs and operate equipment and machinery in accordance with the applicable parts of 29 CFR 1910 and 29 CFR 1926. [**NOTE**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.]

34. Ensure any employee(s) identified to serve in the role of the "competent person" for any operation identified in 29 CFR 1910 or 29 CFR 1926 that require a "competent person" has (1) received the necessary training and experience, (2) is capable of identifying the hazards associated with the operation, (3) has the authority to take the necessary corrective actions, and (4) is knowledgeable of and understands the mandatory and applicable regulations, and standards associated with the equipment or system. [**NOTE** 1: Examples of operations that require a "competent person" in accordance with OSHA include, but are not limited to the following: 1) fall protection systems; 2) erection and use of scaffolds; and 3) excavations.] [**NOTE** 2: Contractor shall maintain a record of this training and made available to the Government upon request.] [**NOTE** 3: Certificate or letter from company providing rationale why the employee is considered a "competent person" or is trained and qualified to perform selected jobs or operate selected equipment.]

35. Ensure each contractor employee receives the initial MSFC SHE Program Awareness Training within 30 days of the Authority to Proceed (ATP) or their arrival at the worksite. [**NOTE** 1: Contractors shall receive, at a minimum, the following training SHE 101C, "MSFC SHE Program Construction Awareness Training." A copy of this training will be provided to the Contractor by the MSFC ISB at the Pre-Construction Conference. The Contractor shall provide in this training within the time limits specified to all contractor employees that will be working onsite in support of this

contracted effort. It is recommended that this training be provided during a weekly pre-work meeting. A signed attendance sheet of employees attending this training shall be provided to the FMO Project Manager as a record of this training being conducted.] [**NOTE** 2: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.]

36. A description of the methods the contractor will use to ensure contractor employees receive a MSFC Safety Certification when required by the Industrial Safety Branch or Environmental Engineering and Occupational Health Office. (**NOTE**: At the present time if the Contractor is expected to operate MSFC owned lifting equipment in accordance with MWI 3410.1 a MSFC Safety Certification is required.)

37. Ensure any contractor developed training that is intended to be used in lieu of MSFC provided training for a MSFC Safety Certification that a copy of this training shall be provided to the MSFC Industrial Safety Branch for approval prior to use when applicable.

38. Ensure all employees are trained and made aware of how to report an emergency or accident while working at MSFC. [**NOTE**: Call 4-HELP (4357) and select the appropriate option. If using a cell phone call 911 and tell the operator you are located at Marshall Space Flight Center, provide building number and road name.]

39. Ensure employees that are required to operate Contractor owned equipment and machinery are trained and qualified to operate the equipment and machinery in accordance with 29 CFR 1926.20(a)(4). [**NOTE**: Contractors shall maintain a record of this training and provide documentation of this training to the Government, when requested.]

40. Ensure employees that are required to handle or use poisons, caustics, and other harmful substances have received training in the safe handling and use, and are made aware of the potential hazards, personal hygiene, and personal protective measures required in accordance with 29 CFR 1926.21(b)(3). [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

41. Ensure employees that are required to handle or use flammable liquids, gases, or toxic materials have received training in the safe handling and use of these materials and made aware of the specific requirements for the liquid, gas or material contained in 29 CFR 1926 Subparts D, F, and other applicable subpart of 29 CFR 1926 in accordance with 29 CFR 1926.21(b)(5). [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

42. Ensure employees that are required to enter into confined or enclosed spaces have received training as to the nature of the hazard involved, the necessary precautions to be taken, and in the use of protective and emergency equipment in accordance with 29 CFR 1926.21(b)(6). [**NOTE**: Employees entering confined spaces at MSFC shall be trained and documented in accordance with MPR 1840.1 and made available to the Government upon request.]

43. Ensure all employees are assessed to ensure they are adequately trained and qualified to perform their job or operate equipment. [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request for any tasks/activities that requires documented training in accordance with 29 CFR 1910 and 29 CFR 1926.]

44. Ensure employees that are required to operate any MSFC owned lifting equipment (forklift, crane, etc.) have received training, are qualified to operate the equipment, and have a MSFC certification

in accordance with MWI 3410.1. [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

45. Ensure rigging and hoisting operations are performed by employees that have received training in these operations and are familiar with rigging and hoisting safety requirements in accordance with 29 CFR 1926.753-761 and 29 CFR 1910.178(l)6). [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

46. Ensure operations performed adjacent to power lines are performed by employees that have received training in this type operation and are familiar with the safety requirements for these type operations in accordance with 29 CFR 1926.950-960.
[**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

47. Ensure operations that require the use of construction equipment considered as heavy equipment or machinery are performed by employees that have received training in the safe operation of this type equipment or machinery and are familiar with the safety requirements in accordance with 29 CFR 1926.600-606. [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

48. Ensure employees required to wear a personal fall arrest system have received training and are familiar with the correct use of these systems in accordance with 29 CFR 1926.503. [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

CPR 5 – Environment Management System

49. Ensure the procurement, storage, use of hazardous chemicals and materials brought on MSFC are in accordance with MPR 8500.1. [NOTE: Coordination with the Environmental Engineering and Occupational Health (EEOH) Office is required.]

50. Ensure the recycling and disposal of any hazardous waste generated on MSFC is in accordance with MWI 8500.1. [**NOTE**: Coordination with EEOH is required.]

51. Ensure all work performed on MSFC is in compliance with environmental laws and regulation of 40 CFR, Alabama Department of Environment Management (ADEM), and MPR 8500.1 by:
    a. Reporting hazardous and toxic substance use.
    b. Implementing and reporting green procurements in accordance with MWI 8540.2.
    c. Reducing, reusing, and recycling of hazardous and toxic substances prior to disposal in accordance with MWI 8550.1.
    d. Minimizing stormwater pollution in accordance with MWI 8550.2.
    e. Ensuring equipment and processes permitted by applicable laws.
    f. Disposing of solid and liquid materials as permitted by laws.

    [**NOTE**: Coordination with EEOH is required.]

ADDITIONAL REQUIREMENTS

Pre-work Inspections

52. Ensure scaffolds and scaffold components are erected and used in accordance with 29 CFR Subpart L and 29 CFR Part 1910.66, and inspected prior to use each day by a “competent employee” in ac-

cordance with 29 CFR 1926.451(f)(3). [**NOTE**: Evidence of this inspection shall be documented and made available to the Government upon request.]

53. Ensure excavations/trenches are dug, formed and inspected prior to entry and as needed throughout the day by a "competent person" in accordance with 29 CFR 1926.651, 29 CFR 1926.652 and 29 CFR 1926.651(k). [**NOTE**: Evidence of this training shall be documented and made available to the Government upon request.]

Equipment and Tools

54. Ensure Contractor owned or rented hoisting equipment (cranes and forklifts) brought on MSFC have their rated load capacities conspicuously posted on the equipment in accordance with 29 CFR 1926.550(a)(2).

55. Ensure any Contractor owned or rented motorized vehicles and lifting equipment brought on MSFC in support of this contracted effort comply with the applicable requirements in 29 CFR 1910.178 – 184, 29 CFR 1926.550-606 and 29 CFR 1926.1000-1003. [**NOTE**: Documentation of equipment inspections made available to the Government upon request.]

56. Ensure Contractor owned or rented hoisting equipment (cranes and forklifts) brought on MSFC have a documented annual inspection in accordance with 29 CFR 1926.550(a)(6). [**NOTE**: The annual inspection documentation shall be made available to the Government upon request.]

57. Ensure a visual inspection is performed of each hoisting equipment (cranes or forklifts) prior to use in accordance with 29 CFR 1926.753(c)(1).

58. Ensure the use of any equipment, machinery or tools discovered to be in an unsafe operating condition is prohibited in accordance with 29 CFR 1926.20 (a)(3).
[**NOTE**: Equipment, machinery or tools discovered in an unsafe operating condition shall be removed from the worksite or identified (tagged) as unsafe, or rendered inoperable by the use of a lock.]

59. Ensure all self-propelled construction equipment is equipped with a reverse signal alarm in accordance with 29 CFR 1926.601. [**NOTE**: This is not required for light service vehicles.]

60. Ensure equipment and materials located outdoors are placed and stored so to not cause possible damage to other buildings or structures during severe weather.

Electrical Equipment

61. Ensure all power portable tools are double-insulated or grounded by means of a 3-wire polarity type grounding system via a ground fault interrupter in accordance with 29 CR 1926.302.

62. Ensure all single-phase 15 and 20 ampere receptacle outlets used by employees at the worksite during the construction are equipped with ground-fault circuit interrupters (GFCI) for employee protection in accordance with 29 CFR 1926.404(b)(1).

63. Ensure all cord sets and receptacles used by employees at the worksite during the construction are equipped with a grounding plug and are grounded in accordance with 29 CFR 1926.404(b)(1).
[**NOTE**: This applies to cord sets and receptacles that are not part of the permanent building structure.]

64. Ensure all equipment and systems are de-energized, placed in a safe work condition and lock out devices applied in accordance with 29 CFR 1910.147, 29 CFR 1926.417 and MWI 8715.2. [**NOTE** 1: At MSFC all locks used for locking out equipment/system while an employee is working on the equipment/system shall be identified by a "red" colored case. These lockout devices shall also be identified with tags containing "red diagonal stripe". Reference MWI 8715.2 for more information.] [**NOTE** 2: Work on energized equipment is strictly prohibited at MSFC, but occasionally a situation will arise where this is not possible. In these situations an Energized Electrical Work Permit shall be required. Contact FMO for more information.]

Lighting

65. Ensure adequate lighting (permanent or temporary) is provided in the work area to enable the employees to safely perform their tasks in accordance with 29 CFR 1926.26.

Fire Protection

66. Ensure fire protection equipment appropriate for the work being performed is available at the worksite in accordance with 29 CFR 1926.24. [**NOTE** 1: Portable fire extinguishers are to be located at the worksite and accessible to employees.]
[**NOTE** 2: Any employee that might use a portable fire extinguisher are to receive training in the general principles of fire extinguisher use and the hazards involved with incipient stage fire fighting in accordance with 29 CFR 1910.157.]

Barricades

67. Ensure barricade fencing that is effective in preventing unauthorized entry is erected around the worksite and hazardous conditions such as excavations, trenches, etc. in accordance with 29 CFR 1926.200 -203, Subpart G and MWI 8715.3.
[**NOTE**: Orange mesh barricade fencing is the preferred method for construction at MSFC, but other means (signs, signals, tags) of warning employees are also acceptable. The FMO inspector or ISB can provide more information.]

68. Ensure structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations are protected against damage.

Personal Protective Equipment

69. Ensure jobs that require Personal Protective Equipment (PPE) to be worn to reduce employee exposure to hazardous conditions are communicated to all employees performing these tasks in accordance with 29 CFR 1926.28 and MWI 8715.4.

70. Ensure signage is posted at the worksite or for operations that require the use of PPE and these requirements are communicated to the employees. The signs shall clearly identify the type PPE and when it is required to be worn at the worksite.

Housekeeping

71. Ensure all scrap lumber and debris is kept cleared from work areas, passageways and stairs in accordance with 29 CFR 1926.25(a).

72. Ensure combustible scrap and debris is removed from the worksite at regular intervals in accordance with 29 CFR 1926.25(b).

73. Ensure containers are provided to collect waste/trash and they are emptied at regular intervals in accordance with 29 CFR 1926.25(c). [**NOTE**: Containers for garbage and other oily, flammable, or hazardous wastes, such as caustics, acids, harmful dusts, etc. shall be equipped with covers and the covers kept closed.]

Permits/Plans

74. Ensure the following abatements/impairment plans are obtained when needed for:

- Lead removal – 29 CFR 1926.62
- Asbestos removal - 29 CFR 1926.1101
- Fire Protection system outages – 29 CFR 1926.150 and MWI 8715.11

75. Ensure the following permits are obtained when needed:

- Hot Work Permits (MSFC Form 1155) shall be required for activities that are not performed in a MSFC Designated Hot Work Area and use an "open flame", welding, cutting, grinding, Tar Kettles. etc.
  [**NOTE**: All hot work shall end 1 hour prior to the end of the normal work day.]
- Digging Permit (MSFC Form 4392) shall be required for all excavations and trenching
- Confined Space Entry Permit (MSFC Form 2519) shall be required for all entries in MSFC spaces identified as a confined space in accordance with MPR 1840.1.
- Energized Electrical Work Permit (MSFC Form 4462) shall be required if the equipment or system cannot be de-energized to perform work.
  [**NOTE**: No work shall be performed on energized equipment without concurrence from FMO and approval from ISB.]

General

76. Ensure all employees are made aware of how to receive emergency medical attention at MSFC in accordance with 29 CFR 1926.23 & 50. [**NOTE**: First aid is available to all employees at the MSFC Medical Center, building 4249.]

77. Ensure employee(s) are identified to serve in the role of a "Competent person" for pre-job inspections/verifications/activities (scaffolding, trenches, etc.) as required by the applicable subparts of 29 CFR 1910 and 29 CFR 1926 for this contracted effort. [**NOTE** 1: A "competent person" is identified in 29 CFR 1926.32 and 29 CFR 1910 as "capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who have authorization to take prompt corrective measures to eliminate them."] [**NOTE** 2: Justification/rational of selecting these employees shall be documented (employee's training, work experience and knowledge of the task) and made available to the Government upon request. The name(s) of the "Competent person(s) and the corresponding job/task for which that are designated to serve as the "Competent person" shall be listed on the attached Emergency Phone listing, Appendix C and posted at the project site or designated meeting area where the worker gather prior to commencing work.]

78. Ensure an employee is appointed to be "in charge and responsible" and is physically located onsite while work is being performed. [**NOTE**: This is normally a job superintendent or foreman.]

79. Provide a list of company employee(s) to be contacted in the event of an emergency while work is performed onsite under this contracted effort.

80. Post the "Emergency Phone List" Appendix C at the project site, or a designated meeting area where workers gather prior to commencing work, or for other activities. The "Emergency Phone List" can also be located in company vehicles if the Contractor does not have a designated meeting area.

81. Provide additional requirements not previously listed, if required, specific to the work performed under this contracted effort in Appendix A.

REPORTS/DOCUMENTATION SUBMITTAL

Reports/documentation listed below shall be made available to the Government upon request.

1. Safety (toolbox) meeting and/or safety awareness training documentation
2. Safety Assessments: Hazard Analysis (HA) or Job Hazard Analysis (JHA), Hazardous Inventory Checklists (HIC) for the work being performed
3. Worksite inspections conducted by the contractor documentation
4. Employee training/qualification/certification records
5. Equipment inspections conducted by the contractor documentation
6. Material Safety Data Sheets (MSDS) for chemical and hazardous materials

SUBMISSIONS FREQUENCY

1. MSFC Contractor Accident and Safety Statistics (MSFC Form 4371) or an equivalent method to the Contracting Officer (CO) or FMO representative designated by the CO. This information shall be provided in accordance to the reporting requirements determined by the CO. At a minimum the following information shall be provided:
   - Contract number
   - National American Standard Industry Code (NASIC)
   - Number of employees and supervisors
   - Number of hours worked during the month
   - Lost work day cases, days away from work, and restricted work days
   - Number of safety meeting and worksite inspection

2. Initial notification for Type A, Type B, Type C, Type D mishaps and close calls – **shall be reported to the MSFC ISB as soon as possible, but no later that one hour of awareness of the occurrence** 1) Call the Safety Hotline at (256)-544-0046 or 4-HELP (4-4357), select the appropriate option, or 2) Submit a "SHE Report" located on "Inside Marshall," or 3) Direct input to the NASA Incident Reporting Information System (IRIS) Quick Incident Report located at https://nasa.ex3host.com/irisquickincident/safety_default.asp., or 4) an equivalent electronic notification method to the MSFC Industrial Safety Branch.

   The link to the "SHE Report" is located at the bottom of the "Inside Marshall" web page under the "MSFC Safety Reporting System" link. Open "SHE Reporting," select "Continue to SHE Report Form," select "Category," select "Incident or Mishap" and enter all the required information,

2.1 The initial notification for all mishaps/close calls shall include 1) location and time of incident, 2) number of fatalities and/or hospitalized employees (if known), 3) Company or MSFC organization contact person and phone number, 4) a brief description of the mishap/close call including damage to equipment and/or facilities.

3. Follow-up reporting and documentation of a mishap/close call shall be within 24 hours of initial notification to the FMO Incident Reporting Information System (IRIS) administrator or ISB in accordance with MWI 8621.1.

4. The extent of investigation to determine the root cause of the mishap or close shall be conducted in accordance with MWI 8621.1.

Approval Signatures

By signing this Alternate SHE Plan the Contactor confirms their agreement and commitment to (1) provide a workplace that is incident and injury free, and (2) to adhere to and comply with all of the requirements contained in MPR 8715.1, MWI 8621.1 and other MSFC SHE documents identified above as applicable to the jobs/tasks associated with this contracted effort while working on MSFC.

Contract Number: _____

Company Name: _____

Company Onsite Superintendent/Foreman

(print):_____

(signature):_____Date:_____

Company Onsite SHE representative

(print):_____

(signature):_____Date:_____

APPENDIX A

Additional requirements, if necessary, specific to the work performed under this contracted effort.

1.

2.

Appendix B

Applicable Documents

Check the box of the MSFC SHE Program documents that are applicable to the work being performed under this contracted effort.

No.	YES	NO	Federal Directives and Standards
1			29 CFR Part 1910, Department of Labor, Occupational Safety and Health Administration Standards for General Industry
2			29 CFR Part 1925, Safety and Health Standards for Federal Service Contracts
3			29 CFR Part 1926, Department of Labor, Occupational Safety and Health Administration Standards for Construction
4			CFR Title 40 Parts 1-1068, Protection of the Environment
5			ANSI Stds., American National Standards Institute, applicable to the scope of this contract
6			ASME, American Society of Mechanical Engineers, applicable to the scope of this contract
7			NPFA, National Fire Protection Association
8			CGA, Compressed Gas Association, applicable to the scope of this contract
			NASA Directives
9			NPR 3792.1, Plan for a Drug-Free Workplace
10			NPR 8715.1, NASA Occupational Safety and Health Programs
11			NPR 8715.3, NASA General Safety Program Requirements
			MSFC Directives
12			MPR 1040.3, MSFC Emergency Plan
13			MPD 1800.1, MSFC Smoking Policy
14			MPR 1800.1, Bloodborne Pathogens
15			MPR 1800.2, MSFC Ergonomics Program
16			MPR 1800.3, MSFC Sanitation Program
17			MPR 1810.1, MSFC Occupational Medicine
18			MPD 1840.1, MSFC Environmental Health Program
19			MPR 1840.1, MSFC Confined Space Entries
20			MPD 1840.2, MSFC Hearing Conservation Program
21			MPR 1840.2, MSFC Hazard Communication Program
22			MPD 1840.3, MSFC Respiratory Protection Program
23			MPR 1840.3, MSFC Hazardous Chemicals in Laboratories Protection Program
24			MPR 1840.4, MSFC Asbestos Program

25			MPR 1860.1, MSFC Radiation Safety Procedural Requirements
26			MPD 1860.2, Radiation Safety Program
27			MPR 1860.2, Nonionizing Radiation Safety
28			MPR 3410.1, Training
29			MWI 3410.1, Personnel Certification Program
30			MPD 8500.1, MSFC Environmental Management Policy
31			MPR 8500.1, MSFC Environmental Management Program
32			MPR 8500.2, MSFC Environmental Management System (EMS) Manual
33			MWI 8540.2, Green Purchasing Program
34			MWI 8550.1, Waste Management
35			MWI 8550.2, Storm Water Management
36			MWI 8550.3, Wastewater Compliance
37			MWI 8550.4, Air Emissions Compliance
38			MWI 8550.5, Chemical Management
39			MWI 8621.1, Mishap and Close Call Reporting and Investigation Program
40			MPR 8715.1, Marshall Safety, Health, and Environmental (SHE) Program
41			MWI 8715.1, Electrical Safety
42			MWI 8715.2, Lockout/Tagout Program
43			MWI 8715.3, Hazard Identification and Warning System
44			MWI 8715.4, Personal Protective Equipment (PPE) and Systems
45			MWI 8715.5, Area/Building Manager Program
46			MWI 8715.9, MSFC Occupational Safety Requirements in Contracts
47			MWI 8715.10, Explosives, Propellant, and Pyrotechnics Program
48			MWI 8715.11, Fire Safety Program
49			MWI 8715.12, Safety, Health and Environmental-Finding Tracking System (SHEtrak)
50			MWI 8715.13, Safety Concerns Reporting System (SCRS)
51			MWI 8715.15, Safety Operational Safety Assessment Program
52			MWI 8715.16, Supervisor Safety Visits
53			MWI 8715.17, Safety Operational Readiness Review Program
54			For Construction - Indefinite Delivery Indefinite Quantity (IDIQ) and Blanket Purchase Agreement (BPA) – MSFC Technical Specifications for Repairs and Construction (TSRC)
55			For Construction – Construction of Facilities (CoF) – MSFC Master Specs

APPENDIX C

MSFC EMERGENCY TELEPHONE LIST

[Post at worksite or a designated meeting area where workers gather prior to commencing work or for other activities. The "Emergency Phone List" can also be located in company vehicles if the Contractor does not have a designated meeting area]

	MSFC NETWORK TELEPHONE	OTHER TELEPHONE
AMBULANCE	**911**	**911- Specify at MSFC or** 544-4357, Option (Security)
CHEMICAL SPILLS	911	544-4357, Option (Security)
Environmental Engineering Office		**544-4246**
FIRE	**911**	**876-2117**
SECURITY	911	544-4357, Option (Security)

MEDICAL CENTER (bldg 4249) 544-2390

[Identify that you are on MSFC property if using a cell phone and give location, building number, road, intersection, etc. if known.]

TO REPORT UNSAFE, UNHEALTHFUL OR ENVIRONMENTAL CONCERNS

OCCUPATIONAL HEALTH SERVICES	**544-2390**
ENVIRONMENTAL ENGINEERING OFFICE	**54 4-4246**
INDUSTRIAL SAFETY BRANCH	**544-0046**

TO REQUEST A PERMIT

Welding/Burning/Cutting Permits	**544-0046**
Inside Test Area	544-7374, 961-1178
CONFINED SPACE PERMITS (call all numbers listed below)	
Occupational Health Services	**544-2390**
Industrial Safety Branch	544-0046
Inside Test Area	544-7374, 961-1178
Fire Department	876-3437
Digging Permit	544-6759

Company Name:	
Company Emergency Contact:	Phone:
Company Emergency Contact:	Phone:
Company Emergency Contact:	Phone:
Company SHE POC:	Phone:
Competent SHE POC (Alt)	Phone:
Competent Person:	Examples -Rigging
Competent Person:	Excavation/Trench
Competent Person:	Lifting Equipment
Competent Person:	Scaffold
Competent Person:	
Competent Person:	

SECTION 010650 — ENVIRONMENTAL COMPLIANCE

PART 1 - GENERAL

1.1 SUMMARY

A. This section deals with hazardous waste only. Refer to section 01 74 19 for construction waste and demolition.

1.2 REFERENCE

A. The publications listed below form a part of this section to the extent referenced:

1. MPR 1840.4, MSFC Asbestos Program
2. MWI 8540.2 Green Purchasing Program
3. Executive Order 13423 Strengthening Federal Environmental Energy, and Transportation
4. Executive Order 13514 Federal Leadership in Environmental, Energy, and Economic Performance
5. MPD 8500.1, MSFC Environmental Management Policy
6. MPR 8500.1, MSFC Environmental Management Program
7. MPR 8500.2, MSFC Environmental Management System
8. Steel Structures Painting Council (SSPC):
   a. SSPC Technology Guide No. 6 (2004) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations

1.3 SUBMITTALS

A. Submit one copy of Material Safety Data Sheets (MSDS) and Chemical Inventory Worksheet for all hazardous materials brought on site. The contractor shall use MSFC Form 4582 provided by the Government.

B. Inspection Reports: Monthly Submittals (by the 10th for the previous month):

C. Closeout Submittals
1. Submit Stormwater Inspection Records (monthly and daily inspections) at the end of the project.
2. Green Purchasing Report: The contractor shall submit a report listing purchases of items containing recycled or biobased materials on MSFC Form 4510 (MSFC Construction Green Purchasing Reporting Form). The contractor shall include the amount spent on items containing recycled materials or biobased products and amount spent on items that

do not contain recycled materials or are not biobased. The accounting shall include the amount spent on all products that meet the EPA (http://www.epa.gov/epaoswer/non-hw/procure/products.htm) guidelines or the USDA guidelines (http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx) whether specified or not.

1.4 DEFINITIONS

A. Construction disturbance: Defined in ADEM Regulation 335-6-12-.02 (e).

B. Environmental Policy: "Enabling NASA's mission by providing environmental compliance and stewardship and a safe and healthful workplace."

C. Inspection: Examining satellite accumulation points to ensure compliance with the State of Alabama Regulations. Examining site conditions, records, and plans for compliance.

D. Postconsumer content: A material or finished product that has served its intended use and has been diverted or recovered from waste destined for disposal, having completed its life as a consumer item. Postconsumer materials are part of the broader category of recovered materials.

E. Qualified Credentialed Inspector (QCI) is an operator, operator employee, or operator designated qualified person who has successfully completed initial training and annual refresher Qualified Credentialed Inspection Program (QCIP) training and holds a valid certification from an ADEM approved cooperating training entity.

F. Qualified Credential Professional (QCP) is any staff member of ADEM designated by the Director, a Professional Engineer, an Alabama Natural Resources Conservation Service professional designated by the State Conservationist, or a Certified Professional in Erosion and Sediment Control (CPESC). A QCP includes a registered landscape architect, a registered land surveyor, a Professional Geologist, a registered forester, a Registered Environmental Manager as determined by the National Registry of Environmental Professionals (NREP), and a Certified Professional Soil Scientist (CPSSc) and other ADEM accepted professional designations, certifications, and/or accredited university programs that can document requirements regarding proven training, relevant experience, and continuing education that enable recognized individuals to prepare Construction Best Management Practice Plans (CBMPPs), to make sound professional judgments regarding Alabama National Pollutant Discharge Elimination System (NPDES) rules, planning, design, implementation, maintenance, and inspection of construction sites, receiving waters, Best Management Practices (BMPs), remediation/cleanup of accumulated offsite pollutants from the regulated site, and reclamation or effective storm water quality remediation of construction associated land disturbances, that meet or exceed recognized technical standard and guidelines, and effective industry standard practice. The QCP shall be in good standing with the authority granting the registration or designation.

G. Waste Stream: A generation of a spent/waste hazardous or recyclable material that requires either recovery or disposal in accordance with appropriate environmental, NASA, Federal, State and local laws and regulations.

1.5 EXPLOSIVE ORDNANCE AND CHEMICAL WARFARE MATERIAL PRECAUTION

A. See Section 01 05 90, 1.4.

PART 2 - PRODUCTS

2.1 ACCUMULATION CONTAINERS

A. Hazardous and controlled waste accumulation containers will be provided by the Government. The containers shall be requested by the Contractor three days in advance of the initial need date.

B. The containers will be labeled by the Government.

C. Ensure that the accumulation containers are secured such that the containers shall not be exposed to vehicular traffic.

D. Turn in the containers when ninety percent (90%) of the rated volume of each container is used for liquid waste. Containers of solid waste may be filled to hundred percent (100%).

E. At the time of turn-in, identify if a replacement container is required.

F. Ensure that hazardous and controlled waste are segregated and labeled by type in different accumulation containers.

PART 3 - EXECUTION

3.1 HAZARDOUS WASTE GENERATOR NOTIFICATION AND TRAINING.

A. The Contractor shall designate a person as point of contact (POC) and as many as two alternate people for each hazardous and controlled waste accumulation site.

B. The POCs shall be responsible for maintaining the Contractor's accumulation site in compliance with all applicable Federal, state and local laws and regulations.

C. The Contractor shall attend the first available SHE 101C, "Safety, Health, and Environmental (SHE) Program Construction Awareness" training after initiation of the contract. The training is conducted on site by the Government at no cost to the Contractor.

D. Government personnel will inspect the accumulation site(s) to ensure compliance.

3.2 HAZARDOUS MATERIAL NOTIFICATION AND TRAINING

A. As required in Federal Standard 313, the Contractor shall submit to the Government a Chemical Inventory Worksheet listing the product names and quantities of all hazardous materials brought on site. The Contractor shall maintain a copy of this list at the job site for inspection by the Government. Copies of the MSDSs shall be readily accessible to all Contractor employees at the job site either hard copy or electronic. Contractor shall provide a copy on MSFC Form 4582.

B. The Contractor shall attend the first available SHE 101C, “Safety, Health, and Environmental (SHE) Program Construction Awareness” training after initiation of the contract. The training is conducted on site by the Government at no cost to the Contractor.

C. The Contractor shall ensure that all personnel working in the area are made aware of the chemical hazards associated with chemicals located at the jobsite.

3.3 HAZARDOUS AND CONTROLLED WASTE COLLECTION

A. The Contractor shall notify the Government of wastes being generated. The Government will determine the correct method of disposal.

B. The following types of hazardous and controlled waste are commonly associated with construction projects; however, it is not necessarily an all inclusive list. All wastes shall be collected and placed into accumulation containers for disposal.

1. All fluorescent light ballasts and lamps.
2. High Intensity Discharge (HID) lamps.
3. Free oil liquids and oil filters. Oil rags that are not saturated (no free liquids dripping) shall be disposed as solid waste.
4. Paint, paint thinners, adhesives, etc.
5. Sandblast material from tanks, equipment, and piping.
6. Materials used for cleaning and degreasing of equipment, tanks, and piping.
7. Paint chips from water blasting operation, scraping, sandblasting, grinding, etc. Shall be collected on a daily basis. Materials to be recycled shall be free of loose lead paint chips prior to recycling.
8. Aerosol cans.
9. Process piping system cleaning operations fluids shall be collected and disposed as directed.

C. The Contractor shall adhere to Government guidelines for inspections, collection, and turn-in of waste materials.

D. Asbestos-containing material (ACM) shall be bagged, labeled and handled in accordance with OSHA and EPA regulations and MSFC procedures per MPR 1840.4, “MSFC Asbestos Program”. The Contractor shall transport and dispose of ACM at the Redstone Arsenal Landfill (RSAL), unless otherwise approved by the Government. See Section 01 35 50 for additional information.

3.4 EMPTY CONTAINER MANAGEMENT

A. Empty hazardous material containers (5 gallons and larger) shall be turned in to the Government. The Contractor shall ensure the containers are empty using practices commonly employed to remove materials from that type of container such as pouring, pumping, and aspirating.

B. Clean and purge/triple rinse all empty containers as required by the Government.

C. Ensure bungs and/or tops are secured prior to storage/turn-in.

D. Empty containers shall not be stacked more than two high for any size container on pallets.

E. Empty containers that are damaged and will not seal shall be taped over the damaged area or turned upside down to prevent rainwater collection.

F. Empty containers shall be turned in frequently, as determined by the Government.

3.5 CONSTRUCTION BEST MANAGEMENT PRACTICES PLAN (CBMPP)

A. Construction Best Management Practices Plan (**Site disturbing greater than 1 acre**): The Contractor shall prepare, submit, and have approved a site specific CBMPP, prior to work commencing on site. The Contractor will implement the CBMPP throughout the duration of the construction. This CBMPP must be prepared in accordance with ADEM Administrative Code 335-6-12-.21 by a QCP. If a Construction Storm Water Notice of Registration (NOR) from ADEM is required, the prime construction Contractor shall apply for the permit and advertise for a period of seven days by placing the permit application in the legal section of the local newspaper 15 days prior to starting any work at the selected site..

B. Construction Best Management Practices Plan (Site disturbing less than 1 acre): The Contractor shall prepare a Site Specific Construction Best Management Practices Plan (CBMPP) (Attachment A). The Contractor will implement the CBMPP throughout the duration of the contract.

C. Daily Stormwater Inspection Record: The Contractor shall perform daily inspections of hazardous waste containers, hazardous materials containers, empty containers, vehicles and equipment, and erosion and sediment controls. The daily inspection will be documented in a similar format as shown on MSFC Form 4524, Stormwater Inspection Record (available from the Government), or other format acceptable to the Contracting Officer. The inspection documentation will be maintained and available at the site for periodic verification of compliance by the Government and will be submitted to the Government upon completion of construction.

1. Inspections: When no work is being conducted (e.g., weekends, holidays, etc.), no inspection is necessary. The Contractor shall ensure that the site is in compliance with the CBMPP. If the project construction site is greater than 1 acre, inspections shall be performed by a contractor representative that meets the requirements outlined in ADEM Administrative Codes 335-6-12-.02(p) and (q), which states that inspections must be conducted by a QCI or QCP or a person under the direct supervision of a QCP (QCP designee).

2. Daily Stormwater Prevention Inspection. The Contractor shall inspect daily, unless otherwise noted, hazardous waste containers, hazardous material containers, empty containers, vehicles and equipment, and erosion and sediment controls for:
   a. Containers protected from traffic
   b. Containers labeled
   c. Storage area neat and orderly
   d. Spillage from material handling
   e. Containers sealed, during inactivity
   f. Damaged pallets
   g. Damaged containers

h. Spill cleanup materials available
i. Containment system in good condition
j. Containment valves closed
k. Containment system water managed appropriately
l. Fluids leaking from vehicles and equipment

D. Monthly Stormwater Inspection Record

1. The Contractor shall perform monthly inspection of erosion and sediment controls for the construction site. The inspection shall be documented in a format acceptable to the Contracting Officer. The inspection documentation shall be maintained and available at the site for periodic verification of compliance by the Government and shall be submitted to the Government upon completion of construction.

2. The Contractor shall inspect erosion and sediment controls for:
   a. No signs of excessive erosion
   b. Erosion controls are effective and in good condition
   c. No sediment buildup in storm water structures (inlets, ditches)

E. Deficiencies and Inspections: Contractor shall take immediate action to correct any environmental findings or non-compliances. Failure to come into compliance or correct a finding to the satisfaction of the contracting officer within 48 hours, from the time when the non-compliance was discovered by the contractor or from the time when the contractor was notified, shall result in the contractor stopping all on-site work at the contractor's sole expense until compliance is achieved as determined by the government and the contracting officer has approved continuation of work. The contractor may submit to the Contracting Officer's Technical Representative (COTR) for approval within the 48 hours an Environmental Recovery Plan detailing day-by-day activities including intermediate protective measures that will be taken in order to come into compliance within a specified recovery period and to forego the stop of work until completion of the approved recovery period.

F. Stockpiles of dirt must be stabilized with temporary or permanent vegetative cover if material is not actively disturbed more than thirteen (13) days per ADEM Admin R. Code 335-6-12-.21(2)5.

3.6 SPILLS OF HAZARDOUS MATERIALS

A. The Contractor shall activate the MSFC Emergency Plan for emergency spills by dialing 911. The contractor may dial 256-544-4357 for non-emergency hazardous material spills that cannot be cleaned up with contractor cleanup material. The Contractor is responsible for costs incurred in cleaning up spills.

B. The Government will determine the correct disposal method for spilled materials.

C. The Contractor shall maintain spill cleanup material for the type of hazardous materials used at the construction site.

3.7 HANDLING, DUST CONTROL, AND DISPOSITION OF LEAD COATINGS

A. The following requirements, except as noted in Paragraph entitled "Requirements for Removing Lead Coatings - Small Scale / Short Duration," shown below, apply to all work performed in connection with the removal of lead-based coatings or materials coated with the lead-based materials:

1. Worker protection and work practices shall conform with OSHA Safety and Health Standards, 29 CFR 1926.62.
2. Methods utilized to remove lead-based coatings shall minimize the amount of dust generated, and shall be in accordance with the Contractor's approved lead coatings safety plan. Engineering controls shall be employed to insure that airborne lead exposures do not exceed 50 micrograms / cubic meter. Contaminated air shall be filtered before it is discharged into the environment away from the source of intake air, in accordance with 29 CFR 1926.353.
3. All workers in the controlled lead abatement area shall wear NIOSH approved respirators with high efficiency filters and protective clothing as required by 29 CFR 1926.62. Use of respirators shall comply with 29 CFR 1910.134.
4. All lead particulate and waste shall be collected and sealed in non-permeable accumulation containers in accordance with article 2.01 of this Section.
5. The Contractor shall submit a written detailed plan, for approval, which describes the methods and equipment to be used to achieve the lead removal in conformance with the requirements listed above. This submittal shall, as a minimum, include the following:
   a. Removal, containment and/or ventilation plans and drawings
   b. Plan for protection of ambient air, soil, and water
   c. Worker protection programs
   d. Plan for handling and disposal of debris

3.8 REQUIREMENTS FOR REMOVING LEAD COATINGS - SMALL SCALE / SHORT DURATION

A. The following minimum requirements shall be followed when removing material by grinding, cutting, or welding, which is attached to the steel structure
1. Comply with 29 CFR 1926.62.
2. Local exhaust shall be used to ventilate the area during welding, cutting, or burning of lead coatings.
3. Personnel required to conduct welding, cutting, or burning of lead coatings, as a minimum, shall be outfitted with a powered air purifying respirator (PAPR) equipped with high efficiency filter. Under certain conditions, i.e. poor ventilation, supplied air respiratory protection may be required.
4. Personnel required to conduct welding, cutting, or burning of lead coatings shall wear protective clothing. Contractors shall arrange for the laundering of protective clothing; or, if disposable protective clothing is used, the Contractor shall maintain an adequate supply at the worksite and arrange for its safe disposal according to applicable Federal (40 CFR 260) and State regulations.
5. Following welding, cutting, or burning of lead coatings, employees must exercise good personal hygiene (i.e., washing hands and face) since lead can become an ingestion hazard.

3.9 GREEN PURCHASING

A. The Resource Conservation and Recovery Act (RCRA) requires that use of recovered/recycled (recycled) materials in the products to the greatest extent practicable. Additionally, Executive Order 13423 requires (1) the reduced use of chemicals and toxic materials and purchase of lower risk chemicals and toxic materials as well as (2) the expanded purchasing of environmentally sound goods and services, including biobased products. Furthermore, Executive Order 13514 requires that 95% of new contract actions are energy-efficient, biobased, environmentally preferable, non-ozone depleting, contain recycled content, or are non-toxic or less toxic. The Farm Security and Rural Investment Act of 2002 (Farm Bill) requires the purchase and use of biobased products.

B. The Contractor shall determine from the technical specifications what products require recycled biobased content and purchase accordingly.

C. Whenever a product is required to contain recycled material or be biobased by the technical specification but cannot be produced as specified, the Contractor shall notify the COTR, by submitting a product substitution request per the Section 016000 entitled "Product Requirements" with a Contractor-signed letter explaining in detail what suppliers and manufactures were contacted and why the product cannot be produced as specified.

D. Green Purchasing Report: See Section 1.3 D for requirements

E. GREEN PURCHASING WAIVER: The Contractor purchase from the list of products (see Section 1.3 D) if one of the following exceptions applies: 1) Inadequate competition; 2) Unreasonable price; 3) Lack of quality/performance specifications or standards; or 4) Unavailable within a reasonable timeframe.

1. The Contractor shall prepare a request for waiver using MSFC Form 4412, "Green Purchasing Request for Waiver". Include any necessary accompanying documentation, and forward the document to the Government for concurrence and approval (follow instructions on the form). If the waiver is approved, the excepted item is available for purchase. The Government shall keep the original signed waiver. If the waiver is disapproved, the Contractor shall revise the purchase request to include the environmentally preferable product. If a disapproved waiver is disputed, the Contractor shall consult the Office of Center Operations management for resolution. If necessary, the Agency Environmental Executive shall be consulted (per NPR 8530.1) to resolve the waiver dispute.

3.10 ENVIRONMENTAL MANAGEMENT SYSTEM REQUIREMENTS

A. The Contractor shall comply with the MSFC Environmental Management Policy in MPD 8500.1 and procedures and requirements including, but not limited to, MPR 8500.1, "MSFC Environmental Management Program" and MPR 8500.2, "MSFC Environmental Management System."

B. The Contractor shall ensure that their offsite employees and subcontractors (through subcontract requirements or other means) with onsite access are aware of any environmental responsibilities associated with their activities onsite. Failure to comply with environmental policies and procedures may result in damage to the environment and could potentially result in regulatory penalties against NASA and/or the Contractor, and Contractor loss of access to NASA/Marshall facilities.

ATTACHMENT A

CONSTRUCTION BEST MANAGEMENT PRACTICES PLAN (CBMPP)
(For sites disturbing less than 1 acre)

Contract Information

Contractor: _____

Address: _____

Phone: _____

Construction Site Contact Name: _____

Construction Contract Number: NNM_____

General Information: Describe the planned construction project. Include a description of amount of disturbed land, expected duration, and location. Provide a site map or use the site map included on the design drawings detailing the construction site including general drainage areas and gradients, nearby landmarks (buildings, paved areas, etc.), erosion control measures, topography.

Construction Materials: Provide a general list of the types of chemicals, substances that will be used at the construction site.

Erosion and Sediment Controls: Describe any erosion and sediment controls necessary. These controls shall be implemented during the construction period to prevent or control the loss of soil from the construction site. The methods could incorporate structural practices and/or vegetative stabilization. Examples are mulching, checkdams, temporary downdrain structures, sediment barriers, etc.

END OF SECTION

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to the base bid amount if the Government decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost for each alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. General: Base Bid and Bid Alternates are configured to allow each Bid Alternate to stand on its own with the Base Bid. The owner shall select Bid Alternates to best fit the available funding for the project.

B. The building is divided in the two major areas:

1. Area A: This area is comprised of office and lab spaces generally south of col. line 8.
2. Area B: This area is comprised of open high bay shop area generally north of col. line 8.

C. The following are general descriptions for the Base Bid and Bid Alternates. The sequence of work for the Bid Alternates will be established in conjunction with the COTR based on the specific Bid Alternates selected by the owner. Coordinate exact sequence of work with COTR.

1. BASE BID :

- Replacement of service entrance switchgear as noted on the drawings
- Replacement of the bus duct system throughout the building
- Replacement of panels as noted on the drawings
- Replacement of circuit breakers, disconnects and transformers as noted on drawings
- Replacement of the acoustic ceiling tile and grid suspension system in corridor north of room E112 parallel to col. line 3 as indicated in drawings.

2. ADD ALTERNATE NO. 1:

- Provide upgrades to the existing fire alarm system, replace the existing fire alarm panel and install per specifications.

3. ADD ALTERNATE NO. 2:

- Provide new Lightning Protection System and install per the specifications.

4. ADD ALTERNATE NO. 3:

- Provide new LED fixtures to replace existing 2x2 and 2x4 light fixtures in the office spaces as indicated in the drawings [Area A noted above].

5. ADD ALTERNATE NO. 4:

- Provide new high bay LED fixtures to replace existing high bay fluorescent light fixtures in the high bay spaces as indicated in the drawings [Area B noted above].

6. ADD ALTERNATE NO. 5:

- Provide new wall mounted exterior LED fixtures to replace existing wall mounted exterior metal halide fixtures as indicated in the drawings.

END OF SECTION 012300

SECTION 012404 - PRECONSTRUCTION SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section identifies the documents required to be submitted and approved prior to the Pre-Construction Conference.

1. Safety and Health Plan shall be submitted in accordance with Section 013300 “Submittals” and Section 010610 in sufficient detail to shown full compliance with the contract documents.
2. Quality Control Plan shall be submitted in accordance with Section 013300 “Submittals” and Section 014000 in sufficient detail to shown full compliance with the contract documents.

B. This Section identifies the documents required to be submitted at the Pre-Construction Conference.

1. Subcontractor List shall be submitted and shall conform to the requirements in Part 2 below.
2. Waste Management Plan shall be submitted in accordance with Section 017419 “Construction Waste management and Disposal”.

1.2 SUBMITTALS

A. Subcontract List: Submit three copies and a CD containing an electronic copy of the subcontract list at the Preconstruction Conference

PART 2 - PRODUCTS

2.1 SUBCONTRACTOR LIST

A. Submit a list of subcontractors identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A or similar form and include the following information in tabular form:

1. Company name, address, telephone number, point of contact, and email of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Contractor’s email address and emergency contact information, including cell phone numbers and home phone numbers for all key personnel and the business owner.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 013200 — PROJECT SCHEDULES

PART 1 - GENERAL

1.1 SUMMARY

1.2 This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work. Upon contract award, the Contractor shall begin preparation of the Contractor's construction schedule, and critical path submittals necessary to meet the Contractor's construction schedule.

1.3 DEFINITIONS

A. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains the least float.

B. Float: The measure of leeway in starting and completing an activity.

1.4 SUBMITTALS

A. Contractor's Baseline Construction Schedule: The Contractor's construction schedule consists of a bar chart identifying the start and finish for all tasks shown in the schedule. When NTP is given, the Contractor shall submit within 30 calendar days of the NTP, a "baseline schedule" changing only the projected NTP date to the actual NTP date on the initial schedule. Subsequent construction schedules shall be submitted every 30 calendar days thereafter, and be chronologically labeled starting with the letter "A". Submit three (3) paper copies and a CD containing the electronic file compatible with "Microsoft Project".

B. Monthly Schedule Updates. The Contractor shall update the previously approved schedule monthly and submit three (3) paper copies and a CD containing the electronic file compatible with "Microsoft Project". Each update shall include a complete revision of all activities and milestones and other and data as needed. Redlined updates will only be acceptable at the weekly meetings. As a minimum, each update shall include revised dates for the following:

1. All tasks started or completed.
2. All tasks with missed start or finish dates.
3. Milestones completed, or missed.
4. Revised percent complete for all active tasks.
5. Revised submittal dates for all submittals
6. Approved changes.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. The Contractor's construction schedule consists of a bar chart identifying the various tasks to be accomplished. Task relationships with predecessors and successors shall be included in the bar chart. Prepare the schedule to ensure consistency of the tasks with each other, the submittals schedule, payment requests, and other required schedules and reports. The schedule shall reflect construction site activities and supporting activities, such as submittal reviews, major material orders and delivery, fabrication, user activities and key milestones, etc., as well as activities at the request of the Contracting Officer.

B. Bar Chart: The Contractor shall:

1. Use a recognized computer software program to prepare the schedule.
2. Prepare the schedule in the form of a bar chart utilizing a format acceptable to the Contracting Officer.
3. Prepare a schedule with sufficient detail to facilitate the Contractor's control of the job and to allow the Contracting Officer to readily follow progress of all portions of the work.
4. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished.
5. Indicate project activities beginning with contract award through actual project close out date, in an organized, logical, and consistent order.
6. Show activities by major headings for primary work activities. Each major heading shall show all activities. All activities shall be shown in sufficient detail to track the progress of the task. Typically, activities shall have durations of 30 work days or less. All activities and milestones shall have at least one predecessor and/or one successor activity and/or milestone.
7. The critical path shall be clearly delineated on the display. When milestone dates are included in the Contract they shall be clearly indicated on the display.
8. As a minimum, the following detailed activities and milestones shall be included:

    a. Milestones: Contract Award, NTP, field work, phased work start and finish, final inspection, project planned completion, contract completion date.
    b. Specific activities: Bonding. Mobilization, Demobilization, Punch-list, Cleanup, and Final close out submittals.
    c. Specific project on-site construction tasks of all activities.
    d. Specific off-site tasks necessary to achieve specific project site activities.
    e. All utility outages and road crossings/closures.
    f. Submittal review activity by the Government, as specified herein and its subparagraphs, for each submittal required. Furthermore, each of these activities shall be linked as a predecessor to all affected tasks.
    g. Major equipment and material procurement including delivery (submittal handling shall be separate per above).
    h. Contract required notices to the Government which affect any task/activity (show as a one-day duration) and shall be entitled "Notice," followed by a brief description.

9. Each line item will show the scheduled percentage complete for that given contract performance period.
10. The estimated cost for each activity on the chart.

PART 3 - EXECUTION

3.1 SCHEDULING AND DETERMINATION OF PROGRESS

A. Independent of partial payments made pursuant to Standard Form 1422, Section I (Payments Under Fixed-Price Construction Contracts), Provision No. 52.232-5, there shall be no payment to exceed 90 percent of the actual cost of materials or equipment that is not installed and no partial payments will be made for materials or equipment not on site. The effort shown toward installation of this equipment will be considered by the Contracting Officer in determining the amount of partial payment.

B. As-Built Drawings: In order to minimize the time for final payment at the completion of the project, the Contractor shall update the as-built drawings every month with the Contracting Officer's authorized representative. This update will be a part of "the monthly request for payment" and payment -- or a portion of the payment, including final payment -- may be withheld until the as-built drawings have been updated, and accepted by the Contracting Officer.

3.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Bar Chart: The bar chart will be utilized for progress payments.

B. Construction Schedule Approval: Government approval of the construction schedule is in general terms of overall compliance. The Government may question and seek clarification of certain details of the schedule to ensure contract compliance. The Contractor shall make such clarifications within 5 working days. The Contractor retains full responsibility for creation and maintenance of the schedule as well as its contents, logic, and use to fulfill all contract obligations.

C. Requests for Time Extensions: In the event the Contractor requests an extension of the contract completion date, he shall furnish a justification for delay, a revised project completion date, and supporting evidence as the Contracting Officer may deem necessary for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

1. Justification for Delay: The Contractor shall submit a justification for each request for a change in the contract completion date, based upon the most recent approved schedule at the time of the Notice to Proceed or constructive direction issued for the change. The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

    a. A list of affected activities, with their associated project schedule activity number.
    b. A brief explanation of the causes of the change.
    c. An analysis of the overall impact of the changes proposed.
    d. A sub-network of the affected area.
    e. Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

D. Directed Changes: If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work. All logic changes pertaining to notice to proceed on change orders, change orders to be incorporated into the schedule, Contractor proposed changes in work reference, correction to schedule logic for out-of-sequence progress, lag duration, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

E. Float off the critical path may be used at the Contractor’s discretion. However, use of float on the critical path shall be coordinated with the Government at each weekly project meeting. The Government reserves the right to utilize at its discretion use of float created by the Government acceleration of activities or milestones such as early GFE delivery, use of facilities or space, and early submittal review.

END OF SECTION

SECTION 013300 — SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

This Section includes administrative and procedural requirements for all project submittals required by the individual Specification Sections.

PART 2 - PRODUCTS

2.1 SUBMITTALS

A. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents.

1. Drawing Preparation: Include the following information, as applicable:

   a. The job name, which shall be the general title of the contract drawings.
   b. The date of the drawings and revisions.
   c. Name of Contractor.
   d. Name of Subcontractor.
   e. The name of the item, material, or equipment detailed thereon.
   f. Dimensions.
   g. Identification of products.
   h. Fabrication and installation drawings.
   i. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
   j. Shopwork manufacturing instructions.
   k. Templates and patterns.
   l. Schedules.
   m. Design calculations.
   n. Compliance with specified standards.
   o. Notation of coordination requirements.
   p. Notation of dimensions established by field measurement.

2. Drawing Format: Drawing submittals shall be prepared using computer interactive graphics and presented on sheets, not less than 11 by 17 inches nor larger than 30 by 42 inches in size, except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawings shall have dark lines on a white background. Drawings shall be numbered in logical sequence. The Contractor may use his own number system. Each drawing set shall contain identification of the transmittal number, specification section or contract number or title. A blank space, no smaller than 4 inches by 4 inches, shall be reserved on the right hand side of each sheet for the Government disposition stamp.

3. Drawings Submittals: Five prints of each drawing shall be submitted. Three prints, marked with review notations will be returned to the Contractor.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.

1. Product Data Preparation: Include the following information, as applicable:

a. Manufacturer's product specifications.
b. Standard color charts.
c. Manufacturer's catalog cuts.
d. Wiring diagrams showing factory-installed wiring.
e. Printed performance curves.
f. Operational range diagrams.
g. Mill reports.
h. Standard product operating and maintenance manuals.
i. Compliance with recognized trade association standards.
j. Compliance with recognized testing agency standards.
k. Application of testing agency labels and seals.
l. Notation of coordination requirements.
m. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1) Preparation of substrates.
2) Required substrate tolerances.
3) Sequence of installation or erection.
4) Required installation tolerances.
5) Required adjustments.
6) Periodic maintenace requirements
7) Recommendations for cleaning and protection.

2. Product Data Format: Required data submittals for each specific material, product, unit of work, or system shall be collected on an individual submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of each submittal to show which products and options are applicable. All options not marked out shall be considered as included. Marking of each copy of product data submitted shall be identical. Partial submittals will not be accepted.

3. Each Product Data Submittal: Five complete sets of indexed and bound data shall be submitted. Three sets marked with review notations will be returned to the Contractor.

C. Samples: Prepare physical units of materials or products, including the following:

1. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

3. Sample Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Government's sample where so indicated. Attach label on unexposed side that includes the following:

    a. Name of project
    b. Name of Contractor
    c. Material or equipment
    d. Place of origin
    e. Name of producer and brand
    f. Specification Section to which sample applies
    g. Samples of furnished material shall have additional markings that will identify them under the finished schedules.

4. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:

    a. Size limitations.
    b. Compliance with recognized standards.
    c. Availability.
    d. Delivery time.

5. Samples Format: Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

6. Sample Submittals: One set of identified samples shall be submitted. Shipping charges shall be paid by the Contractor. Materials or equipment requiring sample approval shall not be delivered to the site or used in the work until approved in writing by the Contracting Officer. A copy of the transmittal form, marked with review notations including selections by the Contracting Officer, will be returned to the Contractor. Samples that are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual technical sections. These samples will be returned to the Contractor, at his expense, to be clearly labeled, with installation location recorded. Samples shall be in undamaged condition at the time of installation. Where mockups and similar large samples are required by individual technical sections, it is recognized that these are a special type of sample which cannot be readily "transmitted" as specified for

submittal of samples. Otherwise, and except as indicated in the individual technical sections, the requirements for samples shall be complied with and a transmittal form shall be processed for each mockup, to provide a record of the activity.

D. Coordination Drawings: Contractor to submit to COTR for approval coordination drawings of all ductwork, including equipment rooms, shafts, hallways, and especially congested areas and areas with possible conflicts. No installation shall proceed without COTR stamped approval of coordination drawings. Submittal to reflect space requirements coordinated with other trades such as Electrical, Plumbing, Mechanical and Structural. Prior to submission to COTR, coordination drawings to have signatory approval of all major trades which occupy ceiling space (HVAC, plumbing, piping, sprinkler, and electrical), to substantiate adequate coordination as to space, accessibility and to ensure no conflict exists between contractors..

1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. The General Contractor shall be responsible for coordination between trades and shall stamp and sign the duct drawings to substantiate that the coordination has been accomplished. Water piping and conduit shall give way to ducts.

E. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.

F. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

G. Contractor’s Construction Schedule: Comply with requirements in Section 013200 "Project Schedules."

H. Submittals Schedule: Comply with requirements in Specification Section "012404."

I. Subcontract List: Comply with requirements Specification Section "012404"

J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

K. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

M. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

N. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

O. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

P. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements. Reports must be signed by authorized representative of the testing agency.

Q. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements. Reports must be signed by authorized representative of the testing agency.

R. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion. Reports must be signed by authorized representative of the testing agency.

S. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements. Reports must be signed by authorized representative of the testing agency.

T. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency. Reports must be signed by authorized representative of the testing agency.

U. Factory Test Reports: Prepare written reports of tests performed by the manufacturer as indicated in individual Specification Sections

V. Operations and Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures” and “Operation and Maintenance Data."

W. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

X. Warranties: Provide Manufacturers warranty as indicated in individual Specification Sections

Y. Product Closeout Submittals Comply with requirements in Division 1 Section "Closeout Procedures”

PART 3 - EXECUTION

3.1 CONTRACTOR

A. All submittals shall be verified for compliance with the Contract Documents and signed by the contractor.

B. No work may begin or materials be ordered for any item, until a submittal is approved and returned to the contractor.

3.2 SUBMITTAL REQUIREMENTS

A. Each submittal shall reference drawing number, Specification Section and paragraph pertaining to the submittal and fully describe the submittal item.

B. The numbering system used (on the transmittal form) for transmission and tracking of submittals shall be provided by the Government and used by the Contractor. The submittal number is composed of the Specification Section number followed by a hyphen, and the numerical order of each submission beginning with 001. Revisions and resubmittals will be numbered chronologically thereafter.

C. Transmittal Form: All transmittals submitted to the Government shall be submitted using MSFC Form 4233. All data fields on the form shall be completed and the form signed by the Contractor. Incomplete submittals will be returned to the Contractor without Government review. Each transmittal form shall transmit items relative to one Specification Section. Data pertaining to that Specification Section may be transmitted together, unless required to be submitted as an individual “item.” An item is an individual piece recognized by the type of data being submitted. Examples in general of acceptable individual submittal transmittals include:

1. Groups of valves of different sizes. A submittal would allow that all of the information pertaining to those valves could be listed and submitted on one submittal transmittal.
2. Structural drawings and calculations for individual structures.

3. Electrical lighting troffers, ballast, bulbs, and lenses along with installation instructions and certificates of compliance.
4. Air handlers of the same type.
5. Submittals can list one individual piece pertaining to specific data, such as one valve on one submittal and one instruction manual on another, etc.

D. Product Selection: Highlight, circle, or otherwise identify the specific item selected for use on the project. Include manufacturer, model, size (where applicable) and options.

E. Deviations: Deviations from the specific product options in the Contract Documents shall be highlighted, circled, or otherwise identified on submittals. Failure to point out deviations may result in the Government rejection and requiring removal of such work at no additional cost to the Government.

F. Substitutions: Indicate if product is a substitution and comply with Specification Section 01 60 00. Failure to point out substitutions may result in the Government rejection and requiring removal of such work at no additional cost to the Government

G. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. The Government reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

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 parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

H. Submittal Quantities: Submit five copies of all submittals unless directed otherwise by the COTR.

3.3 GOVERNMENT'S REVIEW

A. General: The Government will not review submittals that do not bear Contractor's signature and will return them without action. The Government will review submittals and provide pertinent notation within 28 calendar days. The 28-day review clock shall start the day after submittals are received by the Government.

1. Approved Submittals: Approval of the submittals by the Contracting Officer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory. The Contractor shall be responsible for the dimensions and design of connection details and construction of work. If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved

2. Resubmittals: For submittals requiring resubmittal, the Contractor shall make corrections required by the Contracting Officer and resubmit within 14 calendar days of receipt. If

the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or Specifications, notice as required under the clause entitled "Changes" shall be given to the Contracting Officer.

B. Review Notations: Submittals will be returned to the Contractor with the following notations:

1. Submittals marked "Approved (APR)" authorize the Contractor to proceed with the work covered.
2. Submittals marked "Approved as Noted (AAN)" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.
3. Submittals marked "Approved Except as Noted (AEN)" require the Contractor to make a resubmittal for those items that are noted to NOT be in compliance with the contract requirements. Contractor shall obtain an approval for all aspects of the submittal before the depicted work can begin.
4. Submittals marked "Rejected (REJ)" indicate noncompliance with the contract requirements and shall be resubmitted with appropriate changes prior to proceeding with any work. .

C. Sample Approval: The Contractor shall furnish, for the approval of the Contracting Officer, samples required by the Specifications or by the Contracting Officer.

1. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any contract requirements. Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

2. Materials and equipment incorporated in the work shall match the approved samples. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

3. Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. The Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

4. Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. The Contractor shall replace such materials or equipment to meet contract requirements.

5. Approval of the Contractor's samples by the Contracting Officer shall not relieve the Contractor of his responsibilities under the contract.

END OF SECTION

MASTERWORKS SUBMITTAL LOG

PROJECT: REVITILIZE BUILDING ELECTRICAL SYSTEMS (4711)
OWNER:

PROJECT NO: NNM14AA71T/GMC-10: FAC-M5063
CONTRACTOR:

DATE REC'D.	SPECIFICATION SECTION NO.	SUBMITTAL ITEM	Review and Approval Required by NASA	NO. RECEIVED	OTHER REVIEWER					ACTION				DATE RETURNED	COPIES TO			
					DATE SENT	FIRM	NO. COPIES	DUE DATE	DATE REC'D.	APPROVED	APPROVED AS NOTED	REVISE AND RESUBMIT	NOT APPROVED		CONTRACTOR	OWNER	FIELD	FILE
	010590	**SPECIAL CONDITIONS**																
	1.1-A	Photographs of Temporary Structures																
	010610	**GENERAL SAFETY AND ENVIRONMENTAL HEALTH REQUIREMENTS**																
	1.3-A	Safety, Health and Environmental Plan																
	1.3-B	Reports MSFC Form 4371																
	010650	**ENVIRONMENTAL COMPLIANCE**																
	1.3-A	Material Safety Data Sheets [MSFC Form 4582 – Chemical Inventory Worksheet]																
	1.3-B	Monthly Inspection Reports																
	1.3-C	MSFC Form 4510 – Green Purchasing Report																
	012404	**PRECONSTRUCTION SUBMITTALS**																
	1.2-A	Submittals Schedule																
	2.1-A	Subcontract List																
	013200	**PROJECT SCHEDULES**																
	1.4-A	Baseline Construction Schedule																
	1.4-B	Monthly Schedule Updates																
	014000	**CONTRACTOR QUALITY ASSURANCE/QUALITY CONTROL**																
	1.3-A	Contractor's Quality Assurance/Quality Control Plan																
	1.3-B	Records																
	017310	**CUTTING AND PATCHING**																
		Cutting & Patching Proposal																
	017419	**CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**																
		Waste Reduction Final Report																
		Records of Donations																
		Records of Sales																
		Recycling & Processing Facility Records																
		Landfill and Incinerator Disposal Records																
	017700	**CLOSEOUT PROCEDURES**																
		As-Built Drawings																
		Operations and Maintenance Data																
		Warranties																
	017820	**OPERATION AND MAINTENANCE DATA**																
		Operations and Maintenance Manuals																
	018200	**DEMONSTRATION AND TRAINING**																
		Instruction Program																
		Qualification Data																
		Demonstration and Training DVD																
	033000	**CAST-IN-PLACE CONCRETE**																
		Product Data																
		Design Mixtures																

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		Steel Reinforcing Shop Drawings																
		Material Certificates																
		Test Reports																
	036000	**NON-SHRINK GROUT**																
		Product Data																
		Test Reports																
	055000	**METAL FABRICATIONS**																
		Shop Drawings																
	079000	**JOINT SEALANTS**																
		Product Data																
		Samples																
		Testing Results																
	095113	**ACOUSTIC TILE CEILINGS**																
		Product Data																
		Samples																
	099123	**INTERIOR PAINTING**																
		Product Data																
	230923	**Direct Digital Control\Utility Control System**																
		Product Data																
		Shop Drawings (Control Schematic Drawings)																
		Shop Drawings (Sequence of Operation)																
		As-Built Drawings																
		Test Plans, Trend Data, and Test Reports																
		Manufacturer's Instructions																
		Operations and Maintenance Manuals																
		Qualification Data																
		Course Content and Format of Training Materials																
	260501	**ELECTRICAL TESTING**																
		Testing Firm Qualifications																
		Short Circuit Analysis and Coordination Study																
		Test Reports																
	260526	**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**																
		Product Data																
		Field QC Reports																
		Operation and Maintenance Manual																
	260529	**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**																
		Product Data																
	260533	**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**																
		Shop Drawings																

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DATE REC'D.	SPECIFICATION SECTION NO.	SUBMITTAL ITEM	Review and Approval Required by NASA	NO. RECEIVED	OTHER REVIEWER					ACTION				DATE RETURNED	COPIES TO			
					DATE SENT	FIRM	NO. COPIES	DUE DATE	DATE REC'D.	APPROVED	APPROVED AS NOTED	REVISE AND RESUBMIT	NOT APPROVED		CONTRACTOR	OWNER	FIELD	FILE
	260574	**OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY**																
		Arc Flash Hazard Analysis Report - CD																
		Arc Flash Hazard Analysis Report – Bound Copy																
		One-Line Drawing (Electronic Copy - .dwg & .pdf)																
		SKM Project Database Files and Libraries (electronic Copy)																
		Detailed Time Current Curve files																
		Sample of Arc Flash Label																
	262200	**LOW-VOLTAGE TRANSFORMERS**																
		Product Data																
		Shop Drawings																
		Operation & Maintenance Data																
		Field Quality Control field Test Reports																
	262413	**SWITCHBOARDS**																
		Product Data																
		Shop Drawings																
		Field Quality-Control Reports																
		Operation & Maintenance Data																
		Warranty																
	262416	**PANELBOARDS**																
		Product Data																
		Shop Drawings																
		Field Quality-Control Reports																
		Panelboard Schedules																
		Operation & Maintenance Data																
		Warranty																
	262500	**ENCLOSED BUS ASSEMBLIES**																
		Shop Drawings																
		Coordination Drawings																
		Product Certificates																
		Field QC Test Reports																
		Operation & Maintenance Data																
	262713	**ELECTRICITY METERING**																
		Product Data																
		Shop Drawings																
		Field Quality-Control Reports																
	262813	**FUSES**																
		Product Data																
	262816	**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**																
		Product Data																
		Field Quality Control Testing																

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OWNER:

PROJECT NO: NNM14AA71T/GMC-10: FAC-M5063
CONTRACTOR:

DATE REC'D.	SPECIFICATION SECTION NO.	SUBMITTAL ITEM	Review and Approval Required by NASA	NO. RECEIVED	OTHER REVIEWER					ACTION				DATE RETURNED	COPIES TO			
					DATE SENT	FIRM	NO. COPIES	DUE DATE	DATE REC'D.	APPROVED	APPROVED AS NOTED	REVISE AND RESUBMIT	NOT APPROVED		CONTRACTOR	OWNER	FIELD	FILE
	262913	**MOTOR STARTERS**																
		Product Data																
		Shop Drawings																
		Field Quality-Control Reports																
		Load-Current and Overload-Replay Heater List																
		Load-Current and List of Settings of Adjustable Overload Replays																
		Operation & Maintenance Data																
	264113	**LIGHTNING PROTECTION FOR STRUCTURES**																
		Product Data																
		Shop Drawings																
		System Certification [UL Master Label]																
		Qualification Data																
		Roof Adhesive Certification																
		Field Quality-Control Reports																
		Compliance Letter																
	264313	**SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**																
		Product Data																
		Field Quality-Control Reports																
		Maintenance Data																
		Warranty																
	265119	**LED INTERIOR LIGHTING**																
		Product Data																
		Qualification Data																
		Operation and Maintenance Data																
		Warranty																
	265619	**LED EXTERIOR LIGHTING**																
		Product Data																
		Qualification Data																
		Operations and Maintenance Data																
		Test, Inspection, Observation, and Verification Reports																
		Warranty																
	280513	**CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY**																
		Qualification Data																
		Source Quality Control Reports																
		Field Quality Control Reports																
	283111	**DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM**																
		Product Data																
		Shop Drawings																

MASTERWORKS SUBMITTAL LOG

PROJECT: REVITILIZE BUILDING ELECTRICAL SYSTEMS (4711)
OWNER:

PROJECT NO: NNM14AA71T/GMC-10: FAC-M5063
CONTRACTOR:

DATE REC'D.	SPECIFICATION SECTION NO.	SUBMITTAL ITEM	Review and Approval Required by NASA	NO. RECEIVED	OTHER REVIEWER					ACTION				DATE RETURNED	COPIES TO			
					DATE SENT	FIRM	NO. COPIES	DUE DATE	DATE REC'D.	APPROVED	APPROVED AS NOTED	REVISE AND RESUBMIT	NOT APPROVED		CONTRACTOR	OWNER	FIELD	FILE
		Delegated-Design Submittal																
		Qualification Data																
		Field QC Reports																
		Operation & Maintenance Data																
		Software and Firmware Operational Documentation																

SECTION 014000 — CONTRACTOR QUALITY ASSURANCE/QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This specification sets forth quality assurance/quality control requirements for the provision of materials, equipment, systems, inspections, tests, services, and construction of facilities and site improvements. The quality of work-in-progress and finished work is the responsibility of Contractor line management. These requirements provide for an effective system to ensure that contractual quality requirements and technical criteria are satisfactorily met.

1.2 RELATION TO OTHER CONTRACT DOCUMENTS

A. The requirements of this specification shall be fully complied with in close concert with the detail requirements of the technical specifications and all other contract documents. Overlapping and interfacing contractual requirements shall not result in duplication of Contractor efforts. The quality program shall effectively complement and support functions required by the technical specifications and other contract documents.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 013300, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

A. Preconstruction Submittals: The Contractor shall submit a detailed written “Contractor’s Quality Assurance/Quality Control Plan” describing procedures that will be implemented to achieve quality on the project. The plan shall be submitted and approved by the Government prior to Notice to Proceed and describe how the quality requirements of the specifications will be met and address each of the following:

1. Delegation of Contractor's authorized representative responsible for quality assurance/control of contract work.
2. The Contractor's quality assurance/control plan and procedure for accomplishing and reviewing construction methods and controls, fabrication controls, certifications, documentation of quality control operations, inspections, and test records including those required for suppliers and subcontractors. Describe methods to be effected during the procurement cycle (order to deliver) for the selection of construction materials, suppliers, subcontractors, on-site and off-site fabrication and assembly of Contractor- furnished materials and equipment, work procedures, workmanship, and testing to ensure full compliance with plans, specifications, codes, regulatory requirements, and other contract documents.
3. The Contractor's program shall provide for a functional system to document that quality provisions of contract schedules, specifications, and drawings have been performed.
4. Training, certification(s), and re-certification(s) of personnel as required by the specifications.
5. Certification of materials, processes, or equipment as required by the specifications.

6. Qualification of procedures as required by the specifications.
7. Nondestructive testing requirements as required by the specifications.
8. Identification of independent certifying and testing laboratories to be used.

B. Records: Records shall include all quality control data; factory test plans/results, manufacturer's certifications, receiving inspections, deficiency correction reports; construction deficiency reports (CDR); training/certifications; letter of authority or delegation; and routine technical test plans/results, i.e., hydrostatic, electrical continuity, grounding, welding, line cleaning, etc. Quality records shall be available for examination upon request by the designated Government representatives. Quality control records shall be maintained in a central on-site location. Maintenance of quality control records shall not relieve the Contractor from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification. All quality records shall be turned over to the Government's designated representatives as a file of record at contract completion.

1.4 QUALITY ASSURANCE

A. Qualifications: When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the specifications, the Contractor shall obtain necessary approvals or certifications prior to starting the work.

B. Management and Organization: Contractor shall ensure effective execution of quality assurance/quality control functions and provide competent personnel with experience in quality assurance/quality control functions to provide supervision, inspection, and testing. Contractor shall be responsible for each of his suppliers and subcontractors. Contractor shall provide quality assurance oversight of suppliers and subcontractors and ensure that each provides effective quality control in the execution of their work. The program shall encompass management and supervisory actions that affect quality of all work-in-progress and finished construction work. The individual designated to direct the program shall report to the Contractor's management and shall have the necessary authority to discharge his responsibilities.

C. Identification and Data Retrieval: The Contractor shall have an identification and data retrieval system. Records, drawings, submittals, and equipment shall be identified to reference the following:

1. Contract Number
2. Contract Specification Number
3. Contract Drawing Number
4. Submittal Document Number
5. Contract Change Number
6. Contractor's Drawing Number System

D. Procurement: The Contractor shall be responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality requirements. The Contractor shall ensure that his purchase documents include:

1. The basic quality requirements, standards, drawings, and specifications called out in the contract specifications.
2. Inspection and Test Characteristics.

3. Inspection and Test Records.
4. Operational and Maintenance (O&M) manuals, Instructions, Certifications of Compliance, and such other data as may be required by the specification.
5. Preservation, packaging, shipping directions.

E. When Government source inspection is required on a Contractor's purchase, the purchase document shall include the following statement: “All work on this order is subject to inspection and testing by the Government at any time and place. The Contracting Officer shall be notified immediately upon receipt of this order. The Contracting Officer shall be notified 72 hours in advance of the time articles or processes are ready for inspection or test."

F. Procurements that do not require Government source inspection shall include the following statement: "The Government reserves the right to inspect any or all of the materials included on this order at the Contractor's plant."

G. Required Government source inspections will be determined by the Contracting Officer. Government source inspections shall not replace Contractor inspections or relieve the Contractor of his responsibility for ensuring quality procurements and records verifying quality control activities.

H. Receiving Inspection System: Contractor shall maintain a receiving inspection system that ensures procured materials and equipment are inspected and tested as required by specifications, drawings, and approved submittal documents. Shipping/receiving inspection records will accompany each procurement delivery to the construction site. Maintain records of receiving inspections at the construction site by the Contractor. Records shall show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection.

I. Nonconforming Articles and Material Control: The Contractor shall control nonconformances discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to correct deficient operations.

1. Contractor shall prepare a construction deficiency report for each instance comprising:
   a. A unique and traceable number.
   b. Identification of the nonconforming article or material.
   c. A description of the nonconformance and the applicable requirement.
   d. Cause or reason for the nonconformance.
   e. Remedial actions taken or recommended.
   f. Disposition of the nonconforming article or material.
2. The Contractor shall identify, mark, and segregate each nonconforming article for removal from the work area to prevent inadvertent use.
3. The Contractor shall monitor and correct deficient operations.

J. Fabrication, Process, and Work Control: The Contractor's procedures and controls shall be derived from stated requirements in contract specifications and drawings. The Contractor shall establish in-process inspections and ensure compliance with quality requirements that are not readily detectable or measurable by inspection and test of finished elements. Special processes may include, but are not limited to, concrete placement, piping system cleaning, plating, anodizing, nondestructive testing, welding, and soldering.

K. Drawings and Change Control: Drawing-control system shall be maintained to provide revised drawings and change distribution and removal of obsolete drawings from work areas. Changes

involving interface with other work areas, or affecting articles or materials controlled by others shall be controlled by the Contractor. This system shall be integrated with the document requirements of the contract. Drawing changes shall be clearly specified. Accomplished changes shall be clearly identified and associated drawings shall be revised. Drawings that have been approved, or approved as noted, by the Contracting Officer shall be used for fabrication and inspection.

L. Quality Inspections: Government Inspections: Work performed under the general direction of the Contracting Officer will be subject to inspection by authorized representatives. No representative is permitted to change specifications or drawings without written authorization of the Contracting Officer. Government in-process and end-item inspections may, at the Government's discretion, be performed on site and/or at the Contractor's or subcontractor's facility by Government representatives. Government shall be notified with sufficient advance notice of Contractor work plans which will cover up or make inaccessible previously installed work which may require Government inspection, i.e., backfilling or encasing of any underground utility, concrete placement, etc. Failure to provide such notification may require the work be uncovered to inspect the work. Uncovering and restoration of the work shall be at the Contractor's expense. The Contractor's quality assurance/control program is subject to continuous evaluation, review, and verification by the Contracting Officer. The Contractor will be notified in writing of any noncompliance area and will be given 5 days to correct identified deficiencies.

M. Contractor's Quality Inspections: Contractor shall implement an inspection system. Documentation shall indicate quality control through records of inspections and tests. Contractor shall ensure that nonconforming products are discovered, documented, and controlled. Procedures eliminating future deficiencies shall be implemented. Contractor's quality assurance system shall include the following:

1. Single Contractor's representative responsible for on-site/off-site communication and operation of the inspection program.
2. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.
3. Receiving inspection system documenting inspections for each procurement verifying material and equipment is compliant with plans and specifications.
4. Documentation for handling and disposing of nonconforming components and materials.
5. Inspection records as required for each specific section of the specification and drawings.
6. Identification of test(s) to be performed, test procedures, test plans/reports, records, and independent organizations used.
7. Documenting and maintaining certification or re-certification of procedures, personnel, and equipment.
8. Management of Government-furnished equipment, components, and materials.
9. Calibration of gages, tools, measuring instruments, and independent laboratories used and all associated documentation.

N. The Contractor shall establish his own system of scheduled or random sample inspections and audits to ensure objectives are met.

O. Manufacturer's Field Services: Responsibility for Inspection and Testing: Contractor is responsible for the performance of inspections and tests. Each shall be recorded. The Contractor shall utilize independent inspection and testing laboratories or services that are

acceptable to the Government. Tests of construction materials shall be accomplished by the Contractor utilizing the services of an acceptable independent testing laboratory.

P. Inspection and Test Records: The Contractor shall provide on-site records of each inspection and test performed throughout the life of the contract. Records shall include, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, test plans/reports, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Q. Records of in-process inspections and controls away from the job site may be used as evidence of quality of materials/work and, at the discretion of the Government, may reduce further inspection or testing after delivery to the job site.

R. The Contractor shall ensure each record is identified and traceable to specific requirements in the specifications and drawings.

1.5 HANDLING AND STORAGE

A. The Contractor shall provide controls and procedures which meet requirements of each section of the specifications. The Contractor shall include documentation with each shipment. The data shall consist of documentation required by the contract along with specifications required to identify, store, preserve, operate, and maintain the items shipped.

1.6 SEQUENCING AND SCHEDULING

A. Contractor shall notify the Government a minimum of 48 hours prior to scheduled inspections and tests. Contractor shall provide 24-hour notice to the Government of the date when the contract work will begin at the site. When Contractor suspends work for 5 days or longer prior to completion, he shall notify the Contracting Officer. Work shall not suspend nor resume without notification of the Contracting Officer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following administrative and procedural requirements, selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 1 Section "References" for applicable industry standards for products specified.
2. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
3. Remaining Division Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents. Named products or manufacturers are not pre-approved by the Government and are provided for information only. Manufacturers or products named as “Basis of Design” identify type, function, dimension, in-service performance, physical properties, appearance, and other characteristics desired by the Government.
2. Comparable or Equal Product: A product or product substitution that is demonstrated through the submittal process, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that are equal or exceed those of named product. .

B. Substitutions: Contractor proposed use of manufacturer’s products, materials, or equipment different from those identified in the Contract Documents. .

C. Product Specification: Product qualities and features related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for evaluating product compliance with project requirements.

1.3 SUBSTITUTIONS:

A. Substitution Requests: A substitution request form must be completed for all products submitted other than the “Basis of Design” products. Complete the form at the end of this section, and attach to each copy of the submittal of the product. Identify product or fabrication

or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
   a. Statement indicating why specified material or product cannot be provided.
   b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Government and separate contractors that will be necessary to accommodate proposed substitution.
   c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   e. Samples, where applicable or requested.
   f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
   g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
   h. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
   i. Cost information, including a proposal of change, if any, in the Contract Sum.
   j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, the Contracting Officer will determine which products shall be used.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.
10. Product shall be stored and handled in a safe manner and housekeeping conducted daily to the satisfaction of the Contracting Officer.

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
4. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: The Contracting Officer will consider requests for substitution if received within 90 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of the Contracting Officer.

B. Conditions: The Contracting Officer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, the Contracting Officer will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers the Government a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Government must assume.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution is compatible with other portions of the Work.
7. Requested substitution has been coordinated with other portions of the Work.
8. Requested substitution provides specified warranty.
9. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

Advancement of Construction Technology

SUBSTITUTION REQUEST
(After the Bidding Phase)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ Project Number: _____

Re: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Government for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

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SUBSTITUTION REQUEST
(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

GOVERNMENT'S REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ COTR

_____

_____

_____

_____

_____

_____

_____

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SECTION 017000 — PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION CONFERENCE

A. The Contractor shall attend a preconstruction conference scheduled by the Contracting Officer. Work shall not commence prior to the conference. Subcontractor representatives shall attend.

1.2 PROJECT MEETINGS

A. The Contractor shall attend project meetings scheduled by the Government to discuss safety, the project submittals status, the project construction schedule, and construction issues. The Contractor shall provide a representative from his organization with expertise and knowledge in matters related to the project Schedule. The representative shall have the responsibility of updating and coordinating the Schedule with actual job conditions. During this meeting, the Contractor shall describe, on an activity-by-activity basis, all proposed revisions and adjustments to the project Schedule required to reflect the current status of the project. The Contracting Officer shall approve activity progress, proposed revisions and adjustments as appropriate. Only Contracting Officer approved revisions and adjustments shall be incorporated into the schedule. The representative shall also present current information on the status of purchase orders, shop drawings, off-site fabrication, material deliveries, Subcontractor activities, anticipated needs for any Government-Furnished Equipment (GFE), and any problem which may impact the contract performance period. Subcontractor representatives shall attend as appropriate and as requested.

1.3 PREPARATORY MEETINGS

A. The contractor shall conduct preparatory meetings prior to the start of all new elements of work. The meeting shall include as a minimum representatives of the contractor performing the work, the GC site superintendent or foreman, and Government Inspector. Two days advance notice of preparatory meetings shall be given.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017310 - 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. Division 7 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.

2. All Division Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work. Refer to mechanical and electrical Sections for other requirements and limitations applicable to cutting and patching mechanical and 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: Unless otherwise determined by the COTR, the contractor shall submit, at least 10 days before the time of cutting and patching, a proposal describing procedures that will be performed, and request 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 and those that will be temporarily out of service. Indicate how long service will be disrupted.
6. Structural Elements: Where cutting and patching involve modification of any structural element, submit details showing the proposed modification and integration with original structure.

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 that results 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.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results 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 Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. Retain recognized, experienced, and specialized firm to cut and patch exposed Work listed below.

    a. Processed concrete finishes.
    b. Stonework and stone masonry.
    c. Ornamental metal.
    d. Preformed metal panels.
    e. Roofing.
    f. Firestopping.
    g. Window wall system.
    h. Fluid-applied flooring.
    i. Aggregate wall coating.
    j. Wall covering.
    k. HVAC enclosures, cabinets, or covers.

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.

1.5 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 minimize 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 and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. 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.
6. 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 in the new space. 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 in 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 rehang 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 weathertight condition.

END OF SECTION 017310

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 010650 “Environmental Compliance” for MSFC specific waste management procedures

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

G. LEED: Leadership in Energy and Environmental Design Rating System as established by U.S. Green Building Council

H. Total Recovered Material: Waste materials and byproducts that have been recovered or diverted from solid waste, but does not include materials and byproducts generated from, and commonly reused within, an original manufacturing process.

1.4 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Waste:
   a. Masonry and CMU.
   b. Wood.
   c. Metals.
   d. Asphalt.
   e. Concrete.
   f. Mechanical equipment.
   g. Refrigerants.
   h. Electrical equipment.

2. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
   a. Paper.
   b. Cardboard.
   c. Boxes.
   d. Recyclable plastics.
   e. Wood crates/pallets.

1.5 SUBMITTALS

A. Waste Reduction Report: Concurrent with each Application for Payment, submit report. Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work. Use Form CWM-1.

B. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations.

C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations.

D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.

E. Landfill and Incinerator Disposal Records or Recycling and Processing Facility Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities or of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

PART 2 - PRODUCTS

2.1 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification and waste reduction work plan. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan. Use Form CWM-1.

1. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

2. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   a. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
   b. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
   c. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
   d. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

2.2 WASTE REDUCTION REPORT:

A. Use Form CWM-1. Include the following information:

1. Material category.
2. Generation point of waste.
3. Handling and Transportation Procedures.
4. Remarks and Assumptions.
5. Total quantity of waste in tons.
6. Quantity of waste salvaged, both estimated and actual in tons.
7. Quantity of waste recycled, both estimated and actual in tons.
8. Total quantity of waste recovered (salvaged plus recycled) in tons.
9. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Division 01 Sections.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.

2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

2. Comply with Division 01 Sections for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGED MATERIALS

A. Salvaged Items for Reuse Salvage items for reuse and handle as follows:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.

3. Store items in a secure area until installation.

4. Protect items from damage during transport and storage.

5. Turn over to the COR or install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted to be stored on Project site.

C. Lighting Fixtures: Protect from breakage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

NOTE: The policies, procedures and restrictions of the landfill and recycling organizations above are not governed by NASA and are subject to change. All contractors should contact these agencies directly to familiarize themselves with the policies, procedures and restrictions prior to bidding and prepare their bids accordingly. Listed below is provided for information only. Available recycling receivers and processors include, but are not limited to the following:

Solid Waste Disposal Authority, Huntsville, Alabama; 1-256-830-BINS

PBS Services, Inc, Huntsville, Alabama; 256-656-3710

Waste Management Services, Huntsville, Alabama; 1-256- 256-759-3915

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   a. Inspect containers and bins for contamination no less than monthly and remove contaminated materials if found.
2. Do not store within drip line of remaining trees.
3. Store components off the ground and protect from the weather.
4. Remove recyclable waste from Government’s property.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: If greater than 15 tons are to be demolished, asphalt materials shall be recycled.

1. The size of the asphalt shall not be larger than 3’x3’x3’

B. Concrete:

1. Non-structural concrete shall be recycled.
2. If greater than 15 tons of structural concrete are to be demolished, structural concrete materials shall be recycled.
3. The size of the concrete shall not be larger than 3’x3’x3’.
4. Concrete shall be clean of dirt and debris as practicable.

C. Metals: Separate metals by type.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Paper: As much as possible, recycle paper.
2. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
3. Recyclable Plastics: As much as possible, recycle plastics packaging.
4. Wood Crates/Pallets: As much as possible, require deliveries using crates/pallets to remove crates/pallets from Project site.

3.6 DISPOSAL OF WASTE

A. Burning: Do not burn waste materials.

B. Disposal: Transport waste materials and dispose at the Redstone Arsenal Landfill, if permissible, or legally dispose off the Government's property. Review Division 01 Section "Environmental Compliance" for further disposal information.

3.7 REDSTONE ARSENAL LANDFILL (RSAL) (Phone # 256-876-4199)

A. The following restrictions concerning use of the Government's Redstone Arsenal Landfill (RSAL) are provided for general use as an example of some of the policies and restrictions that historically have been associated with the RSAL. They are not to be considered complete or necessarily correct. The policies, procedures, and restrictions of the landfill and recycling organizations above are not governed by NASA and are subject to change. All contractors should contact these agencies directly to familiarize themselves with the policies, procedures, and restrictions prior to bidding and prepare their bids accordingly.

1. No garbage shall be mixed in with the construction rubble for disposal at the Redstone Arsenal Landfill (RSAL).
2. No liquids of any kind shall be disposed of at the RSA
3. No ammunition or explosive type material (including training devices) shall be disposed of at the RSAL.
4. No batteries shall be disposed of at the RSAL.
5. No hazardous wastes shall be disposed of at the RSAL, except asbestos as noted herein.
6. Large pieces of heavy metal, copper, metal shavings, etc. shall not be disposed of at the RSAL.
7. Asbestos shall be segregated and disposed of in a designated area of the RSAL.
8. Cans of 1 gallon or larger that contain paint, solvent, or any other liquid shall not be disposed of in the RSAL.
9. Empty drums in good condition from 5-gallon containers and up shall not be disposed of in the RSAL.

10. Empty drums in poor condition shall be flattened prior to delivery for disposal to the RSAL.

11. There will be no loitering or scrounging at the RSAL.

B. For all demolition and construction waste to be disposed of at the RSAL, the Contractor shall submit documentation ensuring compliance with ADEM Permit No. 45-3 issued for the RSAL. The MSFC Environmental Engineering and Occupational Health Office (AS10) will provide to the Contractor the Certification Number to be used for the project. The Contractor shall complete all applicable portions of the form's "Material Certification" page except as described below. Upon completion, the Facility Management Office Construction Support Contractor shall submit the "Material Certification" to AS10. MSFC AS10 will complete the "Waste Certification" and "Material Certification" sections of the Form 2435-R and forward it to the RSAL. The Contractor shall complete a Form 2435-R, "Delivery Ticket" for each load using the specific project's Certification Number.

C. The Government will refuse any material or not allow dumping of any material at the site if it does not meet the RSAL requirements. If this occurs, the Contractor is responsible to dispose of the waste material offsite at approved landfills at his own expense.

3.8 ATTACHMENTS

A. Form CWM-1 for construction waste.

END OF SECTION 017419

FORM CWM-1: WASTE REDUCTION REPORT

PROJECT TITLE:	**DATE:**
CONTRACT #:	**PROGRESS:** ☐
CONTRACTOR NAME:	**END OF PROJECT:** ☐
CONTRACTOR POC:	**PHONE #:**

MATERIAL CATEGORY	GENERATION POINT	HANDLING AND TRANSPORTATION PROCEDURES (LEED PROJECT ONLY)	REMARKS AND ASSUMPTIONS (LEED PROJECT ONLY)	TOTAL QUANTITY OF WASTE TONS (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
					ESTIMATED TONS (LEED PROJECT ONLY)	ACTUAL TONS (B)	ESTIMATED TONS (LEED PROJECT ONLY)	ACTUAL TONS (C)		
Packaging: Paper										
Packaging: Cardboard										
Packaging: Boxes										
Packaging: Recyclable plastics										
Packaging: Wood crates/Pallets										
Masonry and CMU										
Wood										
Metals										
Asphalt										
Concrete										
Mechanical Equipment										
Refrigerants										
Electical Equipment										
Other:										

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes, but is not limited to, administrative and procedural requirements for contract closeout.

B. Related Sections include the following:

1. Specification Section 017820 "Operation and Maintenance Data" for operation and maintenance manual requirements.
2. Division 1 Section "Demonstration and Training" for requirements for instruction of the Government's personnel.
3. Refer to applicable sections for specific closeout and special cleaning requirements for products of those Sections.

1.2 FINAL INSPECTION

A. Before requesting final inspection, complete the following:

1. All salient parts of the work are substantially complete.
2. All systems and subsystems are substantially complete.
3. Startup testing of systems is complete.
4. Test and Balance is complete and final report is approved.
5. The commissioning is complete to the following level:
   a. Completed and signed start-up and prefunctional checklist documentation.
   b. Requested trend log data provided.
   c. Building UCS system is functioning as designed.
   d. Completion of all functional testing.
   e. Required training of Owner personnel completed.
   f. All identified deficiencies have been corrected or are approved by the Owner to be excepted from this milestone
6. Submission and approval of Operation and Maintenance Manuals.

B. The Owner's Project Manager will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Functional Completion

C. Instruct Government's personnel in operation, adjustment, and maintenance of products, equipment, and systems. The Owner's Project Manager will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Functional Completion.

D. Inspection: Request a final inspection for acceptance. On receipt of request, the Government will either schedule a day for the inspection or reject the Contractor's request for due cause. Requests for "partial" final inspections will only be considered when multiple and functionally

separate buildings are involved or when the project is phased or when systems or occupancies are required by the Government. The Government reserves the right to reject all “partial” requests.

E. After final inspection, the Government shall issue a punch list to be completed by the Contractor.

1.3 PROJECT CLOSEOUT SUBMITTALS

A. As-built Drawings: Submit the redlined as-built drawing set maintained by the Contractor and verified by the Government as defined in Part 2.

B. Operation And Maintenance Data Manuals: Submit O&M manual in accordance with Specification Section 017820

C. Warranties: Organize warranty documents into an orderly sequence.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Provide additional copies of each warranty and include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 AS-BUILT DRAWINGS

A. As-built Drawings: Maintain one set of prints of the Contract Drawings and Shop Drawings at the project site.

1. Preparation: Mark As-built Prints completely and accurately to show the actual installation. The construction contractor shall include on the as-built drawings all variances from that shown on original drawings and all utilities that are field routed in and/or under concrete slabs, walls or masonry walls and/or concealed or buried in the ground. The as-built drawings shall be prepared in reference to the building column lines and include all concealed utilities, depths, and locations from building column lines.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

d. For DCR's, RFI's, CDR's, and Change Items, cloud the area on the drawing affected by the change, note the changing document number, and attach the approved changing document to the affected drawing.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities. Prior to utilities burial or concrete placement, record horizontal location of utilities with respect to distances from column lines or other permanent features and record depth of underground utilities with respect to grade level or top of concrete slab.
   e. Revisions to identified 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.
   k. Changes made following the Contracting Officer's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.
   o. Note and dimension all underground utilities and structures (including existing) on the drawings.
3. Mark as-built set with red-colored pen.
4. Mark important additional information that was either shown schematically or omitted from original Drawings.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period. Post changes and modifications to Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Provide access to Project Record Documents at the project site during normal working hours.

3.2 PROJECT CLOSEOUT

A. General: The final pay application shall not be accepted by the Government until all contract requirements are met and the following is performed.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
l. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Replace parts subject to unusual operating conditions.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction.
q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
r. Leave Project clean and ready for occupancy.

C. Complete all punch list items.

D. Demobilize and remove all temporary utilities.

E. Complete all submittal requirements.

F. All permits shall be closed out, notifications made, and hazardous wastes removed.

G. All DCR's signed and closed out.

H. Turn in excess and salvage materials and spare parts as required.

I. Security: Turn in badges, decals, passes, keys, and all other security items.

J. Final Reports: Contractor accident and safety statistics.

K. Release all liens.

L. All permits shall be closed out, notifications made, and hazardous waste removed.

M. Operation and Maintenance Manuals: Submit operation and maintenance data in accordance with Section 017820.

3.3 PUNCHLIST

A. The Contractor shall complete all punch list items as quickly as possible but within 30 days after final inspection.

END OF SECTION 017700

SECTION 017820 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Operation and Emergency manuals for systems, subsystems, and equipment.
3. Maintenance manuals for the care and maintenance of products, materials, and systems and equipment.

B. Related Sections include the following:

1. Division1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Refer to applicable sections for specific operation and maintenance manual requirements for products in those Sections.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 SUBMITTALS

A. O & M Manual(s) Submittal: Submit 2 hard copies of each manual in final form at least 30 days before final inspection. In addition to hard copies of each manual, provide CD ROM of operation and maintenance data using PDF format from Adobe Acrobat.

1.4 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include a list of equipment for each system.

C. List of Equipment: List equipment organized alphabetically that is not already listed as a part of a system or subsystem.

D. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with the same designation used in the Contract Documents. If no designation exists, consult with the COTR.

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Date of submittal.
4. Name, address, and telephone number of Contractor.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (115-by-280-mm) paper; with

clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets by stating Volume ___ of ___, where the first blank is the subject volume and the second blank is the total number of volumes.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (115-by-280-mm), 20-lb/sq. ft. (75-g/sq. m) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION AND EMERGENCY MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.
11. Type of Emergency
12. Emergency instructions
13. Emergency procedures

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification by MAXIMO number with corresponding serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special/Emergency operating instructions and procedures.

D. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

E. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

F. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

G. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

H. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties: Provide separate booklet of warranties and lists of circumstances and conditions that would affect validity of warranties.

1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in the manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties: Provide separate booklet of warranties and lists of circumstances and conditions that would affect validity of warranties.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Emergency, Operation and Maintenance Manuals: Assemble a complete set of emergency, operation and maintenance data and procedures indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Manuals may be used by emergency personnel and by Owner’s operating personnel for types of emergencies indicated.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work by MAXIMO number if applicable. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents by MAXIMO number if applicable. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in As-Built Drawings to ensure correct illustration of completed installation.

F. Comply with Division 1 Section "Closeout Procedures" for the schedule for submitting operation and maintenance documentation.

END OF SECTION 017820

SECTION 018200 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for training Government's personnel in the operation and maintenance of systems, subsystems, and equipment.

1.2 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, and instructors' names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit one complete training manual(s) for the Government's use in CD .pdf format.

B. Qualification Data: For firms and instructors identified in "Quality Assurance" demonstrate their capabilities and experience to conduct training for the system and equipment specified. Include lists of previous training on completed projects with project names and addresses, and other information specified.

C. Demonstration and Training DVD: Submit two copies at end of each training module.

1.3 QUALITY ASSURANCE

A. Trainer Qualifications: A firm or individual experienced in training maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.

1.4 COORDINATION

A. Coordinate instruction schedule with the Government's operations. Adjust schedule as required to minimize disrupting the Government's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the Government.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
   1. Fire-protection systems, including fire alarm, fire pumps, and fire-extinguishing systems.
   2. Electrical service and distribution, including transformers, switchboards, panel boards, uninterruptible power supplies, and motor controls.
   3. Lighting equipment and controls.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following, if applicable:

   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.

   2. Documentation: Review the following items in detail:
      a. Emergency manuals.
      b. Operations manuals.
      c. Maintenance manuals.
      d. Identification systems.
      e. Warranties.

   3. Emergencies: Include the following, as applicable:
      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.
      f. Special operating instructions and procedures.

   4. Operations: Include the following, as applicable:
      a. Startup procedures.
      b. Equipment or system break-in procedures.
      c. Routine and normal operating instructions.
      d. Regulation and control procedures.
      e. Control sequences.
      f. Safety procedures.
      g. Instructions on stopping.
      h. Normal shutdown instructions.

i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

3.2 INSTRUCTION

A. Trainer: Engage a qualified trainer to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and the Government for number of participants, instruction times, and location.

B. Provide instructors to instruct the Government’s personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Schedule training with the Government at least fourteen calendar days' advance notice.

D. Demonstration and Training Session: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. For each training module, submit list of participants and length of instruction time.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

E. Cleanup: Collect used and leftover educational materials and give to the Government. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 018200

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 QUALITY ASSURANCE

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

1.6 FIELD CONDITIONS

A. Government will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Government's operations will not be disrupted.

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

C. Notify COTR of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: Hazardous materials are present in buildings and structures 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.
3. Government will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

E. Storage or sale of removed items or materials on-site that are not retained by the Government is not permitted.

F. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Government. Government does not guarantee that existing conditions are same as those indicated in record documents.

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

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

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. COTR will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Government.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

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

3.4 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
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. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. 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 fire watch and portable fire-suppression devices during flame-cutting operations.
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 and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Removed and Salvaged Items: Dispose of demolished items and materials promptly Clean salvaged items.

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

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
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.

D. 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 cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Government's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Division 01 Section "Environmental Compliance."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials and dispose of at designated spoil areas on Government's property.

3.7 CLEANING

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

END OF SECTION 024119

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Slabs-on-grade.
3. Equipment pads.

B. Related Sections include the following:

1. Division 26 Electrical.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with fly ash and other pozzolans, subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Curing compounds.

E. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I.

C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Galvanized Reinforcing Bars: ASTM A 615/A 615M**,** Grade 60 (Grade 420).

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M**,** Grade 60 (Grade 420).

E. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M**,** Grade 60 (Grade 420), deformed bars, assembled with clips.

F. Plain-Steel Wire: ASTM A 82, as drawn.

G. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

H. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from galvanized steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I.

a. Fly Ash: ASTM C 618, Class C.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.6 VAPOR RETARDERS

A. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.7 FLOOR AND SLAB TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified concrete supplier for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings, Foundation Walls, Slabs on Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches.
4. Air Content: 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Chamfer exterior corners and edges of permanently exposed concrete.

F. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

G. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items.

1. Install anchor rods, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

A. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

B. Clean and repair surfaces of forms to be reused in the Work. Apply new form-release agent.

3.4 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.5 STEEL REINFORCEMENT

A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

B. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

C. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

D. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing.

E. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

F. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least 1/4 of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness.

1. Consolidate placed concrete with mechanical vibrating equipment.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

C. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.

D. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. Ambient temperature must be at least 40 degrees and rising at time of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use chemical accelerators unless otherwise specified and approved in mixture designs.

E. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.

2. Just before placing concrete, keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

1. Apply a trowel finish to top surfaces of slabs or equipment pads.

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch.

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss before and during finishing operations. Apply according to manufacturer's written instructions.

C. Cure concrete by one or a combination of the following methods:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Maintain continuity of coating and repair damage during curing period.

3.12 LIQUID FLOOR TREATMENTS

A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when required by COTR. Remove and replace concrete that cannot be repaired and patched to COTR’s approval.

B. Perform structural repairs of concrete, subject to COTR’s approval, using epoxy adhesive and patching mortar.

3.15 FIELD QUALITY CONTROL

A. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Curing procedures.

B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample (set of 4 cylinders) for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength.
9. Test results shall be reported in writing to Government CMI, concrete manufacturer, and Contractor within 48 hours of testing.
10. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

END OF SECTION 033000

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength.
9. Test results shall be reported in writing to Government CMI, concrete manufacturer, and Contractor within 48 hours of testing.
10. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

END OF SECTION 033000

SECTION 036000- NON-SHRINK GROUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes non-shrink grout under base plates, bearing plates, and where specified in Contract Documents.

1.2 REFERENCES

A. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

B. ASTM C1107- Standard Specification For Packaged Dry, Hydraulic-Cement Grout (Non- Shrink).

1.3 QUALITY ASSURANCE

A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Perform compressive strength tests in accordance with ASTM C109 with 2-inch x 2-inch cubes. Test one cube at three days, two cubes at seven days and three cubes at 28 days. Perform one compressive strength test for each fifty bags of grout used and/or perform one test minimum for each day of grouting, whichever is more frequent.

1.4 SUBMITTALS

A. Submit product data sheets for review.

B. Submit compressive strength test reports.

PART 2 - PRODUCTS

2.1 GROUT

A. Provide a non-shrink, non-metallic grout that complies with ASTM C1107.

B. Grout shall have a minimum compressive strength of 5000 psi at 28 days.

2.2 WATER

A. Provide clean, potable water.

PART 3 - EXECUTION

3.1 HANDLING

A. Store and protect non-shrink grout from moisture and contamination.

3.2 PREPARATION

A. Remove mud, dirt and other foreign materials from areas to be grouted.

B. Apply grout to rough concrete surface

C. Roughen concrete if necessary prior to placing grout.

3.3 MIXING

A. Mix grout to its fluid, self-leveling consistency in accordance with manufacturer's recommendations.
B. Do not re-temper grout.
C. Do not exceed manufacturer's maximum limit on water content or use at a consistency which produces free bleeding.
D. Mix grout in a paddle-type mortar mixer.
E. Do not mix grout by hand.

3.4 PLACEMENT

A. Consolidate grout to provide uniformity. Do not vibrate grout.

B. Use forms to contain grout.

3.5 PROTECTION

A. Protect grout and areas to be grouted from excessive heat and cold in accordance with manufacturer's specifications.
B. Protect grout from excessive drying shrinkage resulting from wind or direct sunlight.
C. Protect areas grouted from excessive vibrations for three days.

END OF SECTION 036000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Electrical Panel support frame.
2. Anchor bolts and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Sections include the following:

1. Division 01 Section "Selective Structure Demolition"
2. Division 26 Section "Panelboards"

1.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from a maximum change of 100° F in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

B. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1.4 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53/A 53M.

D. Cast Iron: ASTM A 48/A 48M, Class 30.

2.3 FASTENERS

A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325 or ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers, or galvanized to ASTM A 153.

B. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488.

1. Threaded or wedge type.

C. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 09 painting Sections.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 4000 psi, unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Prime plates with zinc-rich primer.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Prime exterior miscellaneous steel trim and interior miscellaneous steel trim, where indicated with zinc-rich primer.

2.9 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

A. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLING METAL BOLLARDS

A. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 055000

SECTION 079000 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

Sealants and joint backing.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.

B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.5 SUBMITTALS

A. Product Data: Provide data indicating sealant chemical characteristics.

B. Samples: Submit two samples, 6 by 6 inch in size illustrating sealant colors for selection.

C. Submit results of field sealant adhesion testing to Architect prior to start of work.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.

1.7 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8 WARRANTY

A. See Section 017700 - Closeout Procedures, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories which fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 – PRODUCTS

2.1 SEALANTS

A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.

B. Use silicone sealants at all exterior joints.

C. Type 1 - Silicone Sealant: Ultra low-modulus, high-performance, one-part, moisture-curing silicone joint sealant. ASTM C920, Type S, Grade NS, Class 100/50, Uses NT, A, G, M, O; single component.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Applications: Use for: Masonry-to-masonry, or masonry-to-stone joints.
   3. Manufacturers/Products:
      a. Pecora Corporation; 890NST Ultra Low Modulus Architectural Silicone Sealant - Class 100: www.pecora.com.
      b. Dow Corning; Product 790: www.dowcorning.com.
      c. Tremco Global Sealants; Product Spectrem 1: www.tremcosealants.com.

D. Type 2 - Silicone Sealant: Medium modulus, one-part, high-performance, neutral-cure silicone sealant. ASTM C920, Type S, Grade NS, Class 50, Uses NT, A, G, M, O; single component.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Applications: Use for: Metal-to-metal, or Window/louvers-to-masonry joints.
   3. Manufacturers/Products:
      a. Dow Corning; Product 795: www.dowcorning.com.
      b. Pecora Corporation; Product 895: www.pecora.com.
      c. Tremco Global Sealants; Product Spectrem 2: www.tremcosealants.com.

E. Type 3 - Polyurethane Sealant: ASTM C920, Type M, Grade NS, Class 50, Uses NT, I, (Class 2), M, A; multi component, chemical curing, capable of continuous water immersion, non-sagging type.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Applications: Use for: Concrete block-to-concrete block, or concrete block-to-poured in place concrete in cavity wall construction. Joints and penetrations in vertical and horizontal surfaces of concrete, and between metal and concrete, mortar or stone; overhead or ceiling joints; perimeters of metal frames; vertical expansion and control joints in masonry and concrete; and at all miscellaneous locations requiring a joint sealant.
   3. Manufacturers/Products:
      a. Sika Corporation; Product Sika Flex 2C: usa.sika.com.
      b. Sonneborn by BASF; Product Sonolastic NP-2: www.buildingsystems.basf.com.
      c. Tremco; Dymeric 240 FC: www:tremcosealants.com.

F. Type 4 - Acoustic Sealant: Butyl or acrylic sealant; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
   1. Applications: Use for concealed locations only: Sealant bead between top stud runner and structure, and between bottom stud track and floor.
   2. Manufacturers/Products - Acrylic:
      a. Tremco Global Sealants: www.tremcosealants.com.
      b. Red Devil; Siliconized Acrylic Construction Grade (35 Year) Sealant: www.reddevil.com.
      c. Sherwin-Williams Company; Shermax Urethanized Elastomeric Sealant: www.sherwin-williams.com.
   3. Manufacturers/Products - Acrylic:
      a. Bostik Inc: www.bostik-us.com.
      b. Pecora Corporation: www.pecora.com.
      c. Sherwin-Williams Company; Storm Blaster All Season Sealant: www.sherwin-

williams.com.

d. Tremco Global Sealants: www.tremcosealants.com.

e. Substitutions: See Section 016000 - Product Requirements.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

C. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Install bond breaker where joint backing is not used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Tool joints concave.

3.4 FIELD QUALITY CONTROL

A. Perform field sealant testing for all sealants that affect watertightness.

1. Test each material scheduled as a substrate for silicone sealants to verify substrate priming and preparation requirements.

2. Field sealant adhesion testing shall be performed by authorized representative of selected sealant manufacturer.

3. Submit results of field sealant adhesion testing to Architect prior to start of work.
4. Coordinate results of testing so that substrate preparation and priming requirements are known at time when needed by sealant applicator before sealant installation.

3.5 CLEANING

Clean adjacent soiled surfaces.

3.6 PROTECTION

Protect sealants until cured.

END OF 079000

SECTION 095113 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Division 26- (Electrical items, light fixtures, etc., mounted in ceilings).

1.2 SUMMARY:

A. This Section includes acoustical and non-acoustical panel ceilings installed with exposed grid suspension systems.

1. Type 1 (ACT-1): Square edge acoustical panel system in Standard Finish Grid (Acoustical panels), at locations indicated on the Drawings.

1.3 SUBMITTALS:

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data for each type of product specified.
2. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

a. 6-inch-square samples of each acoustical panel type, pattern, and color.
b. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project, and which is acceptable to manufacturer of acoustical products herein, as indicated by written statement by their manufacturer(s).

B. Fire-Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire-performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.

   a. Flame Spread: 25 or less.
   b. Smoke Developed: 50 or less.

C. Acoustical Performance Characteristics: Provide acoustical ceiling systems which have been tested by UL or other acceptable independent testing organization, to certify compliance with STC and CAC minimum requirements indicated herein.

D. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a preapproved manufacturer and a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

E. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and wall and partition systems.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

D. Refer to Division 1 Sections “Product Requirements” for additional information and requirements regarding stored materials.

1.6 PROJECT CONDITIONS:

A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.7 EXTRA MATERIAL:

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.

   1. Acoustical Units: Furnish one box of full-size units, in whole unused cartons.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CEILING UNITS, GENERAL:

A. Standard for Acoustical Ceiling Units: Provide manufacturer's standard units of configuration indicated that comply with ASTM E 1264 classifications as designated by reference to types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400 (plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from the test surface) per ASTM E 795.

B. Colors and Patterns: Provide products to match appearance characteristics indicated under each product type, or if not indicated, as selected by COR from manufacturer's standard colors, surface textures, and patterns available for ceiling panels and exposed metal suspension systems of quality indicated herein.

2.2 ACOUSTICAL UNITS:

A. Type 1 (ACT-1): Manufacturer's standard lay-in non-directional random pattern, lightly fissured, heavily perforated panels, and as follows, unless indicated otherwise:

1. Size: 24 inches x 24 inches x 5/8 inch.
2. Edge: Square.
3. NRC Range: 0.55.
4. CAC Range: 35.
5. Color: White.
6. Light Reflectance: 0.86
7. Manufacturer/Product - Provide one of the following; Class A flame spread:

a. Armstrong World Industries, Inc., "School Zone, Fine Fissured", No. 1713, with standard "Humigard Plus" humidity resistance and "Bio-Block" mold/mildew resistant paint and treatment; with Prelude XL 7300 Series grid.
b. CertainTeed "Fine Fissured High NRC", No. HHF-457 HNRC, with standard humidity resistance and mold/mildew resistant paint and treatment; with CertanTeed Classic Stab Series grid.
c. USG Interiors, Inc., "Astro Climaplus,", No., 8221, with standard humidity resistance and mold/mildew resistant paint and treatment; with USG DX/DXL Series grid.

8. Grid: Standard hot-dipped galvanized steel in white color to match ceiling tile; 15/16-inch exposed tee grid.

2.3 METAL SUSPENSION SYSTEMS, GENERAL:

A. Standard for Metal Suspension Systems: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated, unless otherwise required.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

a. Product/Manufacturer: Galvanized, aluminum capped grid.

1) "Environmental ZXLA Grid System," as manufactured by USG Interiors or Donn.
2) "Prelude Plus" Environmental Tee System, as manufactured by Armstrong World Industries, Inc.
3) "Protectone" Series, as manufactured by CertainTeed.

C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

D. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched.

1. Gauge: Provide wire sized to that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct-Hung), will be less than yield stress of wire, but provide not less than 0.106-inch diameter (12 gauge).

E. Hanger Rods - (as required): Mild steel, zinc coated, or protected with rust-inhibitive paint.

F. Angle Hangers - (as required): Angles with legs not less than 7/8 inch wide, formed with 0.0365-inch-thick galvanized steel sheet complying with ASTM A 446, Coating Designation G90, with bolted connections and 5/16-inch-diameter bolts.

G. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit type of edge detail and suspension system indicated.

H. Subject to compliance with requirements, provide suspension systems of one of the following:

1. Manufacturers of Steel Exposed Suspension Systems:

a. Same as ceiling panel unit manufacturer.
b. Armstrong World Industries, Inc.
c. CertainTeed.
d. Chicago Metallic Corporation.
e. Donn Corporation.

2. Manufacturers of Moldings and Trim:

a. Construction Specialties.
b. Fry Reglet Corporation.
c. Gordon, Inc.
d. MM Systems.
e. Technical Ceiling Systems, Inc.
f. Same as Suspension system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling and panel systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors, or supports, whose installation is specified in other sections.

1. Furnish galvanized inserts and similar devices as required for wood structure (if required), to other trades for installation well in advance of time needed for coordination of other work.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION:

A. General: Install acoustical ceiling and panel systems to comply with installation standard referenced below, per manufacturer's current written instructions and CISCA "Ceiling Systems Handbook."

1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.

B. Arrange acoustical units and orient directionally patterned units, (if any) in a manner shown by reflected ceiling plans.

1. Install panels with pattern running in one direction, as indicated, or if not indicated, as requested from and directed by Architect.

C. Suspend ceiling hangers from building structural members and as follows, with system leveling tolerance of 1/8 inch in 12'-0":

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
4. Secure cable, angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to which cables and hangers are attached as well as for type of cable, hanger and hardware involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

5. Space ceiling panel hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

   a. Provide additional hangers as necessary, so that one hanger occurs on each side of lay-in and surface-mounted light fixtures, and at other grid supported equipment, devices, etc.

6. Install “high humidity finish” systems at all areas indicated to receive lay-in vinyl-faced gypsum “non-acoustical” ceiling panels.
7. Install cable hangers with all indicated and otherwise necessary hardware for complete and proper installation of ceiling and panel systems.

D. Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.

   1. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

3.4 CLEANING:

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer’s instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF 095113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY:

A. This Section includes surface preparation, painting, and finishing of exposed interior and exterior items and surfaces, except where noted otherwise.

1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

B. Paint exposed surfaces whether or not colors are designated in “schedules,” except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.

1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
2. Pipe identification tags end markers or bands, direction of flow arrows, voltage identification, etc., if any, are provided under Division 22- “Mechanical”, and Division 26 - “Electrical.”

C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

1. Examples of prefinished items not to be painted include, in part, the following factory-finished components:

a. Metal and plastic laminate toilet enclosures and partitions.
b. Acoustic materials.
c. Plastic laminate casework.
d. Finished mechanical and electrical equipment.
e. Light fixtures.
f. Switchgear.
g. Distribution cabinets.
h. Signage, Plaques, Directories, and Bulletin Boards.
i. Storefront.
j. Finish Hardware.

2. Examples of concealed surfaces not to be painted include, in part, wall or ceiling surfaces in the following generally inaccessible areas:

a. Foundation spaces.
b. Furred areas.
c. Utility tunnels.

d. Pipe spaces or chases.
e. Duct shafts.

3. Examples of Finished metal surfaces not to be painted include, in part, the following:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.
d. Copper.
e. Bronze.
f. Brass.
g. Prefinished aluminum windows and trim.

4. Examples of operating parts not to be painted include, in part, moving parts of operating equipment such as the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Where walls are indicated or otherwise required to be fire-rated or smokestop partitions, and at all corridor partitions, exit enclosures, and fire walls, walls shall be effectively and permanently identified with signs or stenciling in a manner acceptable to the authority having jurisdiction. Such identification shall be above any decorative ceiling and in concealed spaces. Suggested wording, "Fire and Smoke Barrier - Protect All Openings":

1. Minimum size of lettering to be 1-1/2" high.
2. Minimum of one sign or stencil at each side of each such wall.
3. Maximum spacing of signs or stenciling at each side of continuous walls to be 20'-0" on center.

1.3 SUBMITTALS:

A. Product Data: Manufacturer's most current technical information, label analysis, and application instructions for each material proposed for use.

1. List each material and cross-reference to scheduled paint types, and including each specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.

1.4 QUALITY ASSURANCE:

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by paint manufacturer, and use only within the recommended limits.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect of any problems anticipated using the materials specified, prior to proceeding with work.

C. Material Quality: Provide the manufacturer's best quality grade paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude approved equivalent products of other manufacturers.

D. Color Pigments: Pure, non-fading, applicable types to suite substrates and service indicated.

E. Lead content in pigments or other painting materials and components is not allowed.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's name, stock number, and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.

B. Store materials not in use in tightly covered containers in a well- ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers, others present or passing through or inspecting work areas (painting or any other work), and the work areas themselves are protected from fire and health hazards resulting from handling, mixing, and application of materials.

1.6 JOB CONDITIONS:

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F and 90 deg F, unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F and 95 deg F, unless otherwise permitted by paint manufacturer's printed instructions.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer, during application, drying and curing periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Benjamin Moore and Co. (Moore).
2. PPG Industries, Pittsburgh Paints (Pittsburgh).
3. The Sherwin-Williams Company (S-W). *Basis of Design
4. TNEMEC Company, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION:

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.
2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.
b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

   a. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Fill cracks in wood or plywood floors with a latex filler and prime filled areas after sanding, except where otherwise recommended by paint manufacturer. Sand smooth when dried.
   b. Prime, stain, or seal unfinished wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
   c. When transparent finish is required, backprime with spar varnish.
   d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
   e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.

4. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

   a. Treat bare, sandblasted, or pickled clean metal with a metal treatment wash coat before priming.
   b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with non- petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

C. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

D. Tinting: Tint each primer and undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat(s), but provide sufficient differences in shade of undercoats to distinguish each separate coat.

1. Multiple finish coats, if required, shall be same color for each coat.

3.3 APPLICATION:

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied. Use of spray equipment at the site is not allowed, except where specifically indicated.

1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
2. Paint surface treatments and finishes are indicated on the Drawings and in Specifications.
3. Finish colors will be selected after Bidding, unless indicated otherwise.
4. Provide finish coats that are compatible with primers used.
5. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
6. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
7. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, connector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
8. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
9. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
10. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

B. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

C. Finish doors on tops, bottoms, and side edges same as faces.

1. Sand lightly between each succeeding enamel or varnish coat.

D. Primers:

1. Omit primer on metal surfaces that have been shop-primed and touch-up painted, only after verifying full compatibility of shop primers with materials specified for the next coat and finish coats.
2. Primer may be omitted at previously painted existing surfaces in good condition, except at interior concrete, plaster and drywall surfaces, after repairs to any existing damaged substrates and after spot priming of existing damaged paint finish, followed by cleaning and preparation recommended in writing by paint manufacturer.

E. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

F. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

G. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces. Painting of these items should be done to match existing conditions.

1. Mechanical items to be painted include but are not limited to:

a. Piping, pipe hangers, and supports.
b. Tanks.
c. Ductwork.
d. Insulation.
e. Supports.
f. Accessory items.

2. Electrical items to be painted include but are not limited to:

a. Conduit and fittings.
b. Switchgear.

H. Block Fillers: Apply block fillers to new or previously unpainted concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before application of finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.4 CLEANING:

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION:

A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINT SCHEDULE:

A. General: Provide the following paint systems for the various substrates, as indicated.

1: IRON AND STEEL SURFACES:

1. Sherwin-Williams:
   a. Primer (1ct): Pro Industrial Pro-Cryl Universal Primer, B66-310
   b. Finish (2cts): Pro Industrial Acrylic Coating, B66-600 Series
      (Gloss, B66-600 Series / Semi-Gloss, B66-650 Series)
      Gloss Finish (Solvent Base)
      1st Coat: S-W Pro Industrial Pro-Cryl® Primer, B66-310 Series
      (2-4 mils dry)
      2nd Coat: S-W Industrial Enamel, B54 Series
      3rd Coat: S-W Industrial Enamel, B54 Series
      (2.0 - 4.0 mils dry per coat)

2. NOTE: Provide equivalent "dry-fall" product spray-applied finish coats over primer for any steel structure and exposed steel decking which will remain exposed after other work and improvements; 2 Coats.

   Sherwin-Williams:
   a. Primer (1ct): Pro Industrial Pro-Cryl Universal Primer, B66-310
   b. Finish (2cts): Low VOC Waterbased Dry Fall,
      (Flat, B42W81 – EggShell, B42W82 – S/G, B42W83)

   COMPLETELY COVER AND PROTECT ENTIRE FLOOR IN ROOMS WHERE OCCURS, PRIOR TO APPLICATIONS.

2: GALVANIZED STEEL AND ALUMINUM SURFACES:

1. Sherwin-Williams:
   a. Primer (1ct): Pro Industrial Pro-Cryl Universal Primer, B66-310
   b. Finish (2cts): Pro Industrial Acrylic Coating, B66-600 Series
      (Gloss, B66-600 Series / Semi-Gloss, B66-650 Series)
      Gloss Finish (Solvent Base)
      1st Coat: S-W Pro Industrial Pro-Cryl® Primer, B66-310 Series
      (2-4 mils dry)
      2nd Coat: S-W Industrial Enamel, B54 Series
      3rd Coat: S-W Industrial Enamel, B54 Series
      (2.0 - 4.0 mils dry per coat)

3: CONCRETE SURFACES:

1. Sherwin-Williams:
   a. Primer (1ct): Loxon Concrete & Masonry Primer, A24W8300

b. Finish (2cts): ProMar 200 Zero VOC Interior Latex Egg-Shell, B20-2600
c. Option:
Finish (2cts): Harmony Interior Latex Eg-Shel, B09-1000 Series (product is Zero VOC, Tints with Zero VOC Tint, Anti-Microbial, Odor reducing and has VOC Eliminating technology – NO Other products offers the same features)

4: WOOD SURFACES TO BE PAINTED (OPAQUE FINISH):

1. Sherwin-Williams:
a. Primer (1ct): Premium Wall & Wood Primer, B28W8111
b. Finish (2cts): ProMar 200 Zero VOC Interior Latex S/G, B31-2600;

5: DRYWALL SURFACES - (Dry Areas):

1. Sherwin-Williams:
a. Primer (1ct): HB Interior Latex Primer/Surfacer, B28W08601;

Coverage: can be applied from: 400 sq ft/gal @ 4 mils wet; 0.8 mils dry to: 80 sq ft/gal @ 20 mils wet; 4.4 mils dry

Number of coats as required to conceal minor wall irregularities, imperfections, differing textures, joint taping and mudding, etc., prior to finish coats.

b. Finish (2cts): ProMar 200 Zero VOC Interior Latex Egg-Shell, B20-2600
c. Option:
Finish (2cts): Harmony Interior Latex Eg-Shel, B09-1000 Series (product is Zero VOC, Tints with Zero VOC Tint, Anti-Microbial, Odor reducing and has VOC Eliminating technology – NO Other products offers the same features)

6: DRYWALL SURFACES - (Wet Areas: Toilet, Locker, Shower & Janitors Rooms, Kitchen Areas, any room with a plumbing fixture, and areas where food is stored, prepared, cooked or served):

1. Sherwin-Williams:
a. Primer (1ct): HB Interior Latex Primer/Surfacer, B28W08601; Approximately 20-mil dry thickness; This primer only, spray-applied. Number of coats as required to conceal minor wall irregularities, imperfections, differing textures, joint taping and mudding, etc., prior to Second Primer and finish coats.
b. Finish (3cts): Waterbased Catalyzed Epoxy, B70W211 (Semi-Gloss, B60V25 – Gloss, B60V15)

7: CMU AND BRICK SURFACES - (Dry Areas):

1. Sherwin-Williams:
a. Primer (1ct): PrepRite Interior / Exterior Block Filler, B25W25;
b. Finish (2cts): ProMar 200 Zero VOC Interior Latex S/G, B31-2600;
c. All block pores shall be completely filled.

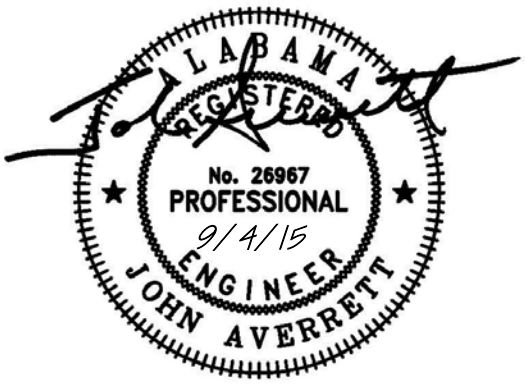
8: CMU AND BRICK SURFACES - (Wet Areas: Toilet, Locker, Shower & Janitors Rooms, Kitchen Areas, any room with a plumbing fixture, and areas where food is stored, prepared, cooked or served):

1. Sherwin-Williams
   a. Primer (1ct): Heavy Duty Block Filler, B42W46;
      Option: Cement-Plex 875 Epoxy Block Filler, B42W200.
   b. Finish (2cts): Pro Industrial Waterbased Catalyzed Epoxy, B73-300 Series.
   c. All block pores shall be completely filled.

END OF 099123

ELECTRICAL SPECIFICATIONS

PREPARED BY



John Averrett, PE

SECTION 230923 - DIRECT DIGITAL CONTROL/UTILITY CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section applies to all Utility Control System instrumentation. Product quality, installation, and operation shall meet the requirements specified herein unless indicated otherwise on the design drawing(s).

B. The existing UCS architecture consists of multiple LAN segments supporting dual servers, operator workstations, printers and Ethernet to MS/TP data routers supporting multiple MS/TP LANs. The MS/TP networks include over 200 point-to-point modems and data converters used to extend each MS/TP LAN segment. Operator workstations are Windows XP based systems running Dorsett's Infoscan, Oracle Client, and other custom applications. Servers are Windows Server 2003 based systems running Dorsett Technologies Inc.'s Infoscan and Oracle Database Manager. The UCS monitors and/or controls more than 3.5 million square feet of conditioned space in excess of 100 buildings, comprising more than 18,000 connected field devices. Due to MSFC's multi-million dollar investment in the large installed UCS product base and to ensure 100% compatibility with the existing hardware and software, all construction, renovation or modification of facilities shall be an extension of the existing UCS architecture. For all modifications and/or additions that include UCS or affect UCS, the design of the UCS control system network and UCS equipment is done by a specialized "in-house" UCS design group at MSFC.

1.2 PRE-CONSTRUCTION MEETING

A. A control system pre-construction meeting shall be held prior to undertaking any control system construction installations at MSFC. The purpose of the meeting is to review this specification and discuss the project prior to starting work. Proper construction techniques and expected results will be discussed. In general, this meeting will address questions, or concerns, by any party, so that a clear understanding of the job scope and contractor responsibility is understood.

B. The contractor's construction supervisor or field manager must attend this meeting. The following individuals shall attend this meeting:

1. Project Manager/COR
2. Construction Inspector
3. Utility Control System Representative
4. Utility Control System Designer
5. Contractor Construction Supervisor

1.3 QUALITY ASSURANCE

A. The instrumentation installation shall be under the direct supervision of individuals with a minimum of 5-years experience in the installation and service of similar instrumentation.

1.4 RELATED SECTIONS

A. Division 26 "Electrical", applies to work specified in this section.

1.5 SYSTEM DESCRIPTION

A. A control system consists of sensors, indicators, final control elements, interface equipment, accessories, software, and other apparatus connected to distributed controllers operating in a multi-user, multitasking environment on Local Area Network(s), and programmed to control specified equipment.

1.6 SUBMITTALS

A. Product Data

1. Provide technical sheets on all system components shown on the design drawing(s).
2. Provide catalog cut-sheets, specifications, product data, warranty information and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. A technical submittal must be submitted including specification compliance, technical sheets, and factory representative authorization. The technical submittal shall contain the following:
   a. Specification Compliance: The compliance document shall address each paragraph of the specification by indicating COMPLY, EXCEED, or EXCEPTION. Do not indicate COMPLY unless the proposed system exactly meets the paragraph requirement. If EXCEED or EXCEPTION is indicated, then provide a clear and concise explanation of the variance from the specifications and the net effect this would have on the proposed system.

B. Shop Drawings (Control Schematic Drawings)

1. The Contractor may not start work until the complete control schematic drawings of the entire control system are approved by the Government.
2. The control schematic drawings shall have a key to all abbreviations.
3. The control schematic drawings will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Communication trunk diagrams shall designate and identify the specific building location of each application specific or multi-function controller card and the relative position of each card on respective trunks.
5. The Contractor shall provide detailed I/O point summaries indicating each instrumentation point with wire termination identifications for each point and grouped by individual I/O card.
6. Provide a full points list with at least the following included for each point.
   a. Include:
      1) <u>Control Points:</u> Points that control equipment and can have setpoints changed (e.g., OSA, SAT)
      2) <u>Intermediate Points:</u> Points whose values are used to make calculations which then control equipment (e.g., space temperatures that are averaged to a virtual point to control reset).

3) Calculated Points: "Virtual" points generated from calculations of other point values.
4) Monitoring Points: Points that do not control or contribute to the control of equipment, but are used for operation, maintenance, or performance verification.

b. Provide the following information for each point:
1) Controlled system
2) Point abbreviation
3) Point description (e.g., DB temp, airflow)
4) Setpoint

C. Sequences of Operation- The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:

1. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
2. All interactions and interlocks with other systems.
3. Detailed delineation of control between any packaged controls and the building automation system, listing what points the UCS monitors only and what UCS points are control points and are adjustable.
4. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
5. Start-up sequences.
6. Warm-up mode sequences.
7. Normal operating mode sequences.
8. Unoccupied mode sequences.
9. Shutdown sequences.
10. Capacity control sequences and equipment staging.
11. Temperature and pressure control: setbacks, setups, resets, etc.
12. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
13. Effects of power or equipment failure with all standby component functions.
14. Sequences for all alarms and emergency shut downs.
15. Seasonal operational differences and recommendations.
16. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
17. Schedules, if known.
18. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

D. As-Builts

1. Provide one hardcopy and compact disc (CD) in either Bentley Systems' Microstation or DXF format and shall include Contractor's original, untranslated drawing file. The as-builts shall include:
   a. Wiring diagrams
   b. System schematics
   c. Communication trunk layout

E. Test Plans, Trends, and Test Reports

1. Thirty days prior to the start of system verification, three (3) copies of written test plans describing control system verification and operational functionality procedures shall be submitted for Government approval. The Contractor is responsible for the development of the test plans. Test plans shall validate the intended purpose and operational effectiveness of the entire system; this includes all hardware devices and software sequences called for on the design drawings.
2. Control system verification procedures describing how the operation of each control loop will be verified shall be submitted by control loop, identifying each sensor, actuator, controller, transducer, and measuring device, as required. The procedures shall describe adjustments in terms of control component positions, input and output signals and ranges, air and water flow rates, temperature and humidity setpoints, calibration of valve and damper actuators and sensors, and all other pertinent control parameters. Submit bound copies of individual trend data, with table of contents, for each control loop identified on the contract drawings for verification of proper control loop operation, at least 30 days before Functional Performance Testing begins. Functional Performance Testing scheduled start date shall be obtained from the MSFC Commissioning Agent. Trend data shall identify that HVAC system that the control loop is installed in, control loop description (e.g., cooling coil control loop), control component designation (e.g., CCSAT-1, CHWV-1), and controlled component value or position for the duration of the control action. Trend data shall be provided for a minimum of two (2) control cycles to verify proper loop control operation.
3. Local Server control system verification test reports describing test results of each control loop shall be submitted in bound form and shall indicate the final values and settings of each control component in each control loop. Where testing indicates a necessary deviation from the contract drawing sequences of operation and controls submittals, the Government shall be informed immediately. Any deviations shall be made only after Government approval and the test report shall note any changes in the control loop or component settings caused by the deviation. Seven (7) hardcopies and two (2) electronic copies on CD of the control system verification test report shall be submitted within 30 days after completion of testing.
4. MSFC/BASSCO Server control system verification test reports describing test results of each control loop shall be submitted in bound form and shall indicate the final values and settings of each control component in each control loop. Seven (7) hardcopies and two (2) electronic copies on CD of the control system verification test report shall be submitted within 30 days after completion of testing.

F. Manufacturer's Instructions: Contractor shall submit three (3) hardcopies and three (3) electronic copies on CD of manufacturer's instructions describing installation of a product or system, special notices and material safety data sheets concerning impediment, hazards, safety precautions, startup, shutdown, and emergency operation.

G. Operation and Maintenance Manuals: Operation and maintenance manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Contractor shall submit three (3) hardcopies and three (3) electronic copies on CD of O&M documentation. Operation and maintenance manuals shall be provided for all control system instrumentation products.

H. Qualification Data: The contractor shall submit a list of personnel qualifications, projects, dates, and control descriptions of installed systems as proof of experience installing similar instrumentation.

I. Course content and format of training materials.

1.7 TELECOMMUNICATIONS

A. Telecommunication lines are furnished by the Government. The Government will provide a telecommunication line between the construction site and the MSFC UCS network. The telecommunication line may be wired or wireless, as determined by the Government, and will be used through all testing and checkout phases, including commission. The Contractor shall submit a written request for the telecommunication line to the UCS Contractor 30 days prior to system startup.

B. The Contractor shall furnish the modems specified below or approved equal for installation as required on contract drawings.

1. Patton Electronics Co.
2. ADC-MegaBit
3. Rack-mount modem:
   a. Patton Electronics P/N 1080ARC
4. Stand-alone modem:
   a. Patton Electronics P/N 1080
   b. ADC-MegaBit DSL P/N MM702G

PART 2 - PRODUCTS

2.1 The Controls Contractor shall furnish components required by design and described herein.

2.2 DIRECT DIGITAL CONTROL (DDC) EQUIPMENT

A. Utility Control System (UCS): This work includes all material, equipment, and appurtenant accessories necessary for, or incidental to, the installation of a complete Direct Digital Control (DDC) System as specified in the design package. The appropriately selected DDC configuration shall be capable of controlling processes in the building through configurable electronic controllers. This configurable hardware shall be electronically interfaced via an Interface Card (CPU), X-Talk or UNV-T-E card, manufactured by Dorsett Technologies Inc., http://www.dorsett-tech.com/, through telecommunication data lines to the central computer-based Utility Control System (UCS) located in Room 29 of Building 4250. Complete operational compatibility shall be maintained between the central UCS Infoscan system, both

hardware and software, as manufactured by Dorsett Technologies Inc. and the direct digital controllers. The central host computer communicates via Government-furnished telecommunication lines and contractor installed modems to Dorsett's Interface Panel(s) located in the building(s) where the project is being performed. The Interface Panel communicates with application-specific controllers or multi-function controller cards, which implement direct control of equipment through industry standard electronic signals.

B. DDC hardware and software will communicate directly with the central host Infoscan application and that all existing UCS programs will function completely to control and monitor related equipment. It also means that engineering units, values, or parameters utilized within the panels or controllers are compatible with units used within the Infoscan System. The field hardware and the central host computer shall communicate and be fully programmable from the host Infoscan application.

C. Operators shall have the ability to specify within the software and in standard engineering units the amount by which the point must change at the sensor before it is reported as changed to the UCS central servers in Building 4250. This feature provides a system function referred to as "report-by-exception."Interface cards only report to the central computers value changes that exceed the selected delta value. This minimizes data traffic on telecommunication lines to and from the UCS central servers.

D. Each point that is used within the process shall be displayable and accessible through an Infoscan point review. When these points are represented as displayed values on computer graphic displays, operators shall be able to select these values with a point device and retrieve accurate data within 20 seconds.

E. Computer graphic displays shall be developed to represent each HVAC or environmental control component or system. These pictorial displays shall represent a chiller with all support pumps, valves, towers, air handlers, etc. All related analog and status points shall be dynamically represented on the display. If an analog or binary point changes value beyond the delta limit, this condition must be reported to an operator workstation within 20 seconds.

F. The Contractor shall perform all application programming and point configurations through existing operator workstations via Infoscan software. All programming and graphic display generation for a completely operational system shall be provided.

G. Field Interface Device: A Field Interface Device, also called FID, SID, MID, JID, etc., is a solid state electronic device with supporting software that provides an interface and permits communication between field controllers and the UCS servers. This device is the Dorsett's CPU card, X-Talk or UNV-T-E card into which the multi-Function or application-specific cards are interfaced. It is connected via Government-furnished telecommunication lines to the UCS central servers in Building 4250. It has hardware and software compatibility with the existing Utility Control System. This card functions on a "report-by-exception" basis as described earlier in this section. If a new Interface Device is required, it shall be acquired from Dorsett Technologies Inc.

H. Multi-Function Controller Card: Is a solid-state electronic controller with universal input-output channels. All configuration parameters are fully programmable via the UCS central servers. Multifunction controller cards are manufactured by Dorsett Technologies Inc. include:

1. MS4-UNV-T-E

2. MS4 xTalk
3. SCADA Controller
4. MS3 Controller Cards

I. Application-Specific Controller: An application-specific controller cards shall be connected and communicate to the UCS system through the CPU, UNV-T-E cards, or X-Talk. An example is an MS4-VAV controller.

J. Equipment Specific Controller (ESC): An equipment specific controller is any controller that is user programmable such as programmable logic controllers (PLC), PID controllers, etc. An ESC, when allowed by contract drawings and specifications, shall have all pertinent accessories included for the programming, downloading, and documentation of software. When available the contractor shall provide a Government approved programming device including software, cables, hardware locks, etc. to provide for the physical connection to the ESC and access to the non- volatile memory for programming of the ESC. Programming software shall be provided on factory media with all/any serial numbers, key codes, etc. such that the media can be registered with the manufacturer. For all ESC's, the contractor shall provide two (2) hardcopies of the factory programmed software logic. Owner's manuals and programming manuals shall also be included with all ESC installations. Where UCS control is desired, ESC's must be compatible with accepted UCS communication protocols. Examples of these protocols are:

1. BACnet – IP
2. BACnet – MSTP
3. N2 – (Johnson Controls Inc.)
4. Modbus RTU.

K. Control Panel (MUX):

1. A control panel is a completely configured field panel consisting of multi-function controller card(s), power supply(s), and terminal strips, fully contained within a UL listed, NEMA rated enclosure. Control panels manufactured by Dorsett Technologies Inc., are available in several sizes and configurations.
2. All control panels shall have a trough wire-way mounted above and below the enclosure for conduits to enter or exit. Chase nipples or conduits shall be used to connect the trough to the bottom of the control panel enclosure. Only penetrations in the bottom of the UCS control panel shall be made.

2.3 FIELD DEVICES

A. General:

1. The use of interface signal converters is not allowed unless otherwise indicated on design drawings.
2. 24 volt AC power sources shall be 120 volt AC primary input, 4 amp minimum rated secondary, on/off switch, circuit breaker mounted in metal enclosure.
3. Uninterruptible Power Sources (UPS) shall have user accessible batteries, automatic voltage regulation and 1 KVA minimum capacity rating.
4. Acceptable industry standard analog voltage and current signals are as follows: 4 to 20mA, 0 to 20mA, 0 to 10VDC and 2 to 10VDC.

B. Utilities Metering: All programmable utility meters as required on contract drawings shall have all pertinent accessories included for the programming, downloading, and documentation of software. When available the contractor shall provide a Government approved programming device including software, cables, hardware locks, etc. to provide for the physical connection to the meter and access to the nonvolatile memory for programming of the meter. For all programmable meters, the contractor shall provide two (2) hardcopies of the factory programmed software logic. Owner's manual and programming manual shall also be included with all installations.

C. Where discrete connections are specified, meter output(s) shall be directly connected to the Utility Control System DDC hardware. Meter electrical ratings shall be compatible with the Utility Control System DDC hardware. Pulse outputs shall indicate an accumulated quantity. Minimum pulse output duration shall be 0.25 seconds. Pulse output type shall be open-collector/current sinking or form C relay contacts. If specified on the contract drawings, the following utility meter to UCS connections may be required:
   1. Interface Communicating output meters:
      a. Electrical power

D. Voltage/Phase-loss monitor: Device shall be plug-in style selected per application; automatic reset type with DPDT form C relay outputs, adjustable trip setpoint.

E. Current Switch: Device shall be capable of switching 150mA continuously. Split core design with adjustable trip point and capable of switching AC or DC circuits. Applicable for VFD applications down to 6Hz and powered by monitored line.

F. Variable Frequency Drive: VFD shall have an analog 0-20mA, 0- 10VDC, 2-10VDC, 4 – 20mA input for speed control, a contact closure input for start/stop control, and N2 communications.

2.4 LABELING

A. Sensor and Control Devices: Each sensor and each control device shall be labeled at the sensor or device with the Infoscan database point name that identifies it. The point name shall be displayed in print achieved electronically or typographically on permanent adhesive labels. Minimum label size shall be 1 inch by 1/2 inch. Label color shall be white background. Printed text shall be black.

B. Enclosures: UCS control panels, as a minimum, shall be labeled. Labels shall be engraved plastic, beveled edges, black background, and white letters. Letter height shall be 1/2 inches minimum. Overall label dimensions shall be 1.25 inches minimum height, length as required. Labels shall be centered along width and located within upper 1/4 area of enclosure door. Minimum distance from top of enclosure shall be 3 inches. Labels shall be affixed with adhesive cement. Panels shall be labeled consistent with design drawing terminology.

C. Terminations: Each terminated wire shall be clearly labeled with Field Device Infoscan point name (example AH1-SAF) at the Field Device and at each wire termination. Labeling shall display device or point names and shall be displayed in print achieved electronically or typographically. The Government shall approve labeling medium and method before work begins. Label shall be Brady model WMS-117- 319 or approved equal.

2.5 WIRING

A. Instrumentation/ Low Voltage and Data Communications Cable Wiring: All wiring shall be installed in dedicated conduit with the exception of plenum-rated wire which may be used in runs in concealed but accessible ceiling areas and computer room sub-floor only. A.C. power wiring greater than 24V shall not be installed in the same conduit, or pathway, with low voltage (24 volt or less) wiring. Conduit shall be 3/4 inches minimum diameter. Flexible conduit shall not exceed 3 feet in length and shall be ½ inch minimum in diameter. Wiring specifications are as follows:

B. Instrumentation/ Low Voltage Wiring:

1. 1-Pair, 22 AWG, stranded (7X30), twisted pair construction, 300 volt, polymer alloy-insulation, maximum O.D. of 0.15 inches, aluminum foil-polyester tape 100% shield, 24 AWG stranded drain wire, and plenum rated-jacket. Gray jacket with one black and one red wire. West Penn part #25291B or approved equal.
2. 2-Pair, 22 AWG, stranded (7X30) twisted pair construction 300, volt, polymer alloy-insulation, maximum O.D. of 0.21 inches, individual aluminum foil-polyester tape shielded pairs, 100% shield coverage, 24 AWG stranded (7X32) tinned copper drain wire, and plenum rated-jacket. Gray jacket with black/red and white/green wire pairs. West Penn part #25510B or approved equal.
3. Control Panel Instrumentation/ Low Voltage Wiring shall have shield/drain wires terminated only at a grounding bar in the wire trough located beneath the MUX panel. A 25 position (minimum) grounding bar shall be mounted and bonded to the wire trough bottom. A maximum of five shield/drain wires shall be terminated at each ground bar position. Shield/drain wires are not permitted in the control panel and shall remain within the wire trough enclosure.

C. Instrumentation/ Low Voltage Wires connecting field devices shall not be spliced or butted together. They shall be "home runs" from the field device to the panel.

D. Data Communications Cable Wiring:

1. 1-Pair, 24 AWG, stranded (7X32), characteristic impedance 120ohms, twisted pair construction, 300V, Foamed Teflon insulation, maximum cable diameter 0.202 inches, aluminum polyester foil 100% shield, 24 AWG stranded tinned copper drain wire, and plenum PVC rated-jacket. Gray jacket with one white/blue wire West Penn part #D254851, Belden part# 82841 or approved equal.

E. Data Communications Cable Conductors: The stripped portion of the stranded data communications cable shall be no more than 3 inches in length.

F. Data Communications Cable Shield/Drain Wire: Data Cable shall have shield/drain wire terminated only at the point of origin to the communication ground. The cable section where the stripped portion ends and the wire jacket begins shall be covered with heat shrinkable tubing. The drain wire length shall be kept to a minimum. The end point of the daisy chain configuration, at the last device, the shield/drain wire shall be cut and covered by heat shrinkable tubing. At connection points on the daisy chain configuration other than the origin or end shield/drain wires shall be connected via but-splice or soldered connection, so that the shield/drain wires are continuous throughout. Shield/drain wires shall not come into contact with any metal surface other than the points of termination.

G. Data Communications Cable Terminators: Each terminator shall be fabricated using 22/24 GA. Stranded lead wire soldered to the termination resistor leads. The lead wire shall be approximately 2 inches in length. The termination resistor and soldered connections shall be covered with heat shrinkable tubing. The termination resistors shall be 120 ohm resistors with 1% tolerance and ¼ watt minimum. A terminator is required, at the endpoints of the daisy chain configuration, on the data communications cable. One terminator shall be located at the point of origin which is the beginning of the data circuit. The other terminator shall be located at the last device in the data circuit /end of line.

H. 24 VOLT POWER WIRING: 2 Conductor, 16 AWG, stranded (19X29) wire for delivering low voltage power to 24 volt UCS connected devices. Plenum rated-jacket, 300 volt, polymer alloy insulation and maximum O.D. of 0.18 inches. Gray jacket with one black and one red-wire. West Penn part #25225B-or approved equal.

2.6 COMMUNICATING/ INTERFACING

A. Equipment described in this section shall interface to the existing InfoScan system using standard interface protocols as shown on contract drawings. Typical industry standard interfaces are Johnson N2, Modbus RTU, BACnet-MSTP and BACnet-IP.

B. Electrical Meter Requirements

1. Read Properties:
   a. KW*
   b. KW (demand)*
   c. KWH
   d. Amps*
   e. Volts*
   f. Neutral Amps*
   g. Power Factor*
   h. THD*
   i. KVA*
   j. KVAR*
   k. KVARHR
   l. Demand Reset
   m. Power Fail Alarm
   *Include Min/Max parameters
2. Write Properties
   a. Demand Period
   b. Number of Demand Periods
   c. Reset KWH
   d. Reset KVARHR
   e. Reset Min/Max Values

PART 3 - EXECUTION

3.1 GENERAL

A. All products shall be installed in accordance with manufacturer's instructions. Installation of control components shall be performed by qualified control and instrumentation specialists. Only penetrations in the bottom of enclosures shall be made unless otherwise specified on contract drawings.

3.2 SERVER

A. The contractor shall host the server function of the UCS system at the building locally. The local server will be utilized through all testing and check out phases, including commissioning.

B. Upon completion of commissioning activities, the contractor will turn over the programming and database information to the MSFC/BASSCO contractor and assist in integrating the software into the MSFC/BASSCO servers.

C. After the software transfer is completed, the system shall be tested per the requirements in paragraph 3.9.E.

3.3 AC POWER WIRING

A. The Contractor shall install 120 Volt AC power wiring for control system instrumentation if required by device. The breaker must be dedicated to the device and labeled. All work shall be performed in accordance with applicable sections of Division 26, "Electrical," unless otherwise specified. Contact the COR before performing any electrical panel modification.

B. The UCS control panel Uninterruptible Power Source (UPS) input voltage shall be supplied by dedicated 120 volt AC duplex receptacle.

C. 120 volt AC input power cord for field panels shall be of sufficient length to allow connection to either UPS output receptacle or 120 volt AC duplex receptacle dedicated for UPS input.

D. A power disconnect switch shall be provided at each VAV used in the control system and located on the high voltage side of the control transformer.

3.4 EQUIPMENT ACCESSIBILITY

A. Enclosures: Enclosures shall be installed in accordance with the National Electrical Code as a minimum standard. Doors shall not be obstructed and shall open a minimum of 90 degrees from its closed position.

B. Instrumentation: All control system instrumentation shall be installed such that each device is accessible and unobstructed to facilitate ease of maintenance. Examples of obstructed equipment typically include piping surrounding valve actuators and covers that protect electronic components in VAV applications.

C. Shelf for Uninterruptible Power Sources (UPS) shall be constructed of corrosion-resistant metal of sufficient gauge to support UPS weight without flexing with a 3/8-inch minimum lip around edge. Shelf shall be mounted beneath field panel and 6 inches minimum above finished floor.

3.5 VIBRATION ISOLATION

A. Controllers and other devices sensitive to vibration shall be isolated by location or utilizing shock absorbing mounting devices.

3.6 SEQUENCE OF OPERATION

A. The sequence of operation shall be as indicated on the design drawing(s). All changes to the Sequence of Operation shall be noted on the as-built drawings.

3.7 CONTROL SYSTEM DRAWINGS

A. At completion of the job, the Contractor shall furnish copies of as-built wiring diagrams, system schematics, and sequences of control. One (1) copy of each shall be enclosed in laminated plastic, suspended at each air handler and/or controlled system and inside each control panel, or as directed by the Contracting Officer's Technical Representative (COR).

B. Wiring diagrams shall show all instrumentation, interlocks and connection information required for controlling the specified equipment.

3.8 SYSTEM GRAPHICS

A. The controls contractor shall provide graphics to include dynamic point summary tables for like systems, schematics with dynamic points for all systems to be controlled, and a summary table for building information to I include all utility meters, pressures, outdoor conditions.

B. Before graphics are programmed and installed, a meeting shall be held with MSFC/BASSCO personnel and the COR. The meeting will coordinate between the existing UCS graphics and the new “to be programmed” graphics. This will ensure that graphics are consistent between the existing and new screens.

C. Building floor plans will be programmed in graphic format by MSFC and is not in this contract.

3.9 SYSTEM VERIFICATION AND STARTUP

A. Verification testing shall be performed in the presence of the Government Construction Management Inspector (or CA in the case of commissioned equipment) and shall be repeated, as necessary, until each system or control loop is successfully verified.

B. The Contractor shall have factory-authorized representatives perform system start-up and adjustment after acceptance of test plans.

C. The Contractor shall demonstrate to the Government through a system verification test that final calibrations and adjustments are accurate and each control loop operates as defined by the sequence of operation. All deficiencies shall be corrected prior to final acceptance. The Government Construction Management Inspector (or CA in the case of commissioned equipment) shall witness all verification tests.

D. The Controls Contractor shall perform a complete checkout and verification of the controls and instrumentation before total system commissioning begins. The Controls Contractor shall participate in the total integrated system commissioning.

E. After the software transfer from the local server to the MSFC/BASSCO server is completed, the system shall be retested per the following. 10% of each type of control loop shall be retested, checked, and compared with the trends from the local server function. If one control loop is found to not function in the same manner, the loop shall be reprogrammed and tuned to the correct function and 50% of each type of control loop shall be tested. If One control loop (out of the 50%) is found to not function in the same manner, the loop shall be reprogrammed and tuned to the correct function and 100% of all control loops shall be tested and any deficiencies corrected.

3.10 TRAINING

A. The Contractor shall provide 2 identical complete on-site instruction Session(s) for approximately 10 personnel. Each session shall consist of a minimum of 8 hours. Instructors shall be factory-authorized representatives. The government shall approve course content and format.

END OF SECTION 230923

SECTION 26 05 01 - ELECTRICAL TESTING

PART 1 GENERAL

1.1 This section covers the general and administrative requirements for testing of electrical systems, materials, and equipment.

A. The Contractor shall engage the services of a recognized independent testing firm for the purpose of performing inspections and tests as herein specified and in other Division 26 Sections. The Contractor shall submit the name and qualifications of the testing firm to the COR for approval within 30 days after Notice to Proceed.

B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

C. It is the purpose of these specifications to ensure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

D. The tests and inspections shall determine suitability for energization.

E. Refer to individual Division 26 sections for equipment and systems to be tested and detailed test requirements.

F. An energized work permit is required for any work where the equipment is not de-energized.

1.2 QUALITY ASSURANCE

A. Testing Firm

1. The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
2. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
3. The testing firm shall utilize technicians who are regularly employed by the firm for testing services.
4. The testing firm shall submit proof of the above qualifications for approval from the Engineer.

B. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked.
3. Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of 2 percent of the scale used.
4. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

C. Test Instrument Calibration

1. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

2. Instruments shall be calibrated in accordance with the following frequency schedule:

   a. Field Instruments: Analog, 6 months maximum; Digital, 12 months maximum
   b. Laboratory Instruments: 12 months
   c. Leased Specialty Equipment: 12 months where accuracy is guaranteed.

3. Dated calibration labels shall be visible on all test equipment.
4. Records, which show date and results of instruments calibrated or tested, must be included in the test report.
5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

1.3 DIVISION OF RESPONSIBILITY

A. The Contractor shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The Contractor shall supply electrical power to each test site. The testing firm shall specify the specific power requirements.

C. The Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The Contractor shall provide and submit for approval a short-circuit analysis and coordination study prior to completion of testing. The Contractor shall provide a complete set of electrical plans, specifications and change orders, as well as pertinent shop drawings, and manufacturer's instructions to the testing firm prior to commencement of testing. Coordination study shall include required set-points for coordinated devices.

E. The testing firm shall notify the COR two weeks prior to commencement of any testing.

F. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported. The COR will direct the Contractor to repair or replace the defective materials or equipment depending upon the effect.

G. The testing firm shall maintain a written record of all tests and shall assemble and certify a final test report.

1.4 SUBMITTALS

A. Submittals for approval.

1. Submit qualifications of testing firm for COR approval.
2. Submit short circuit analysis and coordination study.

B. Submittals for project closeout.

1. Test Reports: The test reports shall include the following:

a. Summary of project
b. Description of equipment tested
c. Description of test and identification
d. Test results
e. Analysis and recommendations and remedial actions taken.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 The Contractor shall perform all tests required by individual Division 26 sections.

3.2 MOTOR TESTS: The independent testing firm shall perform and document the following inspections and tests on motors:

A. Visual and Mechanical Inspection

1. Compare equipment nameplate data with approved Shop Drawings.
2. Inspect physical and mechanical condition.
3. Inspect for correct anchorage, mounting, grounding, connection, and lubrication.
4. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 10.12.
5. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.

3.3 THERMOGRAPHIC SURVEY: The independent testing firm shall perform and document the baseline thermal operating conditions of all panels and electrical connections as described herein.

A. Visual and Mechanical Inspection

1. Inspect physical, electrical and mechanical condition.
2. Remove all necessary covers prior to thermographic inspection.

B. Provide report including the following:

1. Baseline conditions.
2. Discrepancies.
3. Temperature difference between the area of concern and the reference area.
4. Cause of temperature difference.
5. Areas inspected. Identify inaccessible or unobservable areas and/or equipment.
6. Identify load conditions at time of inspection.
7. Provide photographs and thermograms of the baseline conditions and of all deficiencies.

C. Test Parameters

1. Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 degree C at 30 degrees C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
3. Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to NFPA 70B-1998, Section 18-17 (Infrared Inspection).

D. Test Results

1. Temperatures differences of 1 degree C to 3 degrees C indicate possible deficiency and shall be referred to the COR for direction to repair.
2. Temperature differences over 4 degrees C shall be repaired by the Contractor and retested by the testing firm.

END OF SECTION 260501

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-THWN-2. Conductors shall be #12 CU minimum.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

B. Splices shall be mechanical type made out of copper.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION

A. Service Entrance: Type THHN-THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN -THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN -THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN -THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN -THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN -THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. If a panel or equipment needs to be relocated and circuits extended to a new location, contractor shall utilize terminal strips in the existing device with approved cover. Terminal strips will be labeled as to what circuit they are fed form.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

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

B. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

C. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017820 "Operation and Maintenance Data," include the following:

a. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Recommended testing intervals of once every three years.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Bus-Bar Connectors: Mechanical type

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify COR promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC scheduled in NECA 1, where its Table 1 lists maximum spacing less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be twice the weight of supported components.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Existing Concrete: Expansion anchor fasteners.
2. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Spring-tension clamps.
3. To Light Steel: Sheet metal screws.
4. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

C. PVC: Polyvinyl Chloride

D. EMT: Electrical Metallic Tubing

E. FMC: Flexible Metallic Conduit

F. LFMC: Liquid Tight Flexible Metallic Conduit

1.4 SUBMITTALS

A. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. IMC: Comply with ANSI C80.6 and UL 1242.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360. Seal tight type UA conduit.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Mechanical Type
c. Insulated throat

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Flanged-and-gasketed type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

G. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).

H. Gangable boxes are allowed.

I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

J. Cabinets:

1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC concrete encased.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.

C. Minimum Raceway Size 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use Mechanical Type fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of four 90-degree bends in any conduit run. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Q. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

U. Expansion-Joint Fittings:
1. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Y. Locate boxes so that cover or plate will not span different building finishes.

Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 26 05 38 - PULL AND JUNCTION BOXES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide pull and junction boxes of appropriate size and depth or as indicated on the drawings and as specified hereinafter.

1.2 SUBMITTALS

A. Submittals of products furnished under this section are not required.

PART 2 PRODUCTS

2.1 MATERIALS

A. For interior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, 3/4 inch flanges, screw covers, etc.

B. For exterior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, 3/4 inch flanges, bolted covers metal with full gaskets forming a completely raintight assembly.

C. For exterior work in graded areas outside the building, provide heavy duty sidewalk junction boxes externally flanged for flush mounting. Covers to be metal, fully gasketed, watertight and secured with plated screws or bolts.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide junction boxes as shown on drawings and otherwise where required, sized according to number of conductors in box or type of service to be provided. Minimum junction box size 4 inches square and 2-1/8 inches deep. Provide screw covers for junction boxes.

B. Use minimum 16 gauge steel for pull boxes and provide with screw cover.

C. Install boxes in conduit runs wherever necessary to avoid long runs or excessive bends. Do not exceed 100 foot runs, or three 90 degree bends, without pull boxes.

D. Rigidly secure boxes to walls or ceilings. Use of conduit as a support is not acceptable.

E. Install boxes in accessible locations. Size boxes in accordance with Articles No. 312 and No. 314 of the latest edition of the National Electrical Code.

F. Install boxes so that the covers will be accessible at all times.

G. Do not install pull or junction boxes for joint use of line voltage and signal or low voltage controls unless all conductors are insulated for the highest voltage being used in the same box. Emergency system and normal system circuits shall not be routed through a common pull or junction box.

H. Contractor to spot paint all boxes inside and out per the following color code:
   1. Green: Emergency Power/Equipment Branch
   2. Red: Fire Alarm System

END OF SECTION 26 05 38

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceways.
2. Identification for power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Miscellaneous identification products.
7. Wiring device identification labels.

1.3 QUALITY ASSURANCE

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ASME A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600V and less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

C. Colors for Raceways Carrying Circuits at More Than 600V:

1. Black letters on an orange field.
2. Legend: “DANGER CONCEALED HIGH VOLTAGE WIRING.”

D. Vinyl Labels for Raceways Carrying Circuits at 600V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600V and less:

1. Black letters on an orange field.

C. Colors for Raceways Carrying Circuits at More Than 600V:

1. Black letters on an orange field.
2. Legend: “DANGER HIGH VOLTAGE WIRING.”

D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F Comply with UL 224.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted or write-on, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4 FLOOR MARKING TAPE

A. 2-inch-wide, 5-mil pressure sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape materials and ink shall be chemically inert and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Marking Tape Requirements:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 7 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 35 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 300 lbf and 12,500 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.9 WIRING DEVICE IDENTIFICATION LABELS

A. 1/2-inch clear permanent polyester tape for industrial purposes.

B. 1/4-inch black letters on clear tape with circuit numbers.

2.10 Provide arc flash labels per section 260574.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels with mechanical fasteners appropriate to the location and substrate.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use

multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways, Armored and Metal-Clad Cables More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.

B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.

C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral: White.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral: Gray.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where 2 lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Switchgear.
d. Switchboards.
e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
f. Enclosed switches.
g. Enclosed circuit breakers.
h. Enclosed controllers.
i. Push-button stations.
j. Monitoring and control equipment.
k. UPS equipment.
l. Wiring device cover plates.

L. Wiring Devices: Make and install a polyester tape label with branch circuit number on each wiring device.

M. Junction Boxes:

1. Exposed – Provide a tape label with circuit number(s).
2. Concealed – Permanent black marker on blank cover with circuit number(s).

END OF SECTION 260553

SECTION 260574 – STANDARD SPECIFICATION FOR ARC FLASH HAZARD ANALYSIS STUDY

PART 1 - GENERAL

1.1 SCOPE

A. All Marshall Space Flight Center (MSFC) electrical power distribution systems that are planned, designed, or installed as part of a Construction of Facilities (CoF) project, O & M equipment replacement task order, or local design and construction project shall require an Arc Flash Hazard Analysis. This analysis shall include a Short Circuit Analysis and a Protective Device Coordination Study. The Arc Flash Hazard Analysis shall be provided per the requirements set forth in the current issue of NFPA 70E, Standard for Electrical Safety in the Workplace, at the time of construction document development. The Arc Flash Hazard Analysis shall be performed according to the IEEE Standard 1584, IEEE Guide for Performing Arc-Flash Calculations. The use of NFPA 70E tables is not allowed to determine Arc Flash Hazard Categories.

B. The Arc Flash Hazard Analysis shall include all new distribution equipment supplied by the contractor under this contract as well as all directly affected, existing distribution equipment including switchgear, switchboards, panel boards, motor control centers, Power Distribution Units (PDUs), Uninterruptible Power Supplies (UPSs), Automatic Transfer Switches (ATSs), and transformers (utility service and dry type) as listed in 70E.

C. The Arc Flash Hazard Analysis shall require the creation of a complete set of single line drawings if up-to-date drawings do not currently exist. If additional service entrances or standby power generation systems exist, the Arc Flash Analysis shall reflect the energies available from all sources separately and shall list the maximum available energy on the Arc Flash Label.

D. The Arc Flash Hazard Analysis shall include the creation of Arc Flash Hazard labels which shall serve as a guide to assist electricians and others in the selection of proper personal protective equipment (PPE) when working around exposed and energized conductors.

E. The size and scope of the Arc Flash Hazard Analysis shall be determined by the MSFC Contracting Officer’s Representative (COR) and include all electrical distribution equipment or systems as identified by the MSFC COR.

1.2 REFERENCES

A. NFPA 70, latest edition – National Electrical Code

B. NFPA 70E, latest edition – Standard for Electrical Safety in the Workplace

C. IEEE 1584, latest edition - Guide for Performing Arc-Flash Hazard Calculations

D. IEEE 141, latest edition – IEEE Recommended Practice for Electric Power Distribution for Industrial Plants

E. IEEE 242, latest edition – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

1.3 SUBMITTALS

A. Submit one (1) electronic copy on CD and one (1) bound copy of the Arc Flash Hazard Analysis report after equipment installation. Bound copy shall be a minimum of 8.5” x 11” standard paper. The report shall include the following sections as a minimum and shall contain a professional electrical engineer’s seal, signature and date of submission at the beginning of each section:

1. Executive Summary including Introduction and Scope of Work.
2. Short-Circuit Analysis methodology, results and recommendations.
3. Protective Device Coordination methodology, analysis, results and recommendations including a recommended protective device settings table. Also, include the time-current coordination curves and recommendations detailing any possible issues and the recommended solutions.
4. Arc Flash Hazard methodology, analysis, results and recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protective Equipment levels, etc. as detailed throughout this specification.
5. Arc Flash Labeling section showing types of labels to be provided. Section shall contain descriptive information as well as typical label images and labeling methodology.
6. Computer generated, one-line system diagrams clearly identifying individual equipment buses, bus or node numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus or node location, device numbers used in the time-current coordination analysis, and other information pertinent to the Arc Flash Hazard Analysis. One-line diagrams shall be printed at 11” x 17” size and shall be neatly folded to match the size of the other documents in the report.

B. Submit one (1) electronic copy of all one-line diagrams in both .dwg and layered .pdf format.

C. Submit one (1) copy of all SKM project data base files and libraries in electronic format.

D. Submit a list detailing all Time Current Curve (TCC) files added to the library.

E. Submit one (1) actual size sample of a proposed Arc Flash Label complete with all pertinent information listed in section 3.4 C.

1.4 QUALIFICATIONS

A. The Arc Flash Hazard Analysis along with the accompanying Short Circuit Analysis and Device Coordination Study shall be conducted under the responsible charge and approval of a registered professional electrical engineer skilled in performing and interpreting the power system studies. The professional electrical engineer shall have experience in other projects of the same size and complexity accomplished in good standing for the last five years. The documentation of qualifications and experience shall be provided when requested by the MSFC COR.

B. The technician responsible for data collection in existing panels shall be qualified as defined in NFPA 70E. The technician shall have completed an 8-hour instructor-led Electrical Safety Training Course. The course shall include NFPA 70E training which includes the selection and use of personal protective equipment (PPE). The documentation of qualification shall be provided, when requested by the MSFC COR, detailing all necessary information and dates of all training.

PART 2 - PRODUCTS

2.1 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program, latest version at the time of award. No substitutions will be accepted. Use of NFPA 70E tables to determine hazard classification is not acceptable.

PART 3 - EXECUTION

3.1 FIELD DATA

A. Field data collection shall be performed by a qualified technician, as defined by section 1.4.B of this document.

B. The Technician shall visually inspect the equipment ratings, conductor ratings and overcurrent device data by removing panel board covers and doors where required to document the necessary data used in the analysis. For verification of existing data, the Technician can perform these inspections with the equipment energized provided the labeled incident energy values are less than 40cal/cm², an energized work permit has been acquired through the safety department, and proper PPE is worn at all times. Greater incident energy values or unusual site conditions shall require the equipment to be shut down and the power de-energized so the equipment can be safely inspected.

C. MSFC shall provide qualified personnel, when necessary, to show the technician the equipment location and to open all equipment doors, locks, etc. necessary to collect nameplate data.

D. Data collection shall begin downstream of the utility service and continue through the MSFC electrical distribution system as defined under scope of work.

E. The MSFC COR shall provide the utility service minimum, normal, and maximum operating voltage levels, three-phase short circuit MVA, primary power line sizes, utility transformer fuse sizes, and other upstream information required to complete the study.

3.2 ARC FLASH HAZARD ANALYSIS

A. The Arc Flash Hazard Analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E. The Arc Flash Hazard Analysis must be performed after the Short Circuit Analysis and the Protective Device Coordination Study are completed.

B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panel boards, transformers, busway, etc.,) where work could be performed on energized parts.

C. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices shall be retrieved from the short circuit and coordination study model.

E. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

F. When performing incident energy calculations on the line side of a main breaker, the line side and load side contributions must be included in the fault calculation.

G. The Arc Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment.

H. All one-line diagrams resulting from the Arc Flash Analysis shall be formatted in "E" size (40 inches by 28 inches) and shall be drawn and lettered to permit reproduction size (11" x 17"). Lettering shall not be less than 1/8" in height on the E size sheet. This will allow all text to be legible when printed at size (11" x 17"). The government will provide the contractor with a computer generated border sheet and appropriate drawing number and title.

3.3 FIELD ADJUSTMENT

A. Relay and protective device settings shall be adjusted according to the recommended settings table provided in the approved coordination study.

B. Field adjustments shall be completed based on project specifications.

3.4 ARC FLASH LABELS

A. The Arc Flash Labels shall measure 4.0 in. H x 6.0 in. W and be a thermal transfer type label of high adhesion polyester.

B. The labels shall be designed according to the following standards:

1. UL969 – Standard for Marking and Labeling Systems
2. ANSI Z535.4 – Product Safety Signs and Labels
3. NFPA 70 (National Electric Code) – Article 110.16
4. NFPA 70E 2015 edition.

C. The label shall include the following information:

1. Flash Hazard Boundary (inches)
2. Arc Flash incident energy at the working distance (calories/cm2) (inches)
3. Hazard Category
4. Protective Glove Class
5. Shock Hazard Voltage
6. Limited Approach distance (inches)
7. Restricted Approach distance (inches)
8. Prohibited Approach distance (inches)
9. Date of analysis
10. Equipment ID (Maximo number)

D. The labels shall be printed by a thermal transfer type printer, with no field markings.

E. Labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:

1. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.
2. Floor Standing Equipment – Arc Flash Labels shall be provided on the front of the main section. Equipment requiring rear or side access shall have general use safety labels provided on each individual section. Equipment containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
3. Wall Mounted Equipment – Labels shall be provided on the front cover.

F. The labels shall be field installed by the electrical contractor, in accordance with this document, on all equipment identified in the project scope.

END OF SECTION 260574

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

D. Field Quality Control field test reports.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Test and inspect transformers according to IEEE C57.12.91.

D. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.2 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

E. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

F. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.3 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

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

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail metering provisions.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
9. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017820 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

E. Warranty from section 1.8.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NECA 400.

1.6 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify COR no fewer than 3 weeks in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without COR written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

B. Front- and Side-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Front- and Rear-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Fixed and individually compartmented mounted.
3. Sections Rear aligned.

D. Nominal System Voltage: 480Y/277 V and 208Y/120 V.

E. Main-Bus Continuous: 1200, 800 and 600 A.

F. Indoor Enclosures: Steel, NEMA 250, Type 1.

G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

H. Barriers: Between adjacent switchboard sections.

I. Insulation and isolation for main and vertical buses of feeder sections.

J. Cubical Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: Transformer, factory installed in switchboard.

K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

M. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

N. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with tin-plated aluminum or copper feeder circuit-breaker line connections.
2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
3. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

O. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

P. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted mechanical lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. Six-digit, transient-event counter set to totalize transient surges.

B. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.

C. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

D. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277V or 120Y/208V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 or 400 V for 208Y/120.
2. Line to Ground: 800 V for 480Y/277 or 400 V for 208Y/120.
3. Neutral to Ground: 800 V for 480Y/277 or 400 V for 208Y/120.

E. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V or 1000 V for 240 V.
2. Line to Ground: 1500 V for 480 V or 800 V for 240 V.

F. See specification section 264313 “Surge Protection”

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    f. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system.
    g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    i. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

B. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Standard function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time time adjustments.
    c. Ground-fault pickup level, time delay, and I^2t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
7. Control Voltage: 120-V ac.

C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.

1. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
2. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.

   a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.

3. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
4. Service-Rated Switches: Labeled for use as service equipment.
5. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.

   a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
   c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
   d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).

6. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

E. Fuses are specified in Section 262813 "Fuses."

2.4 CONTROL POWER

A. Control Circuits: 120-V ac, supplied from remote branch circuit.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.6 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.

B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

C. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

D. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NECA 400.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness, and concrete base shall extend a minimum of 3” past the footprint of the furnished equipment.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install spare-fuse cabinet.

H. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Instruments and Equipment:

      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip as specified in Section 260574 "Arc Flash Hazard Analysis and Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017820 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

F. Warranty from Section 1.9

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify COR no fewer than 21 days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without COR's written permission.
3. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface mounted cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

    a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Same finish as panels and trim.
    c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Incoming Mains Location: Top and bottom.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

F. Branch Overcurrent Protective Devices: Fused switches.

G. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 LOAD CENTERS

A. Load Centers: Comply with UL 67.

B. Mains: Circuit breaker.

C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

D. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at **75** percent of rated voltage.
f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
g. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
j. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
k. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
l. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
m. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260574 "Arc Flash Hazard Analysis and Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262500 - ENCLOSED BUS ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Feeder-bus assemblies.
2. Plug-in bus assemblies.
3. Bus plug-in devices.

1.3 DEFINITIONS

A. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Shop Drawings: For each type of bus assembly and plug-in device.

1. Show fabrication and installation details for enclosed bus assemblies. Include plans, elevations, and sections of components. Designate components and accessories, including clamps, brackets, hanger rods, connectors, straight lengths, and fittings.
2. Show fittings, materials, fabrication, and installation methods for listed fire-stop barriers.
3. Indicate required clearances, method of field assembly, and location and size of each field connection.
4. Detail connections to switchgear, switchboards, transformers, and panelboards.
5. Wiring Diagrams: Power wiring.

B. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements. Show the following:

1. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
2. Clearances for access above and to the side of enclosed bus assemblies.
3. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
4. Support locations, type of support, and weight on each support.

C. Product Certificates: For each type of enclosed bus assembly, signed by product manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For enclosed bus assemblies to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed bus assemblies and plug-in devices through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA BU 1, "Busways."

D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle enclosed bus assemblies according to NEMA BU 1.1, "General Instructions for Proper Handling, Installation, Operation and Maintenance of Busway Rated 600 Volts or Less."

1.7 PROJECT CONDITIONS

A. Derate enclosed bus assemblies for continuous operation at indicated ampere ratings for ambient temperature not exceeding 122 deg F (50 deg C).

1.8 COORDINATION

A. Coordinate layout and installation of enclosed bus assemblies and suspension system with other construction that penetrates ceilings or floors or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ENCLOSED BUS ASSEMBLIES

A. Feeder-Bus Assemblies: NEMA BU 1, low-impedance bus assemblies in nonventilated housing; single-bolt joints; ratings as indicated.
   1. Voltage: 120/208 and 277/480V; 3 phase; 100 percent neutral capacity.
   2. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
   3. Bus Materials: Current-carrying copper conductors, fully insulated with Class 130C insulation except at joints; plated surface at joints.
   4. Ground:
      a. 50 percent capacity internal bus bars of material matching bus material.

5. Enclosure: Steel with manufacturer's standard finish.
6. Fittings and Accessories: Manufacturer's standard.
7. Mounting: Arranged flat, edgewise, or vertically without derating.

B. Plug-in Bus Assemblies: NEMA BU 1, low-impedance bus assemblies in nonventilated housing; single-bolt joints; ratings as indicated.
1. Voltage: 120/208 and 277/480 V; 3 phase; 100 percent neutral capacity.
2. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
3. Bus Materials: Current-carrying copper conductors, fully insulated with Class 130C insulation except at stabs and joints; plated surface at stabs and joints.
4. Ground:
a. 50 percent capacity internal bus bar of material matching bus material.

5. Enclosure: Steel, with manufacturer's standard finish, plug-in openings 24 inches (610 mm) o.c., and hinged covers over unused openings.
6. Fittings and Accessories: Manufacturer's standard.
7. Mounting: Arranged flat, edgewise, or vertically without derating.

2.2 PLUG-IN DEVICES

A. Fusible Switches: NEMA KS 1, heavy duty; with J-type fuse clips to accommodate specified fuses; hookstick-operated handle, lockable with two padlocks, and interlocked with cover in closed position. See Section 262813 "Fuses" for fuses and fuse installation requirements.

B. Molded-Case Circuit Breakers: NEMA AB 1; hookstick-operated handle, lockable with two padlocks, and interlocked with cover in closed position.

C. TVSS: NEMA 250, Type 1 enclosure with NEMA KS 1, fusible, disconnect switch and external handle to isolate TVSS from busway. TVSS product and installation requirements are specified in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support bus assemblies independent of supports for other elements such as equipment enclosures at connections to panelboards and switchboards, pipes, conduits, ceilings, and ducts.
1. Design each fastener and support to carry 200 lb (90 kg) or 4 times the weight of bus assembly, whichever is greater.
2. Support bus assembly to prevent twisting from eccentric loading.
3. Support bus assembly with not less than 3/8-inch (10-mm) steel rods. Install side bracing to prevent swaying or movement of bus assembly. Modify supports after completion to eliminate strains and stresses on bus bars and housings.
4. Fasten supports securely to building structure according to Section 260529 "Hangers and Supports for Electrical Systems."

B. Install expansion fittings at locations where bus assemblies cross building expansion joints. Install at other locations so distance between expansion fittings does not exceed manufacturer's recommended distance between fittings.

C. Coordinate bus-assembly terminations to equipment enclosures to ensure proper phasing, connection, and closure.

D. Tighten bus-assembly joints with torque wrench or similar tool recommended by bus-assembly manufacturer. Tighten joints again after bus assemblies have been energized for 30 days.

E. Install bus-assembly, plug-in units. Support connecting conduit independent of plug-in unit.

3.2 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to provide dimensions, inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests and inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of bus assembly including joints and plug-in units.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform 2 follow-up infrared scans of bus assembly, one at 4 months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying bus assembly checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.4 ADJUSTING

A. Set field-adjustable, circuit-breaker trip ranges as indicated.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.6 PROTECTION

A. Provide final protection to ensure that moisture does not enter bus assembly.

END OF SECTION 262500

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes equipment for electricity metering by Owner.

1.3 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

B. PC: Personal computer.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Do not proceed with interruption of electrical service without COR written permission.

1.8 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

A. General Requirements for Owner's Meters:

1. Comply with UL 1244.
2. Enclosure: NEMA 250, Type 3R minimum, with hasp for padlocking or sealing.
3. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
4. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
5. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.

   a. Type: solid core.

6. Current-Transformer Cabinet: Shall be a separate enclosure with main power disconnect per N.E.C. and shall be listed or recommended by metering equipment manufacturer for use with sensors indicated.
7. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.

B. Kilowatt-hour Meter: Electronic single and three phase meters, measuring electricity used.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.

2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.

C. Kilowatt-hour/Demand Meter: Electronic single and three phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours, current time and date, current demand, historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.
3. Basis of design: Siemens PAC 4200 with Modbus interface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262713

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Plug fuses rated 125-V ac and less for use in plug-fuse-type fuseholders.
2. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA FU 1 for cartridge fuses.

C. Comply with NFPA 70.

D. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.2 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Plug Fuses:

1. Motor Branch Circuits: Type S, dual element time delay.
2. Other Branch Circuits: Type S, dual-element time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Field quality control testing submittal.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify NASA–no fewer than 21 days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without COR’s written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, 240 or 600 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Type HD, Heavy Duty, Double Throw, 240 or 600 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, 240 or 600 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Type HD, Heavy Duty, Double Throw, 240 or 600 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Hookstick Handle: Allows use of a hookstick to operate the handle.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

A. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240 or 600 V ac, 30, 60 or 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

B. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240 or 600 V ac, 30, 60 or 100 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

B. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

C. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time time adjustments.
3. Ground-fault pickup level, time delay, and I^2t response.

E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

F. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.5 MOLDED-CASE SWITCHES

A. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

B. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 12.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260574 "Arc Flash Hazard Analysis and Overcurrent Protective Device Coordination Study."

END OF SECTION 262816

SECTION 262913 – MOTOR STARTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.

e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.

f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.

D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable

materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify COR no fewer than 21 days in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical systems without COR’s written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Configuration: Nonreversing, Reversing.
2. Surface mounting.
3. Green pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Configuration: Nonreversing, Reversing.
2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
3. Surface mounting.
4. Green pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Configuration: Nonreversing, Reversing.
2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
3. Surface mounting.
4. Green pilot light.
5. N.O. auxiliary contact.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Configuration: Nonreversing, Reversing.
2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Circuits: 120-V ac; with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

5. Melting Alloy Overload Relays:

   a. Inverse-time-current characteristic.
   b. Class 10 tripping characteristic.
   c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

6. Bimetallic Overload Relays:

   a. Inverse-time-current characteristic.
   b. Class 10 tripping characteristic.
   c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
   d. Ambient compensated.
   e. Automatic resetting.

7. Solid-State Overload Relay:

    a. Switch or dial selectable for motor running overload protection.
    b. Sensors in each phase.
    c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    e. Analog communication module.

8. N.C., isolated overload alarm contact.
9. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Fusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
3. Nonfusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

4. MCP Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    d. N.O. alarm contact that operates only when MCP has tripped.
    e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

5. MCCB Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
e. N.O. alarm contact that operates only when MCCB has tripped.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil tight type.

a. Push Buttons: Covered types; maintained as indicated.
b. Pilot Lights: LED types; colors as indicated**;** push to test.
c. Selector Switches: Rotary type.

2. Elapsed Time Meters: Heavy duty with digital readout in hours; nonresettable.
3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. One N.C. and one N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R, Type 4X and Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

H. Cover gaskets for Type 1 enclosures.

I. Terminals for connecting power factor correction capacitors to the load side of overload relays.

J. Spare control wiring terminal blocks, quantity as indicated; unwired.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch enclosed controller.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's central control system.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify COR before starting the motor(s).
5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cool down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify COR before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260574 "Arc Flash Hazard Analysis and Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

END OF SECTION 262913

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes lightning protection for structure.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
3. Plans showing dimensioned as-built locations of grounding features, including Ground Rods and Ground Loop Conductor.

C. System Certification

D. Qualification Data: For qualified Installer and manufacturer. Include certificate as defined in 1.5.A.

E. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

F. Field quality-control reports.

G. Letter stating installation complies with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.5 COORDINATION

A. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

B. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class II, aluminum unless otherwise indicated.

1. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.
2. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: Copper-clad steel, sectional type; 3/4 inch (19 mm) in diameter by 10 feet (3 m) long.

F. Heavy-Duty, Stack-Mounted, Lightning Protection Components: Solid copper.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

G. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

H. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches (600 mm) from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.

I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify COR at least 48 hours in advance of inspection before concealing lightning protection components.

B. Inspection:
   1. UL Inspection: Meet requirements to obtain a UL Master Label for system.
   2. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 264113

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

B. Field quality-control reports.

C. Maintenance Data: For SPDs to include in maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

A. SPDs: Comply with UL 1449, Type 1.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1

1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. Indicator light display for protection status.
d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
e. Surge counter.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 240kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V and 1200 V for 208Y/120 V.
3. Line to Line: 2000 V for 480Y/277 V and 1000 V for 208Y/120 V.

E. SCCR: Equal or exceed 100 kA.

F. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 160 KA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

C. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
3. Neutral to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
4. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V

D. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

E. SCCR: Equal or exceed 100 kA.

F. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

2.5 CONDUCTORS AND CABLES

A. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Qualification Data: Provide photometric data for luminaires.

C. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

C. Emergency Battery/Driver shall be field replaceable or as a manufacturer option, fixture replacement is acceptable in lieu of Battery/Driver replacement.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. Bulb shape complying with ANSI C79.1.

F. Lamp base complying with ANSI C81.61 or IEC 60061-1.

G. CRI of minimum 80. CCT of 4100 K.

H. Rated lamp life of 50,000 hours.

I. Internal driver.

J. Nominal Operating Voltage: 120 V ac or 277 V ac to match existing luminaire voltage.

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

K. Housings:

1. Extruded-aluminum housing and heat sink.
2. White powder-coat finish.

2.2 HIGHBAY, LINEAR

A. Minimum 10,000 lumens. Minimum allowable efficacy of 80 lumens per watt.

2.3 RECESSED LINEAR

A. Minimum 3,000 lumens. Minimum allowable efficacy of 85 lumens per watt.

B. Integral junction box with conduit fittings.

2.4 STRIP LIGHT

A. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

B. Integral junction box with conduit fittings.

2.5 SURFACE MOUNT, LINEAR

A. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

B. Integral junction box with conduit fittings.

2.6 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers:

1. Prismatic acrylic clear, UV-stabilized.
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. White powder-coat finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.7 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.8 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall support a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with four 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.

2. Ceiling mount with four-point pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
3. Ceiling mount with hook mount.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265619 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
9. Product Warranty.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

1.5 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 5 year(s) from date of Substantial Completion.

3. Emergency Battery/Driver shall be field replaceable or as a manufacturer option, fixture replacement is acceptable in lieu of Battery/Driver replacement.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61 or IEC 60061-1.

F. Bulb shape complying with ANSI C79.1.

G. CRI of minimum 80. CCT of 4100 K.

H. L70 lamp life of 50,000 hours.

I. Internal driver.

J. Nominal Operating Voltage: 120 V ac or 277 V ac.

K. In-line Fusing: On the primary for each luminaire.

L. Lamp Rating: Lamp marked for outdoor use.

M. Source Limitations: Obtain luminaires from single source from a single manufacturer.

N. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE TYPES

A. Area and Site:
1. Luminaire Shape: Square.
2. Mounting: Building.
3. Luminaire-Mounting Height: To match existing.
4. Distribution: Type III.

5. Diffusers and Globes: Prismatic glass.
6. Housings:

    a. Extruded-aluminum housing and heat sink.
    b. Bronze powder-coat finish.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

    a. "USE ONLY" and include specific lamp type.
    b. Lamp diameter, shape, size, wattage and coating.
    c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

    a. Color: Medium bronze.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Install lamps in each luminaire.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Wiring Method: Install cables in raceways. Conceal raceways and cables.

E. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

F. Coordinate layout and installation of luminaires with other construction.

G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

   a. IES LM-5.
   b. IES LM-50.
   c. IES LM-52.
   d. IES LM-64.
   e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

3. Verify operation of photoelectric controls.

C. Luminaire will be considered defective if it does not pass tests and inspections.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fire alarm wire and cable.
   2. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

1.4 SUBMITTALS

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

B. Source quality-control reports.

C. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

   1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.3 IDENTIFICATION PRODUCTS

A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.

1. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. General Requirements for Cabling:
1. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
2. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
3. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

3.4 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal raceway according to Section 260533 "Raceways and Boxes for Electrical Systems."

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 CONNECTIONS

A. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

3.8 GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 280513

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. Notification appliances.
4. Addressable interface device.
5. Digital alarm communicator transmitter.
6. Network communications.

B. Related Requirements:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.

10. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
12. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

C. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

D. Qualification Data: For Installer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017820 "Operation and Maintenance Data," include the following:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
g. Record copy of site-specific software.
h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

    1) Equipment tested.
    2) Frequency of testing of installed components.
    3) Frequency of inspection of installed components.
    4) Requirements and recommendations related to results of maintenance.
    5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.
j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

G. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.6 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify COR no fewer than 21 days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without COR's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.7 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational. Corrdinate the additional fire devices and fire alarm control panel change out with the COR.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.

5. Air-sampling smoke-detection system (VESDA).

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Activate alarm system.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate emergency lighting control.
9. Activate emergency shutoffs for gas and fuel supplies.
10. Record events in the system memory.
11. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Alert and Action signals of air-sampling detector system.
2. User disabling of zones or individual devices.
3. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.
5. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    c. The FACP shall be listed for connection to a central-station signaling system service.
    d. The FACP shall be compatible with the existing campus system.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 1.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

    a. One dedicated RS 485 port for remote station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
    c. One RS 232 port for PC configuration.
    d. One RS 232 port for VESDA HLI connection.
    e. One RS 232 port for voice evacuation interface.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.

3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating utilizing the highest candela setting on the visual devices.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 PREACTION SYSTEM

A. Initiate Presignal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device connected as part of a preaction system shall be annunciated at the FACP only, without activation of the general evacuation alarm.

2.5 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show

visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.
4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

B. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit

2. Detector address shall identify the detector's location within the system and its sensitivity setting.

3. The fire-alarm control unit operator shall manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.
7. Notify COR if any duct smoke detectors are not working to get direction on how to proceed.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate.

1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

D. Voice/Tone Notification Appliances:

1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
3. High-Range Units: Rated 2 to 15 W.
4. Low-Range Units: Rated 1 to 2 W.
5. Mounting: surface mounted and bidirectional.
6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

E. Exit Marking Audible Notification Appliance:

1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
2. Provide exit marking audible notification appliances at the entrance to all building exits.
3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.8 GRAPHIC ANNUNCIATOR

A. Graphic Annunciator Panel: Mounted in an aluminum frame with nonglare, minimum 3/16-inch- (4.76-mm-) thick, clear acrylic cover over graphic representation of the facility. Detector locations shall be represented by red LED lamps. Normal system operation shall be indicated by a lighted, green LED. Trouble and supervisory alarms shall be represented by an amber LED.

1. Comply with UL 864.
2. Operating voltage shall be 24-V dc provided by a local 24-V power supply provided with the annunciator.
3. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and a lamp test switch.
4. Surface mounted in a NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
5. Graphic representation of the facility shall be a CAD drawing and each detector shall be represented by an LED in its actual location. CAD drawing shall be at 1/8-inch per foot (10-mm per meter) scale or larger.
6. The LED representing a detector shall flash two times per second while detector is an alarm.

2.9 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically connect to NASA Security through the Simplex Network Communication System. When contact is made with NASA Security, signals shall be transmitted. If service is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal. Transmitter shall automatically report service restoration to the NASA Security through the Simplex Network Communication System.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using Simplex Network Communication System for connection to Existing NASA network loop.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.

3. Expand, modify, and supplement existing control monitoring equipment as necessary to extend existing control monitoring functions to the new points. New components shall merge with existing configuration without degrading the performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

D. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

E. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Alarm-initiating connection to activate emergency lighting control.
2. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
3. Data communication circuits for connection to building management system.
4. Data communication circuits for connection to mass notification system.
5. Supervisory connections at fire-extinguisher locations.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by COR representative.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow COR to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 283111