

SPECIFICATIONS

1.0 Specification PROJECT TABLE OF CONTENTS

Revised the PROJECT TABLE OF CONTENTS to include the following:

- Add the following new Sections:
DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 21 16 MINERAL FIBER BLANKET INSULATION

DIVISION 48 – ELECTRICAL POWER GENERATION

48 01 00 COMMISSIONING OF PHOTOVOLTAIC SYSTEM
48 14 00 SOLAR PHOTOVOLTAIC MEMBRANE ROOFING SYSTEM

PROJECT TABLE OF CONTENTS, pages 1 through 5, incorporating these revisions is attached herewith.

2.0 Specification Section 01 33 00 – SUBMITTAL PROCEDURES

Revised specification Section 01 33 00 – SUBMITTAL PROCEDURES to include the following:

- Added Submittal Register for new Sections 07 21 16 and 48 14 00.
(Note that there is no Submittal Register data for new Section 48 01 00.)

Submittal Register, one page, for Sections 07 21 16 and 48 14 00 is attached herewith.

3.0 Specification Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

Revised specification Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS to include the following:

- Under 1.1 DESCRIPTION, item a. Revised the second sentence to add the words “solar photovoltaic”; revised sentence reads:

“This section supplements other commissioning information and applies to mechanical, plumbing, solar photovoltaic, and electrical systems.”
- Under 1.1 DESCRIPTION, item c. Added new item (4) which reads:

“(4) Section 48 01 00 COMMISSIONING OF PHOTOVOLTAIC SYSTEM for commissioning process activities for solar photovoltaic system.”

Revised specification Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS, pages 1 through 12, incorporating these revisions is attached herewith.

4.0 Specification Section 03 48 24 - PRECAST CONCRETE COLUMBARIUM UNITS

Revised specification Section 03 48 24 - PRECAST CONCRETE COLUMBARIUM UNITS, pages 1 through 12, incorporating descriptive revisions issued under Amendment 2 is attached herewith.

5.0 Specification Section 03 48 26 - PRECAST CONCRETE MEMORIAL WALL UNITS

Revised specification Section 03 48 26 - PRECAST CONCRETE MEMORIAL WALL UNITS, pages 1 through 8, incorporating descriptive revisions issued under Amendment 2 is attached herewith.

- 6.0 **Specification Section 07 21 16 – MINERAL FIBER BLANKET INSULATION**
Added new Section 07 21 16 – MINERAL FIBER BLANKET INSULATION, pages 1 through 4, is attached herewith.
- 7.0 **Specification Section 07 41 13 – METAL ROOF PANELS**
Revised specification Section 07 41 13 – METAL ROOF PANELS to include the following:
- Under 1.8 WARRANTIES, Added new item 1.8.5 Coordination with Photovoltaic System as follows:

“1.8.5 Coordination with Photovoltaic System

All roofing warranties shall be coordinated with the Photovoltaic System installation as specified under Section 48 14 00 SOLAR PHOTOVOLTAIC MEMBRANE ROOFING SYSTEM.”
- Revised specification Section 07 41 13 – METAL ROOF PANELS, pages 1 through 20, incorporating this revision is attached herewith.
- 8.0 **Specification Section 09 69 13 – RIGID GRID ACCESS FLOORING**
Revised specification Section 09 69 13 – RIGID GRID ACCESS FLOORING, pages 1 through 9, incorporating descriptive revisions issued under Amendment 2 is attached herewith.
- 9.0 **Specification Section 26 07 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**
Revised specification Section 26 07 00 – COMMISSIONING OF ELECTRICAL SYSTEMS to include the following:
- Under 1.2 DESCRIPTION. Revised item b. to add the word “photovoltaic” after “solar”; revised sentence reads:

“The systems selected for commissioning will be limited to “energy” use equipment i.e., HVAC & R, lighting controls and hot water systems including solar photovoltaic.”
- Revised specification Section 26 07 00 – COMMISSIONING OF ELECTRICAL SYSTEMS, pages 1 and 2, incorporating this revision is attached herewith.
- 10.0 **Specification Section 48 01 00 – COMMISSIONING OF PHOTOVOLTAIC SYSTEM**
Added new Section 48 01 00 – COMMISSIONING OF PHOTOVOLTAIC SYSTEM, pages 1 and 2, is attached herewith.
- 11.0 **Specification Section 48 14 00 – SOLAR PHOTOVOLTAIC MEMBRANE ROOFING SYSTEM**
Added new specification Section 48 14 00 – SOLAR PHOTOVOLTAIC MEMBRANE ROOFING SYSTEM, pages 1 through 13, is attached herewith.

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SUBMITTAL REGISTER

CONTRACT NO.
899CM2026 Am 4

TITLE AND LOCATION
NATIONAL MEMORIAL CEMETERY OF THE PACIFIC

CONTRACTOR

[illegible]

SECTION 01 91 13

GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

- a. This section includes administrative and procedural requirements as well as a detailed description of the commissioning process. **This section supplements other commissioning information and applies to mechanical, plumbing, solar photovoltaic, and electrical systems. (Amendment 4)** Successful completion of the commissioning process is required to obtain a LEED certification.
- b. Commissioning during the construction phase is intended to achieve the following specific objectives:
 - (1) Verify and document that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing Contractors.
 - (2) Verify and document the performance of applicable equipment and systems meet the SRE/CO's Project Requirements, as documented through acceptance criteria in Divisions 22, 23, and 26.
 - (3) Verify completeness of operations and maintenance materials and ensure SRE/CO and Using Agency Representative's operating personnel are trained on operation and maintenance of building equipment.
- c. Related Information included in the following sections:
 - (1) Section 22 08 00 COMMISSIONING OF PLUMBING for commissioning process activities for restroom fixtures.
 - (2) Section 23 08 00 COMMISSIONING OF HVAC AND CONTROL SYSTEMS for commissioning process activities for heating, ventilating, air conditioning, and thermal comfort systems, assemblies, equipment, and components.
 - (3) Section 26 07 00 COMMISSIONING OF ELECTRICAL SYSTEMS for commissioning process activities for indoor lighting, outdoor lighting, assemblies, equipment, and components.
 - (4) **Section 48 01 00 COMMISSIONING OF PHOTOVOLTAIC SYSTEM for commissioning process activities for solar photovoltaic system. (Amendment 4)**

1.2 SCOPE OF WORK

The Contractor is responsible for completion of specified commissioning work within the contract documents. The Contractor's responsibilities include:

- a. Contractor's Commissioning Coordinator (CCC): The General

Contractor shall provide a Contractor's Commissioning Coordinator (CCC), as defined under Section 01 45 00.00 20 QUALITY CONTROL. The CCC is responsible for managing the Contractor's personnel and scope of work and with coordinating with the Commissioning Authority (CA) to complete the commissioning process. The CCC's scope of work includes:

- (1) Integrate the specified commissioning activities into an overall construction schedule, update the schedule, and provide three-week look-ahead schedules showing the upcoming commissioning related activities.
 - (2) Review and provide all required Contractor commissioning submittals to the Commissioning Authority (CA).
 - (3) Coordinate training with the SRE/CO and ensure that training is provided in accordance with the contract specifications.
 - (4) Ensure that appropriate Subcontractors and equipment suppliers review and provide written approval for all Pre-Functional Test Checklists and Functional Performance Tests (FPT) as provided by the CA. This includes providing written comments regarding issues from all participants of the system tests pertaining to safety, equipment protection, warranty and appropriateness of the test procedure for the systems as provided.
 - (5) Submit completed test reports and progress reports in accordance with the specified requirements of the project contract documents.
 - (6) Manage the Contractor's participation in completing the functional performance tests and demonstration process as specified in the commissioning specifications.
 - (7) Manage the Contractor's participation in the resolution of issues identified during the commissioning process.
 - (8) Ensure that Subcontractors perform preliminary testing to verify readiness for demonstration of final FPT; submit verification that systems will pass FPTs with acceptable results documented in the FPT Reports; and coordinate the FPT demonstrations with SRE/CO and CA.
 - (9) Coordinate repeats of FPTs that fail due to Contractor deficiencies until acceptable results are achieved.
- b. The Contractor shall be responsible for providing material, equipment, and labor to participate in the specified commissioning process. The Contractor will ensure the participation and cooperation of Subcontractors under their jurisdiction, as required to complete the commissioning process.
 - c. The Contractor shall support the commissioning process by integrating it into the construction process and schedule.
 - d. The Contractor shall submit the manufacturer's installation and startup manuals as a part of the initial equipment submittals.
 - e. The Contractor shall submit the manufacturer's operating and

maintenance manuals as a part of the initial equipment submittals.

- f. The Contractor shall review and approve the final Functional Performance Test Procedures in advance of actual functional testing.
- g. The Contractor shall complete the Pre-Functional Test Checklists as provided by the Commissioning Authority prior to the start of functional testing. The Contractor shall be required to verify by a signature that all installation and start-up requirements have been completed and the systems and equipment scheduled for commissioning are ready and capable of successfully completing all functional performance tests as defined by the Commissioning Plan.
- h. The Contractor shall provide qualified personnel to perform functional performance tests and demonstrations as specified in the contract documents and detailed within the Commissioning Plan.
- i. As part of the LEED requirements for this project, the Contractor shall be required to participate in a post-occupancy performance review of the commissioned building systems.

1.3 DEFINITIONS

- a. Commissioning Plan: A document, prepared by the Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation requirement of the commissioning process.
- b. Commissioning Authority (CA): The CA is the project's Commissioning Consultant and the leader of the Commissioning Team. The CA oversees the commissioning process and documents/reports all commissioning issues, emphasizing the long-term performance and maintainability of the systems included in the commissioning scope of work. The CA is required to report issues involving the design, construction, system operation, or other issues that would compromise the ability of the facility to meet the needs of the owner. The CA shall recommend acceptance, modification, or rejection of all procedures, schedules, tests, reports, or other required commissioning submittals. The CA is not authorized to change existing contract documents, schedules, costs, or scope of work for any of the parties involved (Architect or Contractor).
- c. Contractor's Commissioning Coordinator (CCC): Provide an individual on the Prime Contractor's staff who is regularly and frequently on site and shall be responsible for managing the Contractors in their day-to-day performance of the specified commissioning work. Required qualifications for the CCC include relevant process management experience and ability to schedule, coordinate and manage mechanical and electrical Subcontractors. The CCC's responsibilities are further defined in item a. under paragraph entitled "SCOPE OF WORK", hereinabove.
- d. Functional Performance Test (FPT): A documented test of the dynamic functioning and operation of equipment and systems with the goal of verifying that the SRE/CO's Requirements are met. Test requirements are included in the contract documents. Test procedures are developed and results documented by the Commissioning Authority. Test procedures are completed by the

Contractor.

- e. Pre-Functional Test Checklist: A written checklist that includes checks and tests prerequisite to the equipment's functional performance test. Checklists are included in the contract documents. These checklists shall be completed by the Contractor and submitted to the CA prior to the final installation verification and functional performance demonstration process.
- f. Rework Items List: will be identified in the Commissioning Issues Log. All issues raised during commissioning shall be logged and tracked until they have been resolved. A commissioning issues log shall be maintained by the CA. The issues log includes the description of all issues discovered as a result of the commissioning process. The list also includes the current issues status, assignment to the responsible party and the date of final resolution as confirmed by the CA. Items listed may include issues where design, products, execution or performance does not appear to satisfy the project contract documents and/or the design intent. The resolution of issues identified on this list may be the responsibility of the Contractor, Design Team, or the Owner.
- g. Systems, Assemblies, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, equipment, and components.
- h. Commissioning Team:
 - (1) Contractor
 - (2) Contractor's Commissioning Coordinator
 - (3) Contractor's Project superintendent
 - (4) Contractor's Subcontractors of commissioned systems
 - (5) Contractor's material and equipment suppliers of commissioned systems
 - (6) Contractor's Testing and Balance representative
 - (7) Contractor's Controls Contractor
 - (8) Commissioning Authority
 - (9) SRE/CO
 - (10) User Agency Representative
 - (11) Design Team Representative(s)
- i. Commissioning Management Team:
 - (1) Contractor's Commissioning Coordinator
 - (2) Commissioning Authority
 - (3) SRE/CO
- j. Commissioning Report: Document compiled by Commissioning Authority summarizing the tasks, findings and resolutions of the

commissioning process. Content further defined under
COMMISSIONING DOCUMENTATION.

1.4 COORDINATION

- a. The CCC assists the QC Manager with integrating commissioning into the following elements of the Construction Quality Control Plan per Section 01 45 00.00 20 QUALITY CONTROL:
 - (1) List of Definable Features
 - (2) Testing Plan and Log
 - (3) Personnel Matrix
 - (4) Training Procedures and Training Log
 - (5) Commissioning Plan
- b. The CCC attends the following meetings per Section 01 45 00.00 20 QUALITY CONTROL:
 - (1) Coordination and Mutual Understanding
 - (2) Quality Control
 - (3) Preparatory phase
 - (4) Initial phase
- c. Assign a representative with expertise and authority to act on behalf of the Contractor and schedule Subcontractors to participate in and perform commissioning process activities including, but not limited to, the following:
 - (1) Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - (2) Cooperate with the CA for resolution of issues recorded in the "Rework Items List" per Section 01 45 00.00 20 QUALITY CONTROL and per item f. under paragraph entitled "DEFINITIONS", hereinabove.
 - (3) Integrate and coordinate commissioning process activities with construction schedule.
 - (4) Complete paper Pre-Functional Test Checklists and provide to the CA per Section 01 45 00.00 20 QUALITY CONTROL.
 - (5) Accomplish commissioning Functional Performance Test Procedures.
- d. CCC provides a copy of product submittals for systems, assemblies, equipment, and components being commissioned to the CA.
- e. Include a 10-day activity in the construction schedule called Pre-functional Building Commissioning that occurs prior to substantial completion. Additional functional performance testing will occur after substantial completion.

1.5 COMMISSIONING DOCUMENTATION

- a. Commissioning Report: The CA shall compile a Commissioning Report based on data and documents provided by the CCC. The report shall summarize the tasks, findings, conclusions, and recommendations of the commissioning (Cx) process. A list of participants and roles, brief building description, overview of Cx and testing scope, and general description of testing and verification methods shall be included. The report shall list outstanding nonconformance items. Each nonconformance issue shall be referenced to the "Rework Items List" per Section 01 45 00.00 20 QUALITY CONTROL" and per item f. under paragraph entitled "DEFINITIONS" where the deficiency is documented. List any uncorrected compromises in the environmentally responsive features. List recommendations such as improvements to equipment or operations, future actions including testing justified by seasonal conditions or Cx process changes. The CA shall provide the following for each piece of equipment:
 - (1) Assessment of how the equipment meets the specifications and design intent.
 - (2) Equipment installation verification
 - (3) O&M documentation evaluation
 - (4) Operator training evaluation
 - (5) Assessment of the value of the Cx process
 - (6) Completed Functional Performance Tests
- b. Systems Manual: The CCC shall develop an indexed systems manual to be submitted with the Cx Report. The following information shall be compiled into a single manual, regardless of repetition with the O&M manuals:
 - (1) As-built sequences of operations for all equipment as provided by Subcontractors, including time-of-day schedules and schedule frequency, control drawings, and detailed point listings with ranges and initial setpoints.
 - (2) Ongoing operating instructions for all integrated building systems.
- c. FPT results, blank test forms, and recommended schedule for ongoing testing.
- d. Seasonal operational guidelines.
- e. Recommendations for recalibration frequency of sensors and actuators by type and use.
- f. Single line diagrams of each commissioned system.
- g. Troubleshooting table for ongoing achievement of the design intent.
- h. Guidelines for continuous maintenance of the design intent and basis of design.

1.6 RIGOR OF FUNCTIONAL PERFORMANCE TESTING

The Contractor shall be duly advised that the rigor of the Functional Performance Test Procedures may include demonstration of any and all specified operational performance criteria as defined by the project contract documents. The Commissioning Authority shall maintain sole discretion regarding the functional performance demonstration process and those performance criteria deemed to be appropriate for functional performance demonstrations by the Contractor. The approximate rigor of a typical functional performance test may be estimated by review of the sample functional testing procedure document found at the end of this section. The Contractor shall be advised to budget sufficient time to adequately verify and demonstrate that all installed equipment and systems will perform in compliance with the specified project contract document requirements.

1.7 BACK-CHARGING

- a. The CCC is responsible for scheduling, coordinating, preparing for and participating in various commissioning activities. The Contractor shall be responsible for the costs of commissioning activities that must be repeated because of a lack of preparation or coordination by the Contractor. Reimbursable costs may include CA fees, travel/lodging/meals costs and equipment rental costs.
- b. Commissioning issues identified by the CA will be documented in the Commissioning Issues Log. The Contractor shall submit a brief written statement of when and how each issue has been resolved, using issues response forms provided by the CA. The CA shall back-check these issues on a one-time-per-issue basis to verify they have been resolved. If the back-checked issues have not been resolved as reported, the associated cost of the unsuccessful back-check shall be subject to back-charging.
- c. Repeated installation verification: After the Contractor has submitted the completed Pre-Functional Test Checklists, the CA will conduct functional performance tests on selected systems. Discrepancies discovered will be reported in the Commissioning Issues Log. The cost of inspections that do not demonstrate specified acceptance criteria shall be subject to back-charging.
- d. Repeated witnessing of FPT demonstrations: As specified in this section, the Contractor shall demonstrate the functional performance tests to the CA after they have verified that performing the FPTs will yield the documented acceptable results. The cost of CA witnessing demonstrations that do not demonstrate specified acceptance criteria shall be subject to back-charging.
- e. Excessive Contractor coordination by the CA made necessary due to lack of Contractor scheduling, shall be subject to back-charging.
- f. Cancelled functional performance tests or appointments due to the Contractor's lack of preparation or lack of communication, shall be subject to back-charging.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION PHASE COMMISSIONING PROCESS OVERVIEW

- a. After the bid award and acceptance of mechanical and electrical submittals, the Commissioning Authority (CA) will conduct a pre-installation commissioning coordination meeting with the Contractors, SRE/CO or his Representative, and the Design Team. The CA will present the Commissioning Plan, discuss commissioning process in detail, and identify specific commissioning related responsibilities. Milestones shall be discussed, including Contractor start-up and testing forms, preliminary O&M manuals, training agendas and other approved submittals needed to complete the plan. The final Commissioning Plan will be developed after the CA receives all submittals from the Contractor and design team.
- b. The Contractor shall designate a Contractor's Commissioning Coordinator (CCC). See paragraphs entitled "SCOPE OF WORK" and "DEFINITIONS" herein above.
- c. Functional Performance Test Procedures shall be developed by the CA with input from the Contractor, SRE/CO, and Design Team, as specified in Sections 22 08 00 COMMISSIONING OF PLUMBING; 23 08 00 COMMISSIONING OF HVAC AND CONTROL SYSTEMS; and 26 07 00 COMMISSIONING OF ELECTRICAL SYSTEMS.
- d. Commissioning status meetings shall be scheduled to occur during the construction and closeout phase to monitor progress and to help facilitate the commissioning process. Contractor representatives for commissioned systems shall be required to attend these meetings. Meetings will generally be scheduled to occur with scheduled construction or management meetings and the CA will call in.
- e. The Contractor shall update the CA of site conditions and Cx progress.
- f. The Contractors shall prepare the equipment and systems and complete startup in accordance with the project documents, industry standard guidelines, and the guidelines of the equipment and systems manufacturers. The Contractor shall test the systems to verify that they perform in accordance with the project documents, including the commissioning functional performance tests. The CA will request start up sheets including manufacturer's sheets within 5 days of completion. The Contractor shall notify the CA in writing at least 10 working days in advance of the start-up and testing dates.
- g. Pre-Functional Test Checklists document that the equipment has been provided in accordance with the project requirements and is ready for functional testing. The CCC will coordinate timely completion and submittal of these checklists to the CA. The CCC shall review and sign off on checklists. The Contractor must have approval from the CA in order to proceed with subsequent functional performance testing.
- h. Once the Contractor has provided the CA with completed Pre-Functional Test Checklists indicating completion of

installation procedures, the Commissioning Authority will conduct a final functional performance test review of the specific systems and equipment to be commissioned. Issues noted during this process will be documented by the CA in the commissioning issues list.

- i. Upon confirmation of and receipt of the Preliminary Balancing (TAB) Report, functional performance testing shall be scheduled. Functional testing shall not commence until all critical issues identified during the installation verification and TAB report review process are resolved.
- j. The procedure for developing and performing the FPTs shall be as follows:
 - (1) The Contractor shall provide the equipment and commissioning submittals as specified in the project documents.
 - (2) The CA shall update the FPT based on the Contractor's submittals and project documents. The draft procedures shall be submitted to the Commissioning Team for review.
 - (3) The Contractor shall be asked to provide written comments on the associated FPT regarding each of the following issues:
 - (a) Verify that the procedures can be performed without compromising the safety of the participants.
 - (b) Verify that the procedures can be performed without compromising the warranties of equipment, components, and systems.
 - (c) Verify that the procedure is appropriate for the equipment, components, and systems as provided.
 - (d) At the Contractor's option, make recommendations to incorporate the FPTs into the Contractor's in-house startup and QC testing process.
 - (4) The CA shall complete the working drafts of the FPTs.
 - (5) The Contractor shall provide the personnel, expertise and test equipment to operate and maintain the systems during testing.
 - (6) The Contractor shall test all systems within the commissioning scope of work, using the FPTs until the acceptable results specified in the FPTs are verified and documented. If necessary to obtain acceptable results, the Contractor may consult with the CA to acquire clarification and resolve issues.
 - (7) The Contractor shall submit documentation indicating they have completely tested their system and are ready to demonstrate the FPTs to the CA. Acceptable documentation may consist of completed FPT Reports which document acceptable FPT results, or indication on Pre-Functional Test Checklists that the Contractor's functional testing has verified acceptable functional performance.
 - (8) After the CA has accepted the Contractor's documentation of acceptable results, the FPTs shall be demonstrated to the CA. If acceptable results are not demonstrated for an FPT, the Contractor

shall resolve the issue(s) and the demonstration shall be repeated.

(9) The CCC is responsible for scheduling and coordinating functional performance testing. The Contractor shall demonstrate the functional performance tests after they have verified that performing the FPTs will yield the documented acceptable results. The Contractor is subject to backcharging, as specified herein, if acceptable results are not demonstrated because of work that should have been verified during pre-demonstration testing. Acceptable results must be obtained during a single demonstration with no more than 2 delays of 15 minutes or less, during each test.

- k. Issues noted during the functional performance tests will be documented by the CA. When easily corrected, issues will be resolved at the time of discovery. The appropriate Contractor will resolve all other issues at a later time. Issues will be tracked by issue number, responsible party, status and activity date. The Contractor shall be responsible for reporting, in writing, to the CA when issues have been resolved so that the CA can verify the resolution.
- l. The construction phase commissioning process will be complete when all noted issues have been corrected, proved to be in compliance with the project contract documents or otherwise resolved to the satisfaction of the SRE/CO.
- m. The Contractors will participate in the 10 month review with the Design Consultants, User, and Government.

3.2 CLOSEOUT PHASE COMMISSIONING PROCESS OVERVIEW

- a. Contractor closeout responsibilities include completion and submission of the Functional Performance Test Reports for commissioned systems. Project closeout requirements and a draft checklist are included in this section.
- b. Training on related systems and equipment operation and maintenance shall be scheduled after commissioning is satisfactorily completed, O&M manuals have been accepted and delivered to the SRE/CO, and systems are verified to be complete and functional. Each Contractor is responsible to provide a topical outline of all subjects to be covered in the training session(s), the expected length of time for the training sessions, and a brief resume listing the qualifications of the proposed training presenters. Training will be coordinated with the SRE/CO.
- c. Upon request, the Contractor is responsible for providing the CA with copies of all balancing reports, as-built drawings and O&M manuals relevant to the systems commissioned. The CA will review this material for compliance with project contract documents and will note and report all issues for resolution by the responsible party.
- d. Upon completion of all commissioning activities the CA will prepare and submit to the SRE/CO the final commissioning report detailing the Commissioning Plan and all commissioning activities.

3.3 OTHER SPECIFIED FUNCTIONAL PERFORMANCE TESTS

In addition to participating in functional tests developed by the CA, the Contractor shall be required to complete all start-up and testing procedures as specified elsewhere in the project contract documents.

3.4 PERFORMANCE PERIOD

- a. Functional performance testing shall include a performance period test plan, which includes measured variables and success criteria based on performance characteristics described in the project contract documents. The CA will provide the Control System Contractor with a list of required trend log definitions to be implemented as a basis for reviewing performance during this period.
- b. The Contractor will review the performance period test plan and set up the trend log definitions from the CA. The trending shall be provided by the Contractor in both a text and graphic format with related system parameters grouped together for easy comparison. If DDC system resident memory is limited or there are other issues with the trending requirements, the Contractor will notify the CA and request the CA redefine the test plan.
- c. The performance period shall be as specified in the FPTs. If failures are encountered, the performance period shall be aborted. After corrections are made, the performance period shall be re-started at day one. Back-Charging as specified herein shall apply.

3.5 PROJECT CLOSEOUT

- a. Post construction Contractor responsibilities include completion and submission of the Functional Performance Test Reports for each commissioned system to the CA, to verify completion of contractual obligations for the Government. Sample Functional Performance Test Reports are included in Sections 22 08 00 COMMISSIONING OF PLUMBING; 23 08 00 COMMISSIONING OF HVAC AND CONTROL SYSTEMS; and 26 07 00 COMMISSIONING OF ELECTRICAL SYSTEMS.
- b. Training on related systems and equipment operation and maintenance shall only be scheduled to commence after functional testing is satisfactorily completed, O&M manuals have been delivered and approved, and systems are verified to be 100 percent complete and functional. The Contractor is responsible to provide a topical outline of all subjects to be covered in the training session(s), the expected length of time for the training sessions, and a brief resume listing the qualifications of the proposed training presenters. The CCC is responsible for developing the training plan with input from the Contractor. The CCC is responsible for coordinating training with the SRE/CO and CA and to verify execution of the training plan.
- c. Upon request, the Contractor is responsible for providing the CA with copies of all balancing reports, as-built drawings and O&M manuals relevant to the systems commissioned. The CA will review this material for compliance with project contract documents and will note and report all issues for resolution by the responsible party.

3.6 SYSTEMS ACCEPTANCE

Equipment and systems shall not be accepted by the SRE/CO until all commissioning activities are complete and the performance period standards have been met.

3.7 POST-OCCUPANCY PERFORMANCE REVIEW

As part of the LEED requirements for this project, the CA will be conducting a post-occupancy performance review of all previously commissioned systems, sometime prior to the expiration of the one-year warranty period. The Contractor shall be required to respond promptly to additional and otherwise unresolved issues as identified during this review. This may include the Contractor's required attendance at subsequent meetings to discuss new or as yet unresolved issues related to system installation or performance.

-- End of Section --

SECTION 03 48 24

PRECAST CONCRETE COLUMBARIUM UNITS

PART 1 GENERAL

1.1 SUMMARY

a. This section covers the manufacturer and installation of precast concrete columbarium units as shown on the drawings and specified herein, including but not limited to: the steel reinforcement, steel embedment plates, required sleeves, finished exposed surfaces, preparation of setting surface, adhesive, columbarium units fasteners, and niche cover anchor clip assemblies.

b. Acceptable designs of the columbarium units components are provided as shown on the Drawings. The Contractor may use this design for this Work or may propose alternate designs of the corresponding components as follows:

(1) Design for alternate columbarium units shall comply with the design criteria as per Article 1.4 f. and further, if required by the Contractor, shall comply with the functional tests as per Article 1.4 g. of this Specification.

(2) Unless indicated otherwise, all provisions of this Specification shall apply to the Contractor proposed design.

c. The Government may accept or reject part or all of any design proposed by the Contractor.

d. This section includes finishing and staining/coating of exposed faces of the columbarium units as indicated on drawings or described herein.

e. This section covers acceptance and installation of the Government provided niche covers, one for each niche of the new columbarium units.

1.2 RELATED DOCUMENTS

a. Section 03 30 00 CAST-IN-PLACE CONCRETE, for concrete pilings, foundations, and formwork.

b. Section 04 72 00 CAST STONE MASONRY VENEER for veneer on columbarium

c. Section 04 72 10 CAST STONE CAPS FOR COLUMBARIUM MEMORIAL WALL AND COLUMNS

d. Section 04 73 00 COLUMBARIUM NICHE COVERS for granite niche covers.

e. Section 07 14 00 FLUID-APPLIED WATERPROOFING for waterproofing on walls

f. Section 07 92 00 JOINT SEALANTS, Materials and Workmanship for sealant application.

g. Section 32 93 00 EXTERIOR PLANTS, for decorative crushed stone.

h. Section 31 00 00 EARTHWORK

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A615/A615M	(2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 533.3R	(1970) Fabrication, Handling and Erection of Precast Concrete
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NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual	(2013) Quality Control Manual for Precast Plants
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1.4 SUBMITTALS

Government approval by the SRE/CO is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval; the Government reserves the right to review and comment on submittals not having a "G" designation; and submittals with an "L" are for LEED review. LEED review shall be performed by the Contractor's LEED Coordinator and the LEED Administrator. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 01 33 29 LEED(TM) DOCUMENTATION as applicable:

SD-02 Shop Drawings

Precast Concrete Columbarium Units; G

Complete shop and erection drawings of all precast concrete columbarium units, showing all dimensions and details of construction, installation and relation to adjoining work, reinforcements, anchorage, attachments, inserts, location of all pre-drilled sleeves and other items to be installed in the work of other trades, joint treatment and sealant, water-proofing, joint alignment coordinated with columbarium pre-cast cap joints, and other work required for a complete installation. Provide evidence that the Contractor to be installing the cast in place concrete foundations for the columbarium and pier units has been contacted prior to any work relating to the footings for the columbarium construction, and that the construction of the concrete support (foundations) work has been coordinated with the precast columbarium unit manufacturer and installer.

SD-03 Product Data

Precast Concrete Columbarium Units

Manufacturer's Literature and Data for the following:

- a. Each type of Concrete Fastener, including adhesive and anchor devices.
- b. Instructions for final cleaning
- c. Concrete stain/coating, including color charts of manufacturers standard color palette (If applicable for this project.)

SD-04 Samples

Fastener System

Submit sample of all fastening systems, mounting hardware and exposed surface finishes including, but not limited to, the following:

- a. Stainless Steel Angle
- b. Stainless Steel Bolt, Nut and Washers
- c. Tamper Proof Stainless Steel Bolt
- d. Stainless Steel Expansion Anchors, Bolts and pins
- e. Stainless Steel Ferrule loop insert.
- f. Shims
- g. Exposed front of columbarium
- h. Adhesives, sealants, flashing, waterproofing and grouts.

Mock-Up of Double Columbarium; G
Mock-Up of Single Columbarium; G

SD-07 Certificates

Manufacturer Qualifications; G

Manufacturers qualifications specifying precast concrete columbarium units meet the requirements of ACI 533.3R and as specified.

1.5 QUALITY ASSURANCE

- a. Manufacturer's Qualifications: Prior to commencement of work, Contractor shall submit documentation regarding the experience of his precast concrete supplier in the design and manufacture of Precast Concrete structures and custom units.
- b. Precast concrete manufacturer's qualified Registered Professional Structural Engineer to certify that precast reinforced concrete conforms to specified requirements.
- c. Codes and regulations of the Federal, State and County authorities shall apply.
- d. Fabricate to dimensions shown or approved. Replace or correct Columbarium Units that do not comply with the individual dimensions and tolerances.
- e. Construction Tolerances: Most stringent construction tolerances indicated anywhere in the contract documents will be applicable for columbarium construction regardless of any conflicting information.
- f. Design Criteria:
 - (1) The Columbarium Units shall be of the following type, style, and size:
 - (a) **Type: Precast concrete, reinforced or capable of meeting testing requirements below. (Amendment 4)**
 - (b) Size: Interior and exterior dimensions as indicated on plans.
 - (2) Columbarium unit top shall be capable of structurally supporting imposed service live load of no less than 50 lb./ sq ft, and dead loads based on stone veneer thickness and heights, including material composition and element section properties, mortar and grout, and dead loads based on concrete top element sectional properties.
 - (3) The Contractor shall submit to the SRE/CO for review and approval 5 sets of design documentation showing structural design of the complete Columbarium unit. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified Professional Structural Engineer.
- g. Functional Load Tests: If required by the SRE/CO, a functional load test will be made at the Contractor's expense to ensure that

the columbarium proposed by the Contractor, as furnished, will be capable of supporting loads stated in Article 1.4.f.(2). The functional test will consist of 2 loading conditions:

Unconfined Loading: The columbarium unit will be placed on a flat surface with no support against the sides. The entire top of the columbarium will be subjected to a simulated uniform load of live load of 50 lb./sq ft and required dead load simulating stone veneer, mortar, and grout as they will be installed. The load will be maintained for no less than 72 hours. At end of the loading period, the maximum deflection of the Columbarium top elements shall be no more than 1/8-inch. Upon removal of the load from the unit the residual deflection shall be no more than 1/16-inch and concrete elements shall be free of all structural distress.

h. Production Drawings:

- (1) Elevation view of each structural element.
- (2) Planametric view of unit.
- (3) Sections and details to show quantities and position of reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.
- (4) Lifting and erection inserts.
- (5) Dimensions and finishes.
- (6) Method of transportation.
- (7) Method of erection and handling.

- i. Columbarium Manufacturer and/or Installer shall coordinate with Cast-in-Place Contractor to ensure that required clearance for all columbarium placement at courts has been provided including all connection weld plates as indicated on drawings prior to concrete pouring.

1.6 MOCK-UPS

1.6.1 Mock-Up of Double Columbarium

Construct mock up of double columbarium of length necessary to show a complete section including but not limited to:

- a. Double wide columbarium with all items as detailed including but not limited to: foundation, waterproofing system, sealant, cast stone cap, toe kick with cast stone veneer, decorative crushed stone floral strip with installed drainage.
- b. End column including but not limited to: cast-in-place column, foundation, moss rock stone veneer, and cast stone cap.
- c. Intermediate cast-in-place column with integral color and foundation.

- d. Granite niche cover and installation hardware.
- e. Signage including wall identification number with granite plaque, and columbarium niche row and column numbering.
- f. Reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.

Approved section shall become the standard of comparison and remain in place until completion of columbarium work. Sample may be incorporated into completed columbarium.

1.6.2 Mock-Up of Single Columbarium

Construct mock up of single columbarium with retaining wall of length necessary to show a complete section including but not limited to:

- a. Double wide columbarium with all items as detailed including but not limited to: foundation, waterproofing system, sealant, cast stone cap, toe kick with cast stone veneer, decorative crushed stone floral strip with installed drainage.
- b. End column including but not limited to: cast-in-place column, foundation, moss rock stone veneer, and cast stone cap.
- c. Intermediate cast-in-place column with integral color and foundation.
- d. Granite niche covers installation.
- e. Signage including wall identification number with granite plaque, and columbarium niche row and column numbering.
- f. Reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.
- g. Retaining wall with all waterproofing.
- h. Moss rock veneer on back of free-standing single columbarium.

Approved section shall become the standard of comparison and remain in place until completion of columbarium work. Sample may be incorporated into completed columbarium.

1.7 MANUFACTURER QUALIFICATIONS

- a. Precast concrete columbarium units shall be product of manufacturer who has a minimum of 3 years experience in fabrication of the precast concrete columbarium units similar in material design and extent to that indicated on the drawings and specified herein.
- b. Precast concrete columbarium units shall be installed by installer that has a minimum of 3 years experience in installation of the precast concrete columbarium units similar in material design and extent to that indicated on the drawings and specified herein.

- c. Supply and Installation of fastener system shall be by a product manufacturer and installer, both whom have had a minimum of 3 years experience in installation of similar design as indicated on the drawing.
- d. Installation of columbarium granite niche covers will be performed by those companies who have had 3 years experience in installation of similar design as indicated in the drawings and specified herein.
- e. The precast manufacturer plant(s) used shall be National Precast Concrete Association (NPCA) certified in accordance with the NPCA QC Manual.

1.8 ALLOWABLE TOLERANCES

In addition to tolerances of individual elements required by American Concrete Institute Publication 533.3R, erection tolerances shall be as follows:

- a. Variation of anchors and fasteners
from dimensions specified 1/8-inch
- b. Variation in overall dimensions of
precast element (height and width) 1/8-inch
- c. Maximum differential between adjacent
units in erected position 1/4-inch
- d. Variation in thickness of precast
panels and elements 1/8-inch
- e. Maximum vertical differential between
adjacent columbarium units in installed
position 1/8-inch

1.9 DELIVERY AND STORAGE

Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identifications and location. Store materials in protected areas to prevent damage, injurious effects of weather and inclusion of foreign matter.

1.10 COORDINATION

Coordinate the manufacture and erection of precast concrete columbarium units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete columbarium units to the work of other trades, in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete columbarium unit work. See Shop Drawing section for details regarding the coordination of work.

1.11 GUARANTEE

Guarantee precast concrete columbarium units work, including anchorage, joint treatment, water-proofing and related components to be free from all

defects in materials and workmanship, including cracking and spalling, and after erection, completed work will be subject to terms of "Guarantee" article in Division 1 Specification Sections except that guarantee period is one year.

PART 2 PRODUCTS

2.1 BUY AMERICAN ACT

This solicitation is subject to the Buy American Act requirements as defined in the Federal Acquisition Regulation (FAR) Clauses 52.225-9 and 52.225-10.

2.2 ACCEPTABLE MANUFACTURER/DESIGN

- a. Manufacturer's that have previously completed at least one successful NCA columbarium project are deemed to be acceptable for processing their units through the procedures according to these specifications and the drawings.
- b. Manufacturer's that do not have previous successful experience for a NCA columbarium project may be selected by the Contractor for the project. Contractor is hereby notified that the submittal process for a manufacturer with no previous NCA experience with a successful columbarium project, typically takes longer to process.

2.3 COARSE AGGREGATE

Hard durable aggregate carefully graded from coarse to fine in proportions required to match approved samples.

2.4 AGGREGATE FOR BACK-UP MIX (FINE AND COARSE AGGREGATE LIGHTWEIGHT)

ASTM C33/C33M. Limit gradation as required to produce the specified appearance and quality of concrete.

2.5 PORTLAND CEMENT FOR COLUMBARIUM UNITS

ASTM C150/C150M, Type I and Type II; Color as required.

2.6 STRUCTURAL STEEL

ASTM A36/A36M.

2.7 STEEL FABRIC REINFORCEMENT

ASTM A185/A185M, epoxy coated.

2.8 STEEL WIRE REINFORCEMENT

ASTM A82/A82M, cold drawn, epoxy coated.

2.9 REINFORCING STEEL

ASTM A615/A615M, deformed, Grade 60, epoxy coated.

2.10 MISCELLANEOUS GALVANIZED STEEL ITEMS

Bolts, nuts, washers, anchors, inserts, and the like for handling,

erection, or use by other trades.

2.11 MASONRY ANCHOR DOVETAIL CHANNEL

Heckman #100 Standard dovetail Slot. See Plans for spacing and location.

2.12 GRANITE NICHE COVERS

Refer to Section 04 73 00 COLUMBARIUM NICHE COVERS (GRANITE).

2.13 NICHE COVER ATTACHMENT HARDWARE

Refer to Section 04 73 00 COLUMBARIUM NICHE COVERS (GRANITE).

2.14 BACK-UP MATERIAL

Closed cell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1-1/3 times the joint width.

2.15 BOND BREAKERS

Type and material recommended by sealant manufacturer.

2.16 SEALING COMPOUND

ASTM C920, Type S, Grade NS, Class 25.

2.17 WALL JOINT WEEPS

3/8-inch thick x 3-3/8 inches wide x 2-1/2 inches tall flexible 'cellvent' plastic weep insert with restrictive insect and debris ingress, similar to Blok-Lok Cellvent weep holes

2.18 COLD FLUID-APPLIED WATERPROOFING

Refer to Section 07 14 00 FLUID-APPLIED WATERPROOFING.

2.19 FABRICATION

Precast concrete columbarium units shall NOT be fabricated, delivered or incorporated in the work until samples have been approved. Precast concrete shall comply with ACI 533.3R, except as modified herein.

- a. Concrete for precast columbarium units shall have minimum compressive strength of 5,000 psi at 28 days.
- b. Provide additional steel reinforcing as required for casting, handling and erection loads.
- c. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
- d. Columbarium units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain thorough compaction, complete embedment of reinforcement and to assure concrete of

uniform and maximum density without segregation of mix and full thickness of precast element is attained.

(1) Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, notches, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.

(2) All fastener location holes, including those for anchoring of units and attachment of niche covers, shall be cast into units. Drilling to precast concrete columbarium units, after fabrication, shall not be acceptable.

- e. Cement, aggregate and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
- f. Finish: Exposed faces shall have smooth finish, unless otherwise noted. The face of the units shall be processed by the manufacturer, following removal from the forms to ensure that the discoloration and blemishes on the niche faces are removed before shipping to the site. **Natural concrete color. (Amendment 4)**

Specified surface finish for the exposed back of the columbarium units shall be applied during the appropriate time of fabrication and curing. Seal coating of exposed back of units shall be applied as per manufacturer's recommendations.

- g. Curing: Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.
- h. Fluid-Applied Waterproofing: Apply waterproofing to back of precast units as shown on drawings. Apply as per manufacturer's instructions.

PART 3 EXECUTION

3.1 HANDLING AND INSTALLATION

Before beginning installation, inspect work of other trades in-so-far as it effects the work of this Section. Commencing installation of precast concrete columbarium units will be construed as acceptance, as suitable, of such work of other trades. Concrete base for the columbarium units shall be inspected and modified as required, grinding off high spots, to become an acceptable base upon which to install the units. Columbarium units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete columbarium units against staining and other damage. Reinstall, realign and otherwise correct improper installed units.

Accurately place and securely anchor precast concrete columbarium units to adjoining construction in accordance with approved shop and erection drawings.

3.2 SETTING

- a. Concrete footings (pads) for columbaria shall be constructed to

meet all structural requirements to meet local soil and climate conditions and the weight and dimensions of the columbaria. The pad shall be set level and be long enough to carry the end panel stone work.

- b. Where shown, joints shall be filled with sealant. Surfaces and other joints for precast concrete columbarium units shall be cleaned of all dust, dirt and other foreign matter. Exposed surfaces of units shall be protected by anti-graffiti coating at the manufacturer. Units that have been damaged on exposed surfaces by graffiti, when not coated in advance shall be rejected and removed from the site. Each precast element shall be set level and true to line with uniform joints. Joints required to have sealants shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances which are likely to cause staining shall be removed from joints.
- c. Precast Caps shall be installed on top of the columbarium. Specified sealant and flashing shall be in place prior to setting the capping. Four (4) anchor bolts (2 each side) shall be placed through top row of niche wall and into capping on each unit. The cap length shall extend beyond the face of the stone end panel as shown on drawings.

3.3 SEALING OF JOINTS

Where shown and/or where ever required to make the work watertight, joints between precast concrete columbarium units, and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth as shown or recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.

Workmanship shall be in accordance with Division 1 Specification Sections.

3.4 CLEANING

After erection is complete, clean precast columbarium units using materials, equipment and methods recommended by manufacturer.

3.5 REPLACEMENT AND REPAIR

Precast concrete columbarium units which are damaged, cracked, stained, improperly fabricated or otherwise defective shall be removed and be replaced. Precast units having minor defects not affecting serviceability or appearance may be repaired when approved by the Owners Designated Representative. Repaired work shall be sound, permanent, flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and shall show no line of demarcation between original and patched surfaces. Replacement and repairs shall be done at no additional cost to the Government.

3.6 FINISHING OF EXPOSED EDGES AND FACES

Apply coating to complete, cleaned exposed concrete edges as per manufacturers standard specifications and recommendations.

3.7 INSTALLATION OF NICHE COVERS

Install niche covers plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align both horizontally and vertically. Tighten fasteners to achieve snug fit but do not over tighten to the point where they may crack or break niche covers. Due to the manufacturing tolerances in the niche covers and the allowable deviations from the nominal dimensions, it will be impossible to install the niche covers perfectly. Coordinate the installation procedures with the SRE/CO and establish the critical visual line for which the best alignment is to be established.

-- End of Section --

SECTION 03 48 26

PRECAST CONCRETE MEMORIAL WALL UNITS

PART 1 GENERAL

1.1 DESCRIPTION

This section covers the manufacture and installation of precast concrete memorial wall units, as shown on the plans and specified herein, including the steel reinforcement, steel embedment plates, required sleeves, and fasteners.

1.2 RELATED WORK

- a. Cast-in-place concrete work: Section 03 30 00 CAST-IN-PLACE CONCRETE.
- b. Workmanship for sealant application: Section 07 92 00 JOINT SEALANTS.
- c. Memorial Wall Cap: Section 04 72 10 CAST STONE CAPS FOR COLUMBARIUM, MEMORIAL WALL AND COLUMNS.
- d. Decorative Crushed Stone: Section 32 93 00 EXTERIOR PLANTS.
- e. Installation of Memorial Markers: Section 04 73 10 MEMORIAL PLAQUES AND TRIM (GRANITE).

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A615/A615M	(2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates

ASTM C920 (2011) Standard Specification for
Elastomeric Joint Sealants

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 533.3R (1970) Fabrication, Handling and Erection
of Precast Concrete

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual (2013) Quality Control Manual for Precast
Plants (Amendment 4)

1.4 SUBMITTALS

Government approval by the SRE/CO is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval; the Government reserves the right to review and comment on submittals not having a "G" designation; and submittals with an "L" are for LEED review. LEED review shall be performed by the Contractor's LEED Coordinator and the LEED Administrator. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 01 33 29 LEED(TM) DOCUMENTATION as applicable:

SD-02 Shop Drawings

Precast Concrete Memorial Wall Units; G

Complete shop and installation drawings of all precast concrete memorial wall units, showing all dimensions, sizes of units, and details of construction, installation and relation to adjoining work, joint locations and details, reinforcements, anchorage, attachments, inserts, location of all predrilled sleeves (see Fabrication, Paragraph 2.17) and other trades, joint treatment, finishes, and other work required for a complete installation.

SD-03 Product Data

Precast Concrete Memorial Wall Units
Anchors and Fasteners

Manufacturer's Literature and Data for the following:

- a. Each type of fastener or anchorage.
- b. Instructions for final cleaning.
- c. Sealers

SD-04 Samples

Anchors and Fasteners; G
Miscellaneous Stainless Steel Items; G

Submit sample of all fastening systems and mounting hardware including, but not limited to, the following:

- a. Stainless Steel Angle of varying sizes depending on position

of granite marker on memorial wall- see drawings).

- b. Stainless Steel Bolt and Washers
- c. Stainless Steel Spring Plate
- d. Tamperproof Stainless Steel Bolt
- e. Stainless Steel Expansion Anchors and Bolts

Mock-Up Memorial Wall; G

SD-07 Certificates

Manufacturer/Installer Qualifications; G

Manufacturer/Installer qualifications specifying precast concrete memorial wall units meet the requirements of ACI 533.3R as specified.

1.5 MANUFACTURER/INSTALLER QUALIFICATIONS

- a. Precast concrete memorial wall units shall be product of manufacturer who has a minimum of 3 years experience in fabrication and installation of precast concrete units similar in material and design to the extent indicated on the drawings and specified herein. **The precast manufacturer plant(s) used shall be National Precast Concrete Association (NPCA) certified in accordance with the NPCA QC Manual. (Amendment 4)**
- b. Precast concrete memorial wall shall be installed by installer that has a minimum of 3 years experience in installation of the precast concrete wall units similar in material design and extent to that indicated on the drawings and specified herein.

1.6 ALLOWABLE TOLERANCES

Manufacturing and installation tolerances shall be as follows:

- a. Variation of anchors and fasteners for memorial markers from dimensions specified: 1/64-inch.
- b. Variation in overall dimensions of precast element (height and width and depth inside and outside): 1/16-inch.
- c. Variation in thickness of walls of precast units: 1/16-inch.
- d. Maximum vertical and horizontal differential between adjacent units in installed position: 1/8-inch.

1.7 DELIVERY AND STORAGE

Ship precast concrete memorial wall units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identification and location. Store materials in protected areas to prevent damage, injurious effects of weather and inclusion of foreign matter.

1.8 COORDINATION

- a. Coordinate the manufacture and installation of precast concrete memorial wall units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete memorial wall units to the work of other trades, other adjoining units, in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete memorial wall unit work.
- b. Columbarium Manufacturer and/or Installer shall coordinate with Cast-in Place Contractor to ensure that required clearance for all columbarium placement and attachment hardware at courts have been provided prior to concrete pouring.

1.9 GUARANTEE

Guarantee precast concrete memorial wall unit work, including anchorage, joint treatment and related components to be free from all defects in materials and workmanship, including cracking and spalling and after erection, for a period of not less than one year.

1.10 MOCK-UPS

1.10.1 Mock-Up Memorial Wall

Construct mock up of memorial wall of length necessary to show a complete section including but not limited to:

- a. Memorial wall with all items as detailed including but not limited to: foundation, waterproofing system, sealant, cast stone cap, toe kick with cast stone veneer, decorative crushed stone floral strip with installed drainage.
- b. Column Type A including but not limited to: cast-in-place column, foundation, moss rock stone veneer, and cast stone cap.
- c. Column Type B including but not limited to: cast-in-place column, foundation, moss rock stone veneer, and cast stone cap.
- d. Granite memorial markers and installation hardware.
- e. Signage including wall identification number with granite plaque, and memorial marker row and column numbering.
- f. Reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.
- g. Retaining wall with all waterproofing.

Approved section shall become the standard of comparison and remain in place until completion of memorial wall work. Sample may be incorporated into completed memorial wall.

PART 2 PRODUCTS

2.1 BUY AMERICAN ACT

This solicitation is subject to the Buy American Act requirements as defined in the Federal Acquisition Regulation (FAR) Clauses 52.225-9 and 52.225-10.

2.2 COARSE AGGREGATE

Hard durable aggregate carefully graded from coarse to fine in proportions required to match approved samples.

2.3 AGGREGATE FOR BACK-UP MIX (FINE AND COARSE AGGREGATE LIGHTWEIGHT)

ASTM C33/C33M. Limit gradation as required to produce specified appearance and quality of concrete.

2.4 PORTLAND CEMENT

ASTM C150/C150M, Type I and Type III; Color as required to match existing.

2.5 WATER

Water shall be clean, fresh and potable.

2.6 STRUCTURAL STEEL

ASTM A36/A36M.

2.7 STEEL FABRIC REINFORCEMENT

ASTM A185/A185M, galvanized.

2.8 STEEL WIRE REINFORCEMENT

ASTM A82/A82M, cold drawn.

2.9 REINFORCING STEEL

ASTM A615/A615M, deformed, Grade 60.

2.10 MISCELLANEOUS STAINLESS STEEL ITEMS

Bolts, nuts, washers, anchors, inserts, and the like for handling, erection, or use by other trades.

2.11 BACK-UP MATERIAL

Closed cell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1- 1/3 times the Joint width.

2.12 BOND BREAKERS

Type and material recommended by sealant manufacturer.

2.13 SEALING COMPOUND

ASTM C920, Type S, Grade NS, Class 25.

2.14 DECORATIVE CRUSHED STONE

See Section 32 93 00 EXTERIOR PLANTS.

2.15 CONCRETE FOOTINGS

See Section 03 30 00 CAST-IN-PLACE-CONCRETE.

2.16 FABRICATION

- a. Memorial wall units shall be of size and form as indicated on the plans.
- b. Concrete for precast memorial wall units shall have minimum compressive strength of 5,000 psi at 28 days.
- c. Provide additional steel reinforcing as required for casting, handling and erection loads.
- d. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
- e. Memorial wall units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain through compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.
 - (1) Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.
 - (2) All fastener location holes, including those for anchoring of units and attachment of memorial markers, shall be field drilled for anchor bolts.
- f. Cement, aggregate, and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
- g. Architectural Finish: Exposed faces shall have smooth finish, rubbed with a fine abrasive or stone hone to create a cast stone like finish, uniformly smooth. Use ample water during rubbing to prevent working up a lather of mortar or changing texture of concrete. There shall be no air bubble marks or other such imperfections visible on the surface.
- h. Curing: Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.

PART 3 EXECUTION

3.1 CONCRETE FOOTINGS

Place concrete footings per lines and grades indicated on the drawings and in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2 HANDLING AND INSTALLATION

Before beginning installation, inspect work of other trades insofar as it affects the work of this Section. Commencing installation of precast concrete memorial wall units will be construed as acceptance, as suitable, of such work of other trades. Memorial wall units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete memorial wall units against staining and other damage. Reinstall, realign and otherwise correct improperly installed units.

Accurately place and securely anchor precast concrete memorial wall units to adjoining construction in accordance with approved shop and installation drawings.

3.3 SETTING

- a. Concrete footings (pads) for memorial wall units shall be constructed to meet all structural requirements to meet local soil and climate conditions and the weight and dimensions of the memorial wall units.
- b. Joints shall be filled with sealant. Surfaces and other joints for precast concrete memorial wall units shall be cleaned of all dust, dirt and other foreign matter. Each precast element shall be set level and true to line with uniform joints. Joints required to have sealant shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances that are likely to cause staining shall be removed from joints. Where 2 units are butted together, alignment shall be precise so that a smooth continuous line is produced.
- c. Precast Concrete caps shall be installed on top of the memorial wall units. A urethane caulking adhesive shall be in place prior to setting the capping. Four (4) anchor bolts (2 each side) shall be placed through top row of niche wall and into capping on each unit. The cap lengths shall match the memorial wall unit length such that caulk joints between memorial wall units are aligned with the caulk joints between the caps. At locations requiring a concrete spacer between an end or corner pilaster and the adjacent memorial wall unit, the terminal cap shall extend over the spacer, with the terminal caulk joint aligning with the caulk joint that occurs between the concrete spacer and the adjacent pilaster. In locations where memorial wall units step, the cap length shall extend beyond the face of the memorial wall unit as shown on the drawings.
- d. Place decorative gravel to the line and grade as indicated on the drawings. See Section 32 93 00 EXTERIOR PLANTS.

3.4 SEALING OF JOINTS

- a. Where shown and where required to make the work watertight, joints between precast concrete memorial wall units and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.
- b. Workmanship shall be in accordance with Section 07 92 00 JOINT SEALANTS.

3.5 CLEANING

After installation is complete, clean precast memorial wall units using materials, equipment and methods recommended by manufacturer.

3.6 REPLACEMENT AND REPAIR

Precast concrete memorial wall units that are damaged, cracked, stained, improperly fabricated or otherwise defective shall be removed and be replaced. Precast units having minor defects, not affecting serviceability or appearance may be repaired when approved by the SRE/CO. Repaired work shall be sound, permanent, and flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and shall show no line of demarcation between original and patched surfaces. Replacement and repairs shall be done at no additional cost to the Government.

-- End of Section --

SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C665	(2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM E84	(2012a) Standard Test Method for Surface Burning Characteristics of Building Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
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1.2 SUBMITTALS

Government approval by the SRE/CO is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval; the Government reserves the right to review and comment on submittals not having a "G" designation; and submittals with an "L" are for LEED review. LEED review shall be performed by the Contractor's LEED Coordinator and the LEED Administrator. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 01 33 29 LEED(TM) DOCUMENTATION as applicable:

SD-03 Product Data

Blanket insulation

SD-03 Product Data (LEED NC)

Insulation; L (LEED NC)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate dollar value of product.

SD-08 Manufacturer's Instructions

Insulation

SD-11 Closeout Submittals (LEED NC)

Insulation; L (LEED NC)

LEED documentation relative to recycled content materials credit in accordance with the LEED GBDC. Include in the LEED Documentation Notebook.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, or crushed. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C930.

PART 2 PRODUCTS

2.1 BUY AMERICAN ACT

This solicitation is subject to the Buy American Act requirements as defined in the Federal Acquisition Regulation (FAR) Clauses 52.225-9 and 52.225-10.

2.2 BLANKET INSULATION

ASTM C665, Type I, blankets without membrane coverings, except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

Insulation may contain post-industrial or post-consumer recycled content.

See Section 01 33 29 LEED(TM) DOCUMENTATION for cumulative total recycled content requirements.

2.2.1 Thermal Resistance Value (R-VALUE)

Provide R-13 for all stud spaces less than 4 inches and R-19 for all stud spaces over 6 inches unless indicated otherwise.

2.2.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Rock Wool: 75 percent slag
Fiberglass: 20 to 25 percent glass cullet
Postconsumer recycled plus one-half of the preconsumer recycled content not less than 20 percent

2.2.3 Prohibited Materials

Do not provide asbestos-containing materials.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids or compressed insulation. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify SRE/CO of such conditions.

3.2 INSTALLATION

3.2.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.2.1.1 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.2.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, headers and any obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.2.1.3 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between studs and other framing, such as at door and window heads, jambs, sills, and headers.

3.2.1.4 Sizing of Blankets

Provide only full width blankets when insulating between studs. Size width of blankets for a snug fit where studs are irregularly spaced.

-- End of Section --

SECTION 07 41 13

METAL ROOF PANELS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 341 (2005; Suppl No. 1 2005) Seismic
Provisions for Structural Steel Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05 (2005; R 2006) Minimum Design Loads for
Buildings and Other Structures

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3 (2002; Suppl 2001-2004; R 2008)
Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05 (2005; R 2006) Minimum Design Loads for
Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M (2011) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

ASTM B117 (2011) Standard Practice for Operating
Salt Spray (Fog) Apparatus

ASTM C792 (2004; R 2008) Effects of Heat Aging on
Weight Loss, Cracking, and Chalking of
Elastomeric Sealants

ASTM C920 (2011) Standard Specification for
Elastomeric Joint Sealants

ASTM D1056 (2007) Standard Specification for Flexible
Cellular Materials - Sponge or Expanded
Rubber

ASTM D1308 (2002; R 2007) Effect of Household
Chemicals on Clear and Pigmented Organic
Finishes

ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D1970/D1970M	(2011) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D2244	(2011) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2011) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	(2009e2) Measuring Adhesion by Tape Test
ASTM D3363	(2005e1; R 2011) Film Hardness by Pencil Test
ASTM D4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4587	(2011) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D4637/D4637M	(2010) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D522	(1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2008) Standard Test Method for Specular Gloss
ASTM D5894	(2010) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D610	(2008) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2009) Evaluating Degree of Blistering of Paints
ASTM D822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings

ASTM D968	(2005; R 2010) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E1592	(2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E2140	(2001; R 2009) Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head
ASTM E84	(2012a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G152	(2006) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2004; R 2010) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
FM GLOBAL (FM)	
FM 4471	(2010) Class I Panel Roofs
METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)	
MBMA RSDM	(2000) Metal Roofing Systems Design Manual
NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)	
NRCA 0409	(2006) Architectural Sheet Metal and Metal Roofing Manual
NRCA RoofMan	(2012) The NRCA Roofing Manual
SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)	
SMACNA 1793	(2003) Architectural Sheet Metal Manual, 6th Edition
UNDERWRITERS LABORATORIES (UL)	
UL 580	(2006; Reprint Jul 2009) Tests for Uplift Resistance of Roof Assemblies
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED GBDC	(2009) LEED Reference Guide for Green Building Design and Construction
LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

1.2 DESCRIPTION OF METAL ROOF SYSTEM

1.2.1 Performance Requirements

1.2.1.1 Hydrostatic Head Resistance

No water penetration when tested according to ASTM E2140. Submit leakage test report upon completion of installation.

1.2.1.2 Wind Uplift Resistance

Provide metal roof panel system that conform to the requirements of ASTM E1592 and UL 580. Uplift force due to wind action governs the design for panels. Submit wind uplift test report prior to commencing installation.

Roof system and attachments must resist the wind loads as determined by ASCE/SEI 7-05, in pounds per square foot. Metal roof panels and component materials must also comply with the requirements in FM 4471 as part of a panel roofing system as listed in Factory Mutual Guide (FMG) "Approval Guide" for class 1 or noncombustible construction, as applicable. Identify all materials with FMG markings.

1.3 SUBMITTALS

Government approval by the SRE/CO is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval; the Government reserves the right to review and comment on submittals not having a "G" designation; and submittals with an "L" are for LEED review. LEED review shall be performed by the Contractor's LEED Coordinator and the LEED Administrator. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 01 33 29 LEED(TM) DOCUMENTATION as applicable:

SD-02 Shop Drawings

- Roofing Panels
- Flashing and Accessories

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

- Roof Panels
- Factory-Applied Color Finish
- Accessories
- Fasteners
- Pressure Sensitive Tape
- Underlayments
- Gaskets and Sealing/Insulating Compounds

SD-03 Product Data (LEED NC)

- Roof Panels; L (LEED NC)
- Underlayments; L (LEED NC)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate

dollar value of product.

Gaskets and Sealing/Insulating Compounds; L (LEED NC)
Joint Sealants; L (LEED NC)

Provide Manufacturer's data sheet. Highlight VOC content.

SD-04 Samples

Roof Panels; G
Factory-applied Color Finish, samples, 9 inch lengths,
full width; G
Accessories
Fasteners
Gaskets and Sealant/Insulating Compounds

SD-05 Design Data

Wind Uplift Resistance

SD-06 Test Reports

Leakage Test Report
Wind Uplift Test Report
Factory Finish and Color Performance Requirements

SD-07 Certificates

Roof Panels
Self-Adhering Modified Bitumen Underlayment
Qualification of Manufacturer
Qualification of Applicator

SD-09 Manufacturer's Field Reports

Manufacturer's Field Inspection Reports

SD-11 Closeout Submittals

Warranties
Information Card
Date of Installation Wall-Mounted Placard

SD-11 Closeout Submittals (LEED NC)

Roof Panels; L (LEED NC)
Underlayments; L (LEED NC)

LEED documentation relative to recycled content materials credit
in accordance with the LEED GBDC. Include in the LEED
Documentation Notebook.

Gaskets and Sealing/Insulating Compounds; L LEED NC)
Joint Sealants; L LEED NC)

LEED documentation relative to low-emitting materials credit in
accordance with the LEED GBDC. Include in the LEED Documentation
Notebook.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Submit documentation verifying metal roof panel manufacturer has been in the business of manufacturing metal roof panels for a period of not less than 5 years.

Manufacturer must also provide engineering services by an authorized engineer, currently licensed in the geographic area of the project, with a minimum of 5 years experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for MBMA RSDM, ASCE/SEI 7-05, UL 580, and FM 4471. Engineer must provide certified engineering calculations for the project conforming to the stated references.

1.4.1.1 Manufacturer's Technical Representative

The manufacturer's technical representative must be thoroughly familiar with the products to be installed, installation requirements and practices, and with any special considerations in the geographical area of the project. The representative must perform field inspections and attend meetings as specified.

1.4.1.2 Single Source

Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer, and the most recent design of the manufacturer to operate as a complete system for the intended use.

1.4.2 Qualification of Applicator

Metal roof system applicator must be approved, authorized, or licensed in writing by the roof panel manufacturer and have a minimum of 3 years experience as an approved, authorized, or licensed applicator with that manufacturer, approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of 5 projects of similar size and scope constructed by applicator using the manufacturer's roofing products submitted for this project within the previous 3 years.

1.4.3 Field Verification

Prior to the preparation of drawings and fabrication, verify location of roof framing, roof openings and penetrations, and any other special conditions. Indicate all special conditions and measurements on final shop drawings.

1.4.4 Pre-roofing Conference

After approval of submittals and before performing roofing system installation work, hold a pre-roofing conference to review the following:

- a. Drawings, specifications, and submittals related to the roof work. Submit, as a minimum; sample profiles of roofing panels, with factory-applied color finish samples, flashing and accessories samples, typical fasteners and pressure sensitive tape, sample gaskets and sealant/insulating compounds.
- b. Roof system components installation;

- c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;
- d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and
- e. Quality control plan for the roof system installation;
- f. Safety requirements.

Coordinate pre-roofing conference scheduling with the SRE/CO. Attendance is mandatory for the Contractor, the SRE/CO's designated personnel, personnel directly responsible for the installation of metal roof system, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and representative of the metal roofing manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver, store, and handle panel materials, bulk roofing products, accessories, and other manufactured items in a manner to prevent damage and deformation, as recommended by the manufacturer, and as specified.

1.5.1 Delivery

Package and deliver materials to the site in undamaged condition. Provide adequate packaging to protect materials during shipment. Do not uncrate materials until ready for use, except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, deformation, dampness, and staining. Remove affected materials from the site and immediately replace. Remove moisture from wet materials not otherwise affected, restack and protect from further moisture exposure.

1.5.2 Handling

Handle materials in a manner to avoid damage. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.5.3 Storage

Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering which prevents trapping of water or condensation under the covering. Store roof panels so that water which may have accumulated during transit or storage will drain off. Do not store panels in contact with materials that might cause staining. Secure coverings and stored items to protect from wind displacement.

1.6 PROJECT CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit metal roof panel work to be performed

according to manufacturer's written instructions and warranty requirements, and specified safety requirements.

1.7 FABRICATION

Fabricate and finish metal roof panels and accessories on a rolling mill to the greatest extent possible, per manufacturer's standard procedures and processes, and as necessary to fulfill indicated performance requirements. Comply with indicated profiles, dimensional and structural requirements.

Provide panel profile, as indicated on drawings for full length of panel.

1.7.1 Finishes

Finish quality and application processes must conform to the related standards specified within this section. Noticeable variations within the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize any contrasting variations.

1.7.2 Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 as applicable to the design, dimensions, metal, and other characteristics of the item indicated.

- a. Form exposed sheet metal accessories which are free from excessive oil canning, buckling, and tool marks, and are true to line and levels indicated, with exposed edges folded back to form hems.
- b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- c. Sealed Joints: Form non-expansion, but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.
- d. Conceal fasteners and expansion provisions where possible.
- e. Fabricate cleats and attachments devices of size and metal thickness recommended by SMACNA or by metal roof panel manufacturer for application, but not less than the thickness of the metal being secured.

1.8 WARRANTIES

Provide metal roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to manufacturer's standard warranty as required to comply with the specified requirements.

1.8.1 Metal Roof Panel Manufacturer Warranty

Furnish the metal roof panel manufacturer's 30-year no dollar limit roof system materials and installation workmanship warranty, including flashing, gutter liner, components, trim, and accessories necessary for a watertight roof system construction. Make warranty directly to the Government, commencing at time of Government's acceptance of the roof work. The warranty must state that:

- a. If within the warranty period, the metal roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the metal roof system and correction of defective workmanship is the responsibility of the metal roof panel manufacturer. All costs associated with the repair or replacement work are the responsibility of the metal roof panel manufacturer.
- b. If the manufacturer or his approved applicator fail to perform the repairs within 48 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.8.2 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 20 year warranty for the roofing system. Issue the warranty directly to the Government at the date of Government acceptance warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D2244.

1.8.3 Metal Roof System Installer Warranty

Provide roof system installer warranty for a period of not less than 5 years that the roof system, as installed, is free from defects in installation workmanship, to include the roof panel installation, flashing, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Issue warranty directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials is the responsibility of the metal roof system installer. All costs associated with the repair or replacement work are the responsibility of the installer.

1.8.4 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the metal roof system manufacturer warranty for the remainder of the manufacturer warranty period.

1.8.5 Coordination with Photovoltaic System

All roofing warranties shall be coordinated with the Photovoltaic System installation as specified under Section 48 14 00 SOLAR PHOTOVOLTAIC MEMBRANE ROOFING SYSTEM. (Amendment 4)

1.9 CONFORMANCE AND COMPATIBILITY

The entire metal roofing and flashing system must be in accordance with specified and indicated requirements, including wind resistance and seismic per ANSI/AISC 341 requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the MBMA RSDM, NRCA RoofMan, the metal panel

manufacturer's published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the SRE/CO for approval prior to installation.

PART 2 PRODUCTS

2.1 BUY AMERICAN ACT

This solicitation is subject to the Buy American Act requirements as defined in the Federal Acquisition Regulation (FAR) Clauses 52.225-9 and 52.225-10.

2.2 ROOF PANELS

Roof panels may contain post-industrial or post-consumer recycled content. See Section 01 33 29 LEED(TM) DOCUMENTATION for cumulative total recycled content requirements.

2.2.1 Steel Sheet Panels

Roll-form steel sheet roof panels to the specified profile, 22 gauge. Material must be plumb and true, and within the tolerances listed:

- a. Galvanized steel sheet conforming to ASTM A653/A653M and AISI SG03-3.
- b. Individual panels to have continuous length sufficient to cover the entire length of any unbroken roof slope with no joints or seams and formed without warping, waviness, or ripples that are not a part of the panel profile and free from damage to the finish coating system.
- c. Provide panels with thermal expansion and contraction consistent with the type of system specified, and the following profile:
 - (1) Profile to be a 1-1/2 to 1-3/4 inch high standing seam, 16 inch coverage with mechanical crimping or snap-together seams with concealed clips and fasteners.
 - (2) Profile to be smooth, flat surface.

2.3 FACTORY FINISH AND COLOR PERFORMANCE REQUIREMENTS

All panels are to receive a factory applied Kynar 500/Hylar 5000 finish consisting of a baked topcoat with a manufacturer's recommended prime coat conforming to the following:

- a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with an acid rinse, and thorough drying.
- b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. The prime coat must be oven cured prior to application of the finish coat.

- c. Exterior Finish Coating: Apply the exterior finish coating over the primer by roll coating to a dry film thickness of 0.80 plus 0.05 mils (3.80 plus 0.05 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). This exterior finish coat must be oven-cured.
- d. Interior finish coating: Apply an off-white polyester coating as standard with the manufacturer.
- e. Color: The exterior finish chosen from the manufacturer's standard color chart.
- f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General:	ASTM D5894 and ASTM D4587.
Abrasion:	ASTM D968
Adhesion:	ASTM D3359
Chalking:	ASTM D4214
Chemical Pollution:	ASTM D1308
Color Change and Conformity:	ASTM D2244
Creepage:	ASTM D1654
Cyclic Corrosion Test:	ASTM D5894
Flame Spread:	ASTM E84
Flexibility:	ASTM D522
Formability:	ASTM D522
Gloss at 60 and 85 degrees:	ASTM D523
Humidity:	ASTM D2247 and ASTM D714
Oxidation:	ASTM D610
Pencil Hardness:	ASTM D3363
Reverse Impact:	ASTM D2794
Salt Spray:	ASTM B117
Weatherometer:	ASTM G152, ASTM G153 and ASTM D822

2.3.1 Specular Gloss

Finished roof surfaces to have a specular gloss value of 30 plus or minus 5 at an angle of 60 degrees when measured in accordance with ASTM D523.

2.4 MISCELLANEOUS

2.4.1 Exposed Fasteners

Fasteners for roof panels must be corrosion resistant stainless steel, compatible with the sheet panel or flashing material and of the type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories must be the manufacturer's standard. Provide an integral metal washer, matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick for exposed fasteners.

2.4.2 Screws

Provide corrosion resistant stainless steel screws, of the type and size recommended by the manufacturer to meet the performance requirements.

2.4.3 Rivets

Provide closed-end type rivets, corrosion resistant stainless steel where watertight connections are required.

2.4.4 Attachment Clips

Provide stainless steel, series 300 clips. Size, shape, thickness and capacity must meet the thickness and design load criteria specified.

2.5 ACCESSORIES

Accessories must be compatible with the metal roof panels. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories must be not less than the minimum thicknesses specified for roof panels. Provide exposed metal accessories to match the panels furnished. Molded foam rib, ridge and other closure strips must be closed-cell or solid-cell synthetic rubber or neoprene premolded to match configuration of the panels and not absorb or retain water.

2.5.1 Pre-manufactured Accessories

Pre-manufactured accessories must be manufacturer's standard for intended purpose, comply with applicable specification section, compatible with the metal roof system and approved for use by the metal roof panel manufacturer. Construct curbs to match roof slope.

2.5.2 Metal Closure Strips

Provide factory fabricated steel closure strips of the same gauge, color, finish and profile as the specified roof panel.

2.5.3 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber closure strips conforming to ASTM D1056 and ASTM D1667, extruded or molded to the configuration of the specified roof panel profile and in lengths supplied by roof panel manufacturer.

2.6 JOINT SEALANTS

Joint sealants must meet the requirements of LEED low emitting materials credit.

2.6.1 Sealants

Sealants are to be an approved gun type for use in hand or air pressure caulking guns at temperatures above 40 degrees F with a minimum solid content of 85 percent of the total volume. Sealant must dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather tight joint. No migratory staining, in conformance with to ASTM C792, is permitted on painted or unpainted metal, stone, glass, or wood.

Prime all joints to receive sealants with a compatible one-component or 2-component primer as recommended by the roof panel manufacturer.

2.6.1.1 Shop Applied Sealants

Sealant for shop-applied caulking must be an approved gun grade, non-sag one-component polysulfide or silicone conforming to ASTM C792 and ASTM C920, Type II, with a curing time which ensures the sealants plasticity at the time of field erection. Color to match panel color.

2.6.1.2 Field Applied Sealants

Sealants for field-applied caulking must be an approved gun grade, non-sag on-component polysulfide or 2 component polyurethane with an initial maximum Shore A durometer hardness of 25, conforming to ASTM C920, Type II. Color to match panel color.

2.6.1.3 Tape Sealants

Provide pressure sensitive, 100 percent solid tape sealant with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the roof panel manufacturer.

2.6.2 Sheet Metal Flashing and Trim

2.6.2.1 Fabrication, General

Custom fabricate sheet metal flashing and trim to comply with recommendations within the SMACNA 1793 that apply to design, dimensions, metal type, and other characteristics of design indicated. Shop fabricate items to the greatest extent possible. Obtain and verify field measurements for accurate fit prior to shop fabrication. Fabricate flashing and trim without excessive oil canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

2.7 UNDERLAYMENTS

See Section 01 81 19 INDOOR AIR REQUIREMENTS for compliant VOC limits. Underlayments may contain post-industrial or post-consumer recycled content.

2.7.1 Self-Adhering Modified Bitumen Underlayment

Provide self-adhering modified bitumen membrane underlayment material, minimum 0.030-inch thick, in compliance with ASTM D1970/D1970M, suitable for use as underlayment for metal roofing. Use membrane resistant to cyclical elevated high temperatures for extended period of time in high heat service conditions. Provide membrane with integral non-tacking top surface of polyethylene film or other surface material to serve as separator between bituminous material and metal products to be applied above.

2.7.2 EPDM Membrane Gutter Liner

Ethylene Propylene Diene Terpolymer (EPDM), ASTM D4637/D4637M, Type I, non-reinforced, minimum 0.090 inch thick, white high reflective finish. Provide manufacturer's recommended splice tape, lap sealant, adhesive, and accessories.

2.7.3 Slip Sheet

Provide 5 pounds per 100 sf rosin sized unsaturated building paper for slip

sheet or as recommended by the roofing manufacturer.

2.8 GASKETS AND SEALING/INSULATING COMPOUNDS

Gaskets and sealing/insulating compounds must be nonabsorptive and suitable for insulating contact points of incompatible materials. Sealing/insulating compounds must be non-running after drying.

Joint sealing/insulating compounds must meet the requirements of LEED low emitting materials credit. See Section 01 81 19 INDOOR AIR REQUIREMENTS for compliant VOC limits.

2.9 FINISH REPAIR MATERIAL

Only use repair and touch-up paint supplied by the roof panel manufacturer and is compatible with the specified system.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the work. Ensure surfaces are suitable, dry and free of defects and projections which might affect the installation.

Examine insulation and coverboard, blocking, and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer, UL, ASTM, and ASCE/SEI 7-05 and applicable seismic requirements.

Examine rough-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of panels prior to installation.

Submit a written report to the SRE/CO, endorsed by the installer, listing conditions detrimental to the performance of the work. Proceed with installation only after defects have been corrected.

3.2 INSTALLATION

Installation must meet specified requirements and be in accordance with the manufacturer's installation instructions and approved shop drawings. Do not install damaged materials. Dissimilar materials which are not compatible when contacting each other must be insulated by means of gaskets or sealing/insulating compounds. Keep all exposed surfaces and edges clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Remove stained, discolored, or damaged materials from the site.

3.2.1 Preparation

Clean all substrate substances which may be harmful to roof panels including removing projections capable of interfering with roof panel attachment.

3.2.2 Underlayment

Install underlayment according to roof panel manufacturer's written

recommendations and recommendation in NRCA "The NRCA Roofing and Waterproofing Manual".

3.2.2.1 Self-Adhering Sheet Underlayment

Install self-adhering sheet underlayment; wrinkle free on roof deck. Install at locations indicated on project drawings, lapped in a direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within 7 days. Provide slip sheet as indicated and recommended by the roofing manufacturer.

3.2.2.2 EPDM Sheet Gutter Liner

Apply specified EPDM sheet at time of self-adhering roof sheet underlayment installation as recommended by the roof panel manufacturer. Install with minimum number or no joints.

3.3 PROTECTION OF APPLIED MATERIALS

Do not permit storing, walking, wheeling, and trucking directly on applied roofing/insulation materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing/insulation materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.4 FASTENER INSTALLATION

Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions.

3.5 FLASHING, TRIM, AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently water tight and weather resistant. Work is to be accomplished to form weather tight construction without waves, warps, buckles, fastening stresses or distortion, and to allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accomplish the work must conform to the manufacturers written instructions.

3.5.2 Metal Flashing

Install exposed metal flashing at building corners, rakes, eaves, and changes off slope or direction in metal roofing, building expansion joints and built-in gutters.

Exposed metal flashing must be the same material, color, and finish as the specified metal roofing panels. Furnish flashing in minimum 8 foot lengths. Exposed flashing must have 1 inch locked and sealed end joints.

Fasten flashing at not more than 8 inches on center for roofs, except where flashing is held in place by the same screws used to secure panels. Exposed flashing and flashing subject to rain penetration must be bedded in

specified joint sealant. Flashing which is contact with dissimilar metals must be isolated by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.6 ROOF PANEL INSTALLATION

Provide metal roof panels of full length as indicated. Anchor metal roof panels or other components of the Work securely in place, with provisions for thermal and structural movement in accordance with NRCA 0409.

- a. Steel Roof Panels: Use stainless steel fasteners.
- b. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions. Provide all blocking and nailers as required.
- c. Metal Protection: Where dissimilar metals contact each other or possibly corrosive substrates, protect against galvanic action by coating contact surfaces with a bituminous coating, applying rubberized asphalt underlayment to each contact surface, or permanent separation as recommended by the metal roof panel manufacturer.
- d. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and required for weatherproof performance of metal roof panel system. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

3.6.1 Handling and Erection

Erect roofing system in accordance with the approved erection drawings, printed instructions and safety precautions of the manufacturer.

Do not subject panels to overloading, abuse, or undue impact. Do not apply bent, chipped, or defective panels. Damaged panels must be replaced and removed from the site at the Contractors expense. Erect panels true, plumb, and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with indicated rake, eave, and curb overhang. Allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Do not permit storage, walking, wheeling or trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of the roof construction.

Roof panels must be laid with pans in the direction of the roof slope.

Field cutting of metal roof panels by torch is not permitted. Field cut only as recommended by manufacturer's written instructions.

3.6.2 Closure Strips

Install closure strips at required locations.

3.6.3 Workmanship

Make lines, arises, and angles sharp and true. Free exposed surfaces from any visible wave, warp, buckle and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing in the angles formed where roof decks abut curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and as necessary to make the work watertight.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect metal roofing straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions. Horizontal lines must not vary more than 1/8 inch in 40 feet.

3.7.2 Leakage Tests

Finished application of metal roofing is to be subject to inspection and test for leakage by the SRE/CO or his designated representative. Inspection and tests will be conducted without cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and removal/replacement of defective materials.

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials and as recommended by the metal roof panel manufacturer. Finished repaired surfaces must be uniform and free from variations of color and surface texture. Repaired metal surfaces that are not acceptable to the project requirements are to be immediately removed and replaced with new material.

3.7.4 Paint Finished Metal Roofing

Paint finished metal roofing will be tested for color stability by the SRE/CO during the manufacturer's specified guarantee period. Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government. New panels will be subject to the specified tests for an additional year from the date of their installation.

3.8 CLEAN UP AND DISPOSAL

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and

oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, and damage to the finish coating. Touch up scratches in panel finish with manufacturer supplied touch-up paint system to match panel finish.

Collect all scrap/waste materials and place in containers. Promptly dispose of demolished and scrap materials. Do not allow scrap/waste materials to accumulate on-site; transport immediately from the government property and legally dispose of them.

3.9 FIELD QUALITY CONTROL

3.9.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of 3 times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Make inspections during the first 20 squares of roof panel installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections are required for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the SRE/CO. After each inspection, submit a report, signed by the manufacturer's technical representative to the SRE/CO within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

Submit 3 signed copies of the manufacturer's field inspection reports to the SRE/CO within one week of substantial completion.

3.10 INFORMATION CARD

Furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 1 mm (0.032) inch thick aluminum card for exterior display. Format as directed in paragraph titled "Form One".

Make card 8-1/2 by 11 inches minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, roof panel manufacturer and product name, type underlayment(s), date of completion; installing Contractor identification and contact information; manufacturer warranty expiration, warranty reference number, and contact information. Install card at location as directed by the SRE/CO and provide a paper copy to the SRE/CO.

3.10.1 Form One

See attached.

FORM 1 - PREFORMED STEEL PANEL ROOFING SYSTEM AND COMPONENTS

1. Contract Number:
2. Building Number & Location:
3. Specification Number:
4. Deck/Substrate Type:
5. Slopes of Deck/Roof Structure:
6. Insulation Type & Thickness:
7. Insulation Manufacturer:
8. Vapor Retarder: () Yes () No
9. Vapor Retarder Type:
10. Preformed Steel Standing Seam Roofing Description:
 - a. Manufacturer (Name, Address, & Phone No.):
 - b. Product Name:
 - c. Width:
 - d. Gage:
 - e. Base Metal:
 - f. Method of Attachment:
11. Repair of Color Coating:
 - a. Coating Manufacturer (Name, Address & Phone No.):
 - b. Product Name:
 - c. Surface Preparation:
 - d. Recoating Formula:
 - e. Application Method:
12. Statement of Compliance or Exception: _____

13. Date Roof Completed:
14. Warranty Period: From _____ To _____
15. Roofing Contractor (Name & Address):
16. Prime Contractor (Name & Address):
- Contractor's Signature _____ Date: _____
- Inspector's Signature _____ Date: _____

3.11 DATE OF INSTALLATION WALL-MOUNTED PLACARD

For each metal roof panel installation, furnish an exterior "Date of Installation Placard", 0.032 inch thick aluminum, 8-1/2 inches high by 11 inches wide, with mounting accessories, photoengraved to include the following information:

Facility Name and Number

Approximate Roof Area Newly Installed and Date of Completion

Manufacturer, Type of Roof Panel and Name

Underlayment and Insulation System, R value

Installing Contractor and Contact Information

Warranty Expiration Date

Warranty Reference Number and Contact Information

Install placard as directed by the SRE/CO.

-- End of Section --

SECTION 09 69 13

RIGID GRID ACCESS FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A780/A780M (2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION (CISCA)

CISCA Access Floors (2007) Recommended Test Procedures for Access Floors

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC300 (2009) Acceptance Criteria for Access Floors

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2009; Errata First Printing) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2007; Change 1) Seismic Design for Buildings

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED GBDC (2009) LEED Reference Guide for Green Building Design and Construction

LEED NC (2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

1.2 SYSTEM DESCRIPTION

Install access flooring at the location and elevation and in the arrangement shown on the drawings. The floor system shall be of the rigid grid stringer type, complete with all supplemental items, and be the standard product of a manufacturer specializing in the manufacture of access flooring systems.

- a. Provide for self-alignment of floor panels, adjustable pedestals

and readily removable floor panels covered as specified.

- b. Lateral stability of floor support system shall be independent of panels. Provide a finished assembly that is rigid and free of vibration, noises, and rocking panels. Provide bolted stringer system with equipotential plane grounding.
- c. Submit Certificates for the complete Access Flooring System including, but not limited to the following:
 - (1) Compliance with ICC-ES AC300. Submit design data substantiating compliance with International Building Code Acceptance Criteria for Access Floors.
 - (2) Load-bearing capabilities of pedestals, floor panels, and pedestal adhesive resisting force.
 - (3) Supporting independent laboratory test reports. For panel loads, test results include concentrated loads at center of panel, panel edge midpoint, ultimate loads and uniform loads.
 - (4) Material requirements.
 - (5) An elevated floor system free of defects in materials, fabrication, finish, and installation, that will remain so for a period of not less than 5 years after completion.
- d. Warrant that, upon notification by the Government, defective work will be immediately replaced with new work at no additional cost to the Government.
- e. Submit manufacturer's descriptive data, catalog cuts, and installation instructions. Include in the data information about any design and production techniques, total system including all accessories and finish coatings of under-floor components, procedures and policies used to conserve energy, reduce material, improve waste management or incorporate green building/recycled products into the manufacturer of their components or products. Include cleaning and maintenance instructions. Systems which contain zinc electroplated anti-corrosion coatings are prohibited.

1.2.1 Allowable Tolerances

- a. Floor Panel Flatness: Plus or minus 0.02 inch on diagonal on top of panel or underneath edge.
- b. Floor Panel Length: Plus or minus 0.015 inch.
- c. Floor Panel Squareness: Plus or minus 0.02 inch in panel length.
- d. Finish Floor: Level within plus or minus 0.062 inch in 10 feet, and plus or minus 0.10 inch for entire floor.

1.2.2 Floor Panels

Conduct floor panel testing in accordance with CISCA Access Floors. When tested as specified, make all deflection and deformation measurements at the point of load application on the top surface of the panel. Floor panels shall be capable of supporting the following loads:

- a. Concentrated load of 1250 pounds on one square inch, at any point on panel, without a top-surface deflection more than 0.10 inch, and a permanent set not to exceed 0.01 inch in any of the specified tests.
- b. Uniform live load of 300 psf, without a top-surface deflection more than 0.06 inch, and a permanent set not to exceed 0.01 inch in any of the specified tests.
- c. A rolling load of 1000 pounds applied through hard rubber surfaced wheel 6 inch diameter by 2 inch wide for 10,000 cycles over the same path. Permanent set at conclusion of test shall not exceed 0.040 inch.
- d. A rolling load of 1250 pounds applied through a 3 inch diameter by 1-13/16 inch wide caster for 10 cycles over the same path, without developing a local overall surface deformation greater than 0.04 inch. In accordance with CISCA Access Floors, the permanent deformation limit under rolling load shall be satisfied in all of the specified tests.
- e. An impact load of 150 pounds anywhere on the panel dropped from a height of 36 inches onto a 1 square inch area without failure of the system, according to CISCA Access Floors, Section 8 Drop Impact Load Test.
- f. Ultimate Concentrated Load. Panels shall provide a safety factor of 3 times the specified concentrated load indicated above, when tested in accordance with CISCA Access Floors, Section 2 Ultimate Loading.

1.2.3 Stringers

Provide stringers capable of supporting a 250 pound concentrated load at midspan without permanent deformation in excess of 0.010 inch.

1.2.4 Pedestals

Pedestals shall be capable of supporting a 5000 pound axial load without permanent deformation.

1.2.5 Bonding Strength of Pedestal Adhesive

Adhesive for anchoring pedestal bases shall have a bonding strength capable of resisting an overturning moment of 1,000 lbf-in when a force is applied to the top of the pedestal in any direction.

1.2.6 Seismic Calculations

Submit calculations for special bracing to resist the effects of seismic or other forces in accordance with UFC 3-310-04, ICC IBC and ICC-ES AC300. Submit design calculations which demonstrate that the proposed floor system meets requirements for seismic loading. Certified copies of test reports may be submitted in lieu of calculations.

1.3 SUBMITTALS

Government approval by the SRE/CO is required for submittals with a "G"

designation; submittals not having a "G" designation are for Contractor Quality Control approval; the Government reserves the right to review and comment on submittals not having a "G" designation; and submittals with an "L" are for LEED review. LEED review shall be performed by the Contractor's LEED Coordinator and the LEED Administrator. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 01 33 29 LEED(TM) DOCUMENTATION as applicable:

SD-02 Shop Drawings

Detailed Installation Drawings

SD-03 Product Data

Access Flooring System

SD-03 Product Data (LEED NC)

Floor Panels; L (LEED NC)

Panel Support System; L (LEED NC)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate dollar value of product.

SD-04 Samples

Floor Panels; G

Panel Support System; G

Accessories; G

SD-05 Design Data

Compliance with ICC-ES AC308

Seismic Calculations

SD-06 Test Reports

Factory Tests

SD-07 Certificates

Access Flooring System

SD-11 Closeout Submittals (LEED NC)

Floor Panels; L (LEED NC)

Panel Support System; L (LEED NC)

LEED documentation relative to recycled content credit in accordance with LEED GBDC. Include in LEED Documentation Notebook.

1.4 QUALITY ASSURANCE

Submit drawings showing location, details at floor perimeter, method of anchorage to structural subfloor, grounding, description of factory coating, installation height above structural floor, accessories and other details as specified. Take measurements from finished areas at site and

submit Detailed Installation Drawings indicating:

- a. Location of panels
- b. Layout of supports, panels, and cutout locations
- c. Sizes and details of components
- d. Lateral bracing
- e. Typical cutout details

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in undamaged condition, in original containers or packages, complete with accessories and instructions. Label packages with manufacturer's name and brand designations. Package materials covered by specific references bearing specification number, type and class as applicable.

1.5.2 Storage

Store all materials in original protective packaging in a safe, dry, and clean location. Store panels at temperatures below 90 degrees F, and between 20 and 70 percent humidity. Replace defective or damaged materials.

1.5.3 Handling

Materials shall be handled and protected in a manner to prevent damage during the entire construction period.

1.6 EXTRA MATERIALS

Provide 10 percent floor panels complete with specified floor covering for future use.

1.7 RELATED WORK

Carpet tile overlayment is provided under Section 09 68 00 CARPET.

PART 2 PRODUCTS

2.1 BUY AMERICAN ACT

This solicitation is subject to the Buy American Act requirements as defined in the Federal Acquisition Regulation (FAR) Clauses 52.225-9 and 52.225-10.

2.2 FLOOR PANELS

Floor panels may contain post-industrial or post-consumer recycled content. See Section 01 33 29 LEED(TM) DOCUMENTATION for cumulative total recycled content requirements.

2.2.1 Floor System Drawings And Planer Quality

- a. Submit Fabrication Drawings for elevated floor systems consisting

of fabrication and assembly details to be performed in the factory.

- b. Indicate on Location Drawings exact location of pedestals, cable cutouts, and the panel installation pattern.
- c. Provide Detail Drawings showing details of the pedestals, pedestal-floor interlocks, floor panels, panel edging, floor openings, cutout treatment, and peripheral support facilities.
- d. Design and workmanship of the floor, as installed, shall be completely planar within plus or minus 0.060 inch in 10 feet, 0.100 inch for the entire floor, and 0.030 inch across panel joints.
- e. Floor-panel joint-width tolerances shall be 0.017 inch as measured with a feeler gage at any point in any joint when the panels are in the pressure contact required in final installation.

2.2.2 Panel Construction

- a. Base access floor system on a 24 by 24 inch square module providing clearance as indicated between structural floor and bottom of finished floor. Fabricate so accurate job cutting and fitting may be done using standard sizes for perimeters and around columns.
- b. Provide cutouts and cutout closures to accommodate utility systems. Reinforce cutouts to meet design load requirements. Provide extra support pedestals at each corner of cutout for cutout panels that do not meet specified design load requirements.
- c. Use panels of uniform dimensions within specified tolerances. Permanently mark panels to indicate load rating and model number.
- d. Machine square floor panels to within plus or minus 0.005 inch with edge straightness plus or minus 0.0025 inch.

2.2.2.1 Metal-Clad Cementitious Fill (Composite Panels)

- a. Provide composite panels of die-formed steel construction totally enclosing the panel, including the top surface. The void spaces between the top sheet and the formed steel bottom sheet shall be completely filled with an incombustible cementitious or concrete material. Seal cut edges in accordance with manufacturer's recommendations. Gravity held panels with bolted stringer understructure: Fasten end of each stringer and mid-point of each 4 foot stringer positively to pedestal heads, using manufacturer's standard screws. Provide screws that are removable from top.
- b. Grid supported panels shall be further tested by supporting them at two opposite edges and applying a 500-pound load at the center of a panel selected; the panel shall be similarly tested while supported at the other 2 edges. Weld failure at any point under this loading is not acceptable. This additional test shall be applied to one panel per 500 square feet of floor in the system, but in no case less than 2 panels. When any weld fails, the number of panels designated by the SRE/CO shall be similarly tested; replace those panels that have a weld failure at no cost to the Government.

2.2.2.2 Lightweight Concrete Panels

Lightweight concrete panels must be of lightweight structural concrete with either structural reinforcing or a die-formed, electro-galvanized steel bottom pan. All concrete surfaces, including those resulting from field cuts, must be sealed with the manufacturer's standard sealer before covering the surfaces with other materials. (Amendment 4)

2.2.3 Accessories

Provide the manufacturer's standard transition type where indicated.

2.2.4 Lifting Device

Provide each individual room with one floor panel lifting device standard with the floor manufacturer. Furnish a minimum of 2 devices.

2.3 PANEL SUPPORT SYSTEM

Design support system to allow for 360 degree clearance in laying out cable and cutouts for service to machines and so that panel and stringer together take up maximum of 2 inches. Submit one sample of each panel type and suspension system proposed for use.

Panel support system may contain post-industrial or post-consumer recycled content. See Section 01 33 29 LEED(TM) DOCUMENTATION for cumulative total recycled content requirements.

2.3.1 Pedestals

Provide pedestals made of steel or aluminum or a combination thereof. Ferrous materials shall have a factory-applied corrosion-resistant finish. Provide pedestal base plates with a minimum of 16 square inches of bearing surface and a minimum of 1/8 inch thickness. Pedestal shafts shall be threaded to permit height adjustment within a range of approximately 2 inches, to permit overall floor adjustment within plus or minus 0.10 inch of the required elevation, and to permit leveling of the finished floor surface within 0.062 inch in 10 feet in all directions. Provide locking devices to positively lock the final pedestal vertical adjustments in place. Pedestal caps shall interlock with stringers to preclude tilting or rocking of the panels.

2.3.2 Stringers

Provide stringers of rolled steel or extruded aluminum, to interlock with the pedestal heads to prevent lateral movement. Provide stringers that can be added or removed after floor is in place.

2.4 FACTORY TESTS

Factory test access flooring, using an independent laboratory, at the same position and maximum design elevation and in the same arrangement as shown on the drawings for installation so as to duplicate service conditions as much as possible.

2.4.1 Load Tests

Conduct floor panel, stringer, and pedestal testing in accordance with

CISCA Access Floors.

2.5 CUT OUTS

Provide cutouts finished with rigid polyvinylchloride or molded polypropylene edging to conform to the appearance level of the floor surface and to cover raw edges of the cutout panel.

- a. Provide non-metallic adapter for openings less than 4 inches wide. Secure adapter adhesively in cutout to preclude removal from panel. Provide at least 2 adapters per 1000 square feet for future use.
- b. Openings larger than 4 inches wide shall use rigid polyvinylchloride or molded polypropylene edging. Perform cutting of panels, including cutouts, outside of the building.
- c. When size of cutout reduces the performance requirement of panel, provide intermediate stringers adjacent to cutouts.

PART 3 EXECUTION

3.1 INSTALLATION

Install the floor system in accordance with the manufacturer's instructions and with the approved detail drawings. Maintain areas to receive access flooring below 90 degrees F, and between 20 and 70 percent humidity for 24 hours prior to and during installation.

3.1.1 Preparation for Installation

Clear of all debris the area in which the floor system is to be installed. Thoroughly clean structural floor surfaces and remove all dust. Install floor coatings, required for dust or vapor control, prior to installation of pedestals, only if the pedestal adhesive will not damage the coating. If the coating and adhesive are not compatible, apply the coating after the pedestals have been installed and the adhesive has cured.

3.1.2 Pedestals

Pedestals shall be accurately spaced, and set plumb and in true alignment. Set base plates in full and firm contact with the structural floor, and secured to the structural floor with steel expansion anchors.

3.1.3 Stringers

Interlock stringers with the pedestal caps to preclude lateral movement, spaced uniformly in parallel lines at the indicated elevation.

3.1.4 Auxiliary Framing

Provide auxiliary framing or pedestals around columns and other permanent construction, at sides of ramps, at open ends of the floor, and beneath panels that are substantially cut to accommodate utility systems. Use special framing for additional lateral support as shown on the approved detail drawings. Provide additional pedestals and stringers designed to specific heights and lengths to meet structural irregularities and design loads. Connect auxiliary framing to main framing.

3.1.5 Panels

Interlock panels with supports in a manner that will preclude lateral movement. Fasten perimeter panels and cutout panels to the supporting components to form a rigid boundary for the interior panels. Floors shall be level within the specified tolerances. Cut edges of composite panels shall be coated with a silicone rubber sealant or with an adhesive recommended by the panel manufacturer.

3.1.6 Repair of Zinc Coating

Repair zinc coating that has been damaged, and cut edges of zinc-coated components and accessories, by the application of a galvanizing repair paint conforming to ASTM A780/A780M. Areas to be repaired shall be thoroughly cleaned prior to application of the paint.

3.2 CLEANING AND PROTECTION

3.2.1 Cleaning

Free of all debris the space below the completed floor. Before carpeting is started, clean the completed floor in accordance with the floor covering manufacturer's instructions.

3.2.2 Protection

Protect traffic areas of raised floor systems with a covering of building paper, fiberboard, or other suitable material to prevent damage to the surface. Cover cutouts with material of sufficient strength to support the loads to be encountered. Place plywood or similar material on the floor to serve as runways for installation of heavy equipment not in excess of design load capacity. Maintain protection until the raised floor system is accepted.

3.2.3 Surplus Material Removal

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work. Remove all installation equipment, surplus materials, and rubbish from the work site.

3.3 SEISMIC SPECIAL INSPECTION AND TESTING

Perform special inspections and testing for seismic-resisting systems and components in accordance with UFC 3-310-04 and Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.4 OPERATION AND MAINTENANCE MANUALS

Submit maintenance instructions for proper care of the floor panel surface.

-- End of Section --

SECTION 26 07 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE Guideline 0-2005

The Commissioning Process

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC

(2009) Leadership in Energy and
Environmental Design(tm) New Construction
Rating System

1.2 DESCRIPTION

- a. The Government is expecting the design and construction of this project to achieve Leadership in Energy and Environmental Design "LEED" Silver. This project will follow LEED NC version 2009 (LEED New Construction and Major Renovations) and ASHRAE Guideline 0-2005. While credit will not be received for Energy and Atmosphere Credit 3 (Enhanced Commissioning), this project shall follow it to the maximum extent possible.
- b. The systems selected for commissioning will be limited to "energy" use equipment i.e., HVAC & R, lighting controls and hot water systems including solar photovoltaic. (Amendment 4)**
- c. Commissioning is the process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the Government's project requirements.
- d. Commissioning is a part of this project and all Contractors performing work governed by this division of the specification shall refer to specification Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS for complete commissioning requirements that apply to all related work within this division.

- e. Commissioning of the EMCS/UMCS devices, water measurement and energy measurement devices is a coordinated effort between the mechanical and electrical commissioning sections. The meter commissioning shall follow applicable provisions of Section 23 08 00 COMMISSIONING OF HVAC AND CONTROL SYSTEMS and this section.
- f. Commissioning Support: The Contractor shall provide onsite qualified manufacturer's technicians when required to make adjustments or demonstrate the correct operation of the equipment at no additional cost. Provide all necessary technical staff, software, and hardware to operate the direct digital controls system to support the commissioning effort at no additional cost.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 48 01 00

COMMISSIONING OF PHOTOVOLTAIC SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE Guideline 0-2005 The Commissioning Process

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC (2009) Leadership in Energy and
Environmental Design(tm) New Construction
Rating System

1.2 DESCRIPTION

- a. The Government is expecting the design and construction of this project to achieve Leadership in Energy and Environmental Design "LEED" Silver. This project will follow LEED NC version 2009 (LEED New Construction and Major Renovations) and ASHRAE Guideline 0-2005. While credit will not be received for Energy and Atmosphere Credit 3 (Enhanced Commissioning), this project shall follow it to the maximum extent possible.
- b. The systems selected for commissioning will be limited to "energy" use equipment i.e., HVAC & R, lighting controls and hot water systems including solar photovoltaic.
- c. Commissioning is the process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the Government's project requirements.
- d. Commissioning is a part of this project and all Contractors performing work governed by this division of the specification shall refer to specification Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS for complete commissioning requirements that apply to all related work within this division.
- e. Commissioning of the photovoltaic system, EMCS/UMCS devices, water measurement and energy measurement devices is a coordinated effort between the mechanical and electrical commissioning sections. The meter commissioning shall follow applicable provisions of Section 23 08 00 COMMISSIONING OF HVAC AND CONTROL SYSTEMS, Section 26 07 00 COMMISSIONING OF ELECTRICAL SYSTEMS, and this section.
- f. Commissioning Support: The Contractor shall provide onsite qualified manufacturer's technicians when required to make

adjustments or demonstrate the correct operation of the equipment at no additional cost. Provide all necessary technical staff, software, and hardware to operate the direct digital controls system to support the commissioning effort at no additional cost.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 48 14 00

SOLAR PHOTOVOLTAIC MEMBRANE ROOFING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

Provide solar photovoltaic thin film, flexible membrane roofing system, complete including, but not limited to:

- a. Solar flexible, thin film, laminate with pre-applied adhesive, roof panels integrated within the standing seam metal roof
- b. Solar array combiner boxes
- c. Solar array DC disconnect switch
- d. DC to AC inverter
- e. Isolation transformer
- f. AC disconnect switch

1.2 RELATED WORK SPECIFIED ELSEWHERE

- a. Standing Seam Galvanized Aluminum Roofing - Section 07 41 13 METAL ROOF PANELS: Coordinate photovoltaic system requirements, including ridge and midspan roof caps to conceal wiring, with Section 07 41 13 METAL ROOF PANELS and architectural drawings.
- b. Wiring and conduits from solar roof panels to the Solar Electric System Balance of System equipment as specified under DIVISION 26 - ELECTRICAL.
- c. Utility interface and utility-required equipment as specified on the electrical drawings.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE

ASCE/SEI 7-05 (2005; R 2006) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C603 (2004; R 2008) Extrusion Rate and Application Life of Elastomeric Sealants

ASTM C681 (2014) Standard Test Method for Volatility of Oil- and Resin-Based, Knife-Grade, Channel Glazing Compounds

ASTM C907 2012) Standard Test Method for Tensile Adhesive Strength of Preformed Tape Sealants by Disk Method

ASTM D217	(2010) Cone Penetration of Lubricating Grease
ASTM D297	(1993; R 2006) Rubber Products - Chemical Analysis
ASTM D412	(2006ae2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D71	(2009) Standard Test Method for Relative Density of Solid Pitch and Asphalt (Displacement Method)
ASTM D746	(2007) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1337	Standard Practice for Storage Life of Adhesives by Viscosity and Bond Strength
ASTM D3359	(2009e2) Measuring Adhesion by Tape Test
ASTM E96/E96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	Radio Frequency Devices (47 CFR 15)
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012) National Electrical Safety Code
IEEE 519	(1992) Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems
IEEE 928	(1996) Recommended Criteria for Terrestrial PV Power Systems
IEEE 929	(2000) Recommended Practice for Utility Interface of Photovoltaic Systems
IEEE 1373	Recommended Practice for Field Test Methods and Procedures for Grid-Connected PV Systems
IEEE 1374	Guide for Terrestrial PV Power System Safety

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2009; Errata First Printing) International Building Code
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INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 1173	Overvoltage Protection for PV Power
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Generating Systems

IEC 1277	Guide General Description of PV Power Generating System
IEC (6)1646	Thin Film Terrestrial Photovoltaic Modules
IEC 1721	Susceptibility of a Module to Accidental Impact Damage (Resistance to Impact Test)
IEC 1727	PV Characteristics of the Utility Interface

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
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UNDERWRITERS LABORATORIES (UL)

UL 1741	(1999) Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems
UL 1703	Standard for Safety for Flat-Plate Photovoltaic Modules and Panels

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System
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1.4 DEFINITIONS

Abbreviations used in this section have the following meanings:

A	Ampere (also I)
AC	Alternating current
AM 1.5	Air Mass 1.5
BOS	Balance of system
DC	Direct current
deg. or N	Degree
IMax	Maximum current
ISC	Short circuit current
J	Joule
lbf	foot-pounds
min	minimum
MPPT	maximum power point tracking
N	Newton
%	percent
PV	Photovoltaic
psi	Pounds per square inch
SI	Solar irradiance
V	Volt
Vmax	Maximum voltage

Voc Open circuit voltage
W Watt

1.5 SYSTEM DESCRIPTION

- a. The solar PV membrane roofing system shall be designed for installation over a completed aluminum standing seam metal roof panel system. The system shall comply with IEEE 928 and IEEE 1374.
- b. The solar PV roof panels shall be flexible, laminates with pre-applied butyl rubber based, adhesive backing , roofing adhesive designed to serve the bi-functional needs of roofing and power generation. The panel shall consist of flexible PV modules, factory fused to a single-ply roofing sheet with integral reinforcement for high strength and containing ultraviolet (UV) stabilizers, flame retardant and biocide. Panels shall be made from either Copper Indium Gallium diSelenide (CIGS) or Triple Junction Amorphous Silicone Solar cells. Panels shall be designed to fit within and adhere to 16 inch standing seam metal roofing. Each solar panel shall be capable of generating DC power. The system shall be formulated for stability in low light and continuous exposure to ambient weather conditions. The non-glass cover shall be made of a durable, non-breakable, walk-over high light-transmissive, UV stabilized polymer to repel dust and environmental pollutants.
- c. The wiring interconnecting leads from the PV modules shall be two factory installed, positive and negative #12 wires embedded within the output of the PV module membrane. The PV modules shall have a stainless steel substrate and bypass diodes for each cell for shade tolerance.

1.6 SUBMITTALS

Government approval by the SRE/CO is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval; the Government reserves the right to review and comment on submittals not having a "G" designation; and submittals with an "L" are for LEED review. LEED review shall be performed by the Contractor's LEED Coordinator and the LEED Administrator. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 01 33 29 LEED(TM) DOCUMENTATION as applicable:

SD-02 Shop Drawings

Solar Roof Panels

Submit complete shop drawings showing plans, sections, elevations and details.

- a. Roof plan flexible PV laminate panel layout. Submit a wind uplist study.
- b. Include locations and types of all penetrations, drains, vents and mechanical equipment.
- c. Show all roof structures and screens, dimensioned for size and location.

d. Provide site plans and elevations showing all adjoining shading structures, including trees, adjacent buildings and structures. Indicate location, height, and type of structure.

e. Electrical single line diagram and three-line diagram.

f. Electrical equipment room layout drawing to scale.

SD-03 Product Data

Solar Roof Panels

Describe physical characteristics, sizes, patterns, and method of installation.

SD-07 Certificates

Qualifications

Submit certified evidence of installer's qualifications and experience record in installation of solar roof panel systems, or submit certification from manufacturer of solar roof panels that proposed installer has been trained by manufacturer's representatives and is considered by manufacturer to be fully qualified to install the system.

Warranty

Roofing and solar panel manufacturer's written 20 year warranty on standing seam metal roofing and solar panels.

Solar panel manufacturer's 20 year warranty covering power output of panels and 5 year warranty of rebated material and workmanship.

SD-08 Manufacturer's Instructions

Solar Roof Panels

Submit manufacturer's detailed installation manual.

SD-11 Closeout Submittals

Compliance with Regulatory Requirements

Submit evidence indicating compliance with State and local building codes.

Operation and Maintenance Manual

Submit manufacturer's recommended cleaning and maintenance data. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

Record Drawings

Provide complete drawings showing dimensioned locations of panels, junction boxes, combiner boxes, disconnect switches and

isolation transformer. Provide complete wiring and circuit diagrams.

1.7 QUALITY ASSURANCE

1.7.1 Qualifications

- a. Manufacturer: Company specializing in solar roof panel system manufacturing with a minimum of 4 continuous years of documented experience.
- b. Installer: Company with a minimum of 3 years documented experience in the installation of solar power systems on standing seam metal roof systems, approved by manufacturers of both.
- c. Submit a list of at least five 5 installations that have been in use for a minimum of two years using solar power systems as described in this document. Include contact name and phone numbers.
- d. Installer shall be certified by the manufacturer.

1.7.2 Compliance with Regulatory Requirements

The installation of solar panels and electrical components shall be performed in compliance with IEEE 928, IEEE 929, IEEE 1374, IEC 1277, NFPA 70 Article 690 - Solar Photovoltaic Systems and Article 705 - Interconnected Electric Power Production Sources, the National Electrical Safety Code (IEEE C2), Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1910), International Building Code (ICC IBC), State and local codes.

1.7.3 Environmental Impact Characteristics

The system shall qualify for Leadership in Energy and Environmental Design (LEED NC) credit category EA 2.2 (7 to 9 percent annual electrical energy cost supplied by solar sources).

1.7.4 Pre-Installation Meeting

After approval of submittals but prior to beginning installation of work of this Section, conduct a meeting at the site attended by QC Manager, SRE/CO, Contractor, installers of roof panel system and related electrical work to be installed with the system, to describe in detail the installation process and to establish agreement, coordination, safety and responsibilities. Prepare a detailed report of this meeting and furnish copies to the SRE/CO and all attendees.

1.7.5 Record Drawings

Submit record drawings.

1.8 DELIVERY, STORAGE AND HANDLING

Solar roof panels shall be stored in an ambient temperature of 40.1 degrees F to 80.1 degrees F. Panels shall be delivered to the site in the original unopened containers or wrappings. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture. Leave protective packaging in place until panels are installed. Panels shall be

handled so that the solar modules are not creased or bent and panels shall not be coiled tighter than 18 inches in diameter.

1.9 PROJECT SITE CONDITIONS

1.9.1 Coordination

The installation of solar PV membrane roofing system requires close coordination between the work of installation of the basic roofing system, the electrical wiring connecting the various components, installation of the panels and their connections, and wiring connections to the combiner boxes, DC disconnect, inverters, AC disconnect and isolation transformer.

1.10 SYSTEM STARTUP

Furnish the services of a trained representative of the solar panel manufacturer to instruct the Government personnel in operation and routine maintenance of the solar panel system for a period of not less than one day at a time or as directed by SRE/CO.

1.11 OPERATION AND MAINTENANCE MANUAL

Furnish a complete operation and maintenance manual to the SRE/CO at time of system startup.

1.12 WARRANTY

Provide certified copies of the following manufacturer's product warranties:

- a. Roofing and solar panel manufacturer's written 20 year warranty on standing seam roofing and solar panels against all defects in materials or workmanship and to maintain work of this section in watertight condition for 20 years; warranty shall include connections to roof drainage fittings, sheet metal in connection with roofing.
- b. Solar panel manufacturer's 20 year warranty covering power output of panels and 5 year warranty of rebated material and workmanship.
- c. PV Power Output Warranty: Standard form in which manufacturer agrees to repair or replace PV modules that fail to perform as follows:
 - (1) Produce a minimum of 92% of the minimum power output rating during the first 10 years
 - (2) Produce a minimum of 84% of the minimum power output rating during years 11 - 20
 - (3) Produce a minimum of 80% of the minimum power output rating during years 21 - 25

PART 2 PRODUCTS

2.1 BUY AMERICAN ACT

This solicitation is subject to the Buy American Act requirements as defined in the Federal Acquisition Regulation (FAR) Clauses 52.225-9 and 52.225-10.

2.2 SOLAR ROOF PANELS

a. Solar Photovoltaic Panels consisting of flat PV cells, factory laminated to 60 mil roof membrane sheets. Membrane sheets shall be heat-weldable roof membrane, reinforced with integral fiberglass mat. Membrane sheets shall contain UV light stabilizers, flame retardant and biocide. Sheet shall be formulated for direct exposure to weather. Solar PV panels shall comply with UL 1703, IEC (6)1646 and IEC 1721. Solo-Power, Xunlight or equal flexible, PV laminate, modules.

b. Physical Characteristics: Panels shall be as follows:

(1) Length: 86.5 inches or 212.3 inches

(2) Width: 15.7 inches or 14.9 inches

(3) Weight Per Sheet: 4.6 pounds or 11.7 pounds (1 Panel)

(4) Rated DC Power (Watts):

STC 95 or 144: Standard Test Conditions (full sun, 95 watts, 77 degrees F ambient temperature, air mass 1.5) full sun, 144 watts, 77 degrees F ambient temperature, air mass 1.5

PTC 90.7: PTC: PV USA Test Conditions (full sun, 90.7 watts, 68 degrees F ambient temperature, air mass 1.5, wind speed 5 mph at 33 feet above the ground) or (full sun, 122.4 watts, 68 degrees F ambient temperature, air mass 1.5, wind speed 5 mph at 33 feet above the ground)

(5) Nominal Operating Voltage: 26.2 or 35.2 each

(6) Operating Voltage (volts): 26.2 or 35.2 each

(7) Operating Current (amps): 3.6 or 4.09 each

(8) Open-Circuit Voltage (volts): 34.8 or 48.4 each

(9) Short Circuit Current (amps): 4.2 or 5.1 each

(10) Series Fuse Rating (amps): 7 or 8 each

(11) Minimum Blocking Diode (amps): 7 or 8 each

c. Adhesive Characteristics:

PARAMETERS	ASTM TEST METHOD	TYPICAL VALUE
Color	Visual	Black
Permeability	ASTM E96/E96M	0.60 Perm-Mils

Hardness	ASTM D217	110 dmm
Ash Content	ASTM D297	16 percent
Brittleness Temperature	ASTM D746	-50 degrees F
Solids Content	ASTM C681	98 percent
Tensile Adhesive Strength	ASTM C907	35 psi (alum)
Tensile Strength (tape)	ASTM D412	50 psi min
Elongation (tape)	ASTM D412	>1000 percent
Specific Gravity -40 degrees F	ASTM D71	0.97
ADHESIVE STRENGTH:		
Peel Strength on PVDF Coated Metal		12 psi @ 70 degrees F
Shear Strength on PVDF Coated Metal		15 psi @ 70 degrees F
Service Temperature	ASTM D3359	-40 to 250 degrees F
Application Temperature	ASTM C603	-40 to 250 degrees F
Storage Temperature	ASTM D1337	68 to 250 degrees F
Minimum Shelf Life 7.3 ft-lbf	ASTM D1337	2 years

2.3 BALANCE OF SYSTEM COMPONENTS (BOS)

2.3.1 Solar Array Combiner Boxes

UL listed, series fusing or circuit breakers for solar roof panel source circuits in NEMA 3 or NEMA 3R enclosure as required.

2.3.2 Solar Array DC Disconnect Switches

UL listed, heavy duty fused safety switches on the output of the solar array in NEMA 3 or NEMA 3R enclosures as required.

2.3.3 DC-to-AC Inverter

High efficiency, UL listed, utility interactive, phase, voltage and current matched to line and load, with maximum power point tracking (MPPT) electronics, over- and under-voltage and frequency protection in accordance with requirements of UL 1741, harmonic control in accordance with IEEE 519, and anti-islanding protection as required by IEEE 929. Inverter shall have automatic start-up, shut-down, self-diagnosis, and fault detection. The units shall comply to FCC Electromagnetic Interference (EMI) Part 15, Subparts A, B and J (FCC Part 15), and IEC 1727.

2.3.4 Isolation Transformer

UL listed or UL Recognized when combined with the approved inverter, high efficiency, low impedance, noise filtering, NEMA 3 or NEMA 3R enclosure as required.

2.3.5 AC Disconnect Switch

UL listed heavy duty fused safety switch on the output of isolation transformer in NEMA 3 or NEMA 3R enclosure as required.

2.3.6 kWh Meter Socket and Meter Main

As required by the local electrical utility company, shall be phase, voltage and current matched to load, 10k RMS amperes short circuit current rated or higher with utility approval, UL listed, NEMA 3 or NEMA 3R enclosure as required, including required openings and lugs.

2.3.7 Electric Service Panel Interconnection

UL listed circuit breaker or tap, in accordance with National Electrical Code, local codes and local electric utility company requirements. Circuit breaker or tap shall be located in existing or new electric service panel enclosure as required.

PART 3 EXECUTION

3.1 EXAMINATION

- a. Verify that the DC to AC inverters have ground fault protection and that the DC circuits of the PV system are not earth grounded.
- b. Verify that roof temperature is a minimum of 60 degrees F for proper adhesive performance.

3.2 SPECIAL CAUTION TO BE OBSERVED IN WORKING WITH THE PANELS

- a. The solar roof panel system contains live electrical components enclosed and protected within. Do not cut or drive screws into any part of the Solar Roof Panel and System where solar panels or wiring are present which includes, but is not limited to the Uni-Solar module, the inter-panel wiring assembly and the rooftop solar array wiring.
- b. Avoid electrical hazards when installing, wiring, operating and maintaining the solar roof panel and all other electrical equipment.
- c. The panels generate DC electricity when exposed to sunlight or other light sources.
- d. Do not touch the exposed copper wire leads while the panel is exposed to light or during installation. Use properly insulated tools only.
- e. Work only under dry conditions with a dry panel and tools.
- f. The solar roof panels are slippery when wet. Use extreme caution and proper roof safety practices when working on or near the panels.
- g. Do not stand or step on the panels.
- h. Do not drop panels or allow objects to fall on the panels. Do not place equipment on the panels.

- i. Cover solar panels with an opaque material before making wiring connections to reduce the risk of electric shock or sparks.
- j. Do not leave panels unsecured. Keep the panel front and back surface free from foreign objects.
- k. Do not install panels where flammable gases or vapors are present since sparks may be produced.
- l. Do not drill or cut holes in the panel solar modules or wiring. Avoid sharp edges.
- m. Artificially concentrated sunlight shall not be directed on the panel.
- n. Use the panel for its intended use only. Do not disassemble the panel or remove any part or label installed by the manufacturer.

3.3 PREPARATION

The roof deck shall be structurally sound, clean, dust free, smooth and level. Cracks and holes in excess of 1/16-inch should be filled with an underlayment material.

3.4 INSTALLATION

3.4.1 Sequence of Installation

- a. Make a solar panel roof layout drawing to include conduit runs, junction boxes, combiner boxes and electrical homerun to the DC disconnect switch and inverter.
- b. Clean the roof deck surface of dirt, debris and foreign materials.
- c. Locate the panels as indicated and in accordance with IEEE C2 and ASCE/SEI 7-05. Do not install wiring in conduit at this time.
- d. Locate the panels as indicated. Do not install wiring in conduit at this time.
- e. Install conduit, junction boxes and combiner boxes on the roof deck per standard commercial practices and codes.
- f. Install insulation board and gypsum board in accordance with manufacturers' recommendations and mark conduit runs to prevent penetrating conduit with roofing nails or screws.
- g. Install a single-ply roof in accordance with manufacturer's recommendations.
- h. Before installing solar panels, feed a mandrel through conduit to ensure that conduit is clear of roofing nails or screws. Install solar panels in accordance with manufacture's recommendations and approved submittals.
- i. Feed the solar panel wiring into the junction box and conduit.
- j. Attach the solar panel perimeter to the roof membrane in

accordance with the recommendations of panel manufacturer, roofing manufacturer and the approved submittals.

- k. Complete the panel wiring in the combiner box and array homerun.
- l. Install and connect the Balance of System (BOS) equipment (Combiner Box, DC Disconnect Switch Inverter, Isolation Transformer, AC Disconnect Switch and Utility Interconnection equipment) in accordance with IEEE 929 and IEC 1173.
- m. Inspect, test and startup the solar power system in accordance with the panel solar panel manufacturer's installation manual and in accordance with IEEE 1373.

3.4.2 Installation of Underlayment

- a. Install underlayment to span routed channels for conduits within insulation and to provide secondary cover for conduits and insulation.
- b. Install underlayment in manner to provide smooth uniform surface for roof membrane installation, and to comply with Class A or B Fire Rating as required.
- c. Installation of Roof Membrane: Install roof membrane over underlayment.
- d. Installation of Flexible Membrane Integrated PV Panels:
 - (1) Install modules over roof membrane immediately by hot-air welding in accordance with manufacturer's instructions.
 - (2) Install modules in location and orientation as indicated on the drawings.
 - (3) Install modules in accordance with NFPA 70.
- e. Wire solar PV membrane roofing system as specified on the electrical drawings.
- f. Install solar array combiner box, array DC disconnect switch, inverter, isolation transformers and other equipment in accordance with the electrical drawings.

3.5 FIELD QUALITY CONTROL

- a. An authorized representative of the manufacturer shall inspect the installation periodically during construction and at completion to assure that the system is installed in compliance with these specifications.
- b. Upon completion, in addition to code required testing of electrical components and system, megger test each circuit, and furnish a report of the tests to the SRE/CO.

3.6 ADJUSTING

Adjust electrical components for proper operation.

3.7 CLEANING

Immediately prior to final acceptance, clean the panels and electrical components.

3.8 PROTECTION

Protect finished installation.

-- End of Section --