

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 - GENERAL

1.1 1.2 SUMMARY

- A. General: This Section specifies administrative and procedural requirements for field-engineering services including, but not limited to, the following:
 - 1. Land survey work.
 - 2. Civil-engineering services.
 - 3. Damage surveys.
 - 4. Geotechnical monitoring.
 - 5. As-Built documentation.
 - 6. Non-destructive testing services through electromagnetic investigation.

1.2 SUBMITTALS

- A. Certificates: Submit a certificate signed by the land surveyor or professional engineer certifying the location and elevation of improvements.
- B. Final Property Survey and As-Built documentation Survey: Submit 2 paper copies, 1 mylar and and CD/DVD of AutoCAD & PDF files of the final property survey (42"x30" format).

1.3 QUALITY ASSURANCE

- A. Surveyor Qualifications: Engage a land surveyor registered in the State of Florida to perform required land-surveying services.
- B. Engineer Qualifications: Engage an engineer of the discipline required, licensed in the State of Florida to perform required engineering services.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Identification: The Contractor will be required to establish its own Project control points.
- B. Verify layout information shown on the Drawings, in relation to the property survey, existing benchmarks and location of existing underground or concealed utilities and conduits, before proceeding to lay out the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
 - 1. Do not change or relocate benchmarks or control points without prior written approval of the OAR. Promptly report lost or destroyed reference points or requirements to relocate reference points because of necessary changes in grades or locations.

2. Promptly replace lost or destroyed Project control points utilizing the original survey control points.
 3. Establish and maintain a minimum of 5 permanent benchmarks on the site, referenced to data established by survey control points.
 4. Record benchmark locations, with horizontal and vertical data, on Project As-Built Documents.
- C. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground or concealed utilities and other construction by use of non-destructive testing through electromagnetic investigation.
1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping. Document the information on the As-Built Documents.
 2. Develop a detailed plan for non-destructive testing service by use of electromagnetic investigation that includes the following (at a minimum):
 - a. area of investigation
 - b. depth of investigation
 - c. items to be located
 - d. operational constraints

3.2 PERFORMANCE

- A. Work from lines and levels established by the contract documents. Establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
1. Advise entities engaged in construction activities of marked lines and levels provided for their use.
 2. As construction proceeds, check every major element for line, level, and plumb.
- B. Surveyor's Log: Maintain a surveyor's log of control and other survey work. Make this log available for reference to the OAR and the Designer.
1. Record deviations from required lines and levels, and advise the OAR when deviations that exceed indicated or recognized tolerances are detected. On Project As-Built Drawings, record deviations that are accepted and not corrected.
- C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels, and control lines and levels required for mechanical and electrical work.
- E. Existing Utilities: Furnish information necessary to adjust, move, or relocate existing structures, utility poles, lines, services, or other appurtenances located in or affected

by construction. Coordinate with the appropriate Utility and the local Authorities Having Jurisdiction.

- F. As-Built Documents: All concealed and underground utilities, equipment, foundations or other permanent conditions shall be surveyed and documented on the As-Built Documents. This includes all discovered conditions. All shall be tied to permanent benchmarks showing horizontal and vertical data. GPS coordinates are to be provided for all beginning/end points and changes in direction. See Closeout Submittals 01 78 00 for all As-built requirements.
- G. Final Property Survey: Prepare a final property survey showing significant features (real property) for the Project. Include on the survey a certification, signed by the surveyor, that principal metes, bounds, lines, and levels of the Project are accurately positioned as shown on the survey.
 - 1. Recording: At Substantial Completion, have the final property survey recorded by or with local governing authorities as the official "property survey."

END OF SECTION 01 71 23

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Installation of the Work.
 - 2. Coordination of Owner-installed products.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 23 "Design Submittals, Shop Drawings, Product Data, and Samples" for submitting surveys.
 - 3. Section 01 35 46 "Indoor Air Quality" for air quality measures.
 - 4. Section 01 74 19 "LEED v4 Construction Waste Management and Disposal" for waste disposal.
 - 5. Section 01 78 00 "Closeout Submittals" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 6. Section 01 8113.14 "Sustainable Design Requirements - LEED v4 BD+C" for LEED requirements.
 - 7. WS-110 project Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

- B. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 "Project Management and Coordination."

3.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01 78 00 "Closeout Submittals" for repairing or removing and replacing defective Work.

3.4 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with the requirements of GS-42 "Green Seal Environmental Leadership Standard for Commercial Cleaning Services" and Section 01 35 46 "Indoor Air Quality".
 2. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 3. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 5. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 45 00 "Quality Control".

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes cutting into existing construction to provide for installation or performance of the Work, subsequent fitting, and patching required to restore surfaces to original condition.
 - 1. Execute cutting, fitting, and patching, including excavation and backfill, required to perform Work and to:
 - a. Make parts fit together properly.
 - b. Remove and replace defective work.
 - c. Remove and replace Work not conforming to requirements of Contract Documents.
 - d. Uncover Work to allow for the OAR's observation of covered Work which has been covered prior to required observation of the OAR.
 - 2. Drilling of holes for the installation of fasteners and similar operations is not considered to be cutting and patching.

1.2 BUILDING MODIFICATIONS

- A. General: Modifications to existing facilities and structures shall be provided as indicated and as necessary to accomplish the Work.
 - 1. Modifications shall include the removal of existing structure, relocation of materials indicated, termination and relocation of utilities, cutting, patching, cleaning, adjusting, and refinishing, and all incidental work related and required for the installation of new Work.
 - 2. It is intended to maintain daily occupancy functions during the progress of this Work. The Contractor shall closely coordinate his Work to minimize any inconvenience to the Owner or Owner's operations.
 - 3. No Public Services or utility systems shall be interrupted without first notifying the OAR and obtaining concurrence for the interruption as instructed in Section 01 31 14.13.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable:
 - 1. Describe the extent of cutting and patching required and how it is to be performed.
 - 2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 - 3. List products to be used and firms that will perform Work.
 - 4. Indicate dates when cutting and patching is to be performed.

5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
 6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
 7. Approval by the OAR to proceed with cutting and patching does not waive the Owner's right to later require complete removal and replacement of Work found to be cut and patched in an unsatisfactory manner.
- B. Hot Work and Dust Hazard - Notify the OAR 48 hours (excluding weekends and holidays) in advance of any welding, cutting, burning, soldering, dust activities or any hot work. Utilize the Owners Hot Work/Dust Hazard Permit Forms.

1.4 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.
1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Electrical wiring systems.
 - d. Control systems.
 - e. Communications systems.
 - f. Conveying systems.
 - g. Shoring, bracing, and sheeting.
 - h. Primary operational systems.
 - i. Air or smoke barriers.
 - j. Fire protection systems.
 - k. Noise and vibration control elements and systems.
 - l. Water lines.
 - m. Sewer lines.
 - n. Other special construction.
- C. Visual Requirements: Do not cut and patch construction in a manner that would degrade the building's aesthetics, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched unsatisfactorily.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, obtain the OAR's

approval to use substitute materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

- B. Verify that new materials are compatible with existing materials in all respects where cutting and patching occurs.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
 - 1. Before proceeding, meet at the site with all parties involved in cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts with OAR before proceeding.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
 - 1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- C. Cutting: Take all precautions necessary to avoid cutting existing pipe or conduit serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.
 - 1. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
 4. Comply with requirements of applicable sections of Division 31 specifications where cutting and patching requires excavating and backfill.
 5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
 - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat.
 4. Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.4 CLEANING

- A. Thoroughly clean areas where cutting and patching is performed or used as access. Remove completely any paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29

SECTION 01 74 19 – LEED V4 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.
- G. Source Separation: Sorting of different materials comprising a waste (such as glass, concrete, wood, metal, drywall, etc.) at its point of generation

1.3 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. In addition to the above diversion rate goals, Contractor shall identify a minimum of 4 (four) other single stream, source separated materials. Single source streams shall be included within their Waste Management Plan and source separated shall be implemented for those streams. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials including the following:
 - 1. Demolition Waste:

- a. Asphalt paving.
- b. Concrete.
- c. Concrete reinforcing steel.
- d. Brick.
- e. Concrete masonry units.
- f. Wood studs.
- g. Wood joists.
- h. Plywood and oriented strand board.
- i. Wood paneling.
- j. Wood trim.
- k. Structural and miscellaneous steel.
- l. Rough hardware.
- m. Roofing.
- n. Insulation.
- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.
- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- n n. Switchgear and panelboards.
- oo. Transformers.
- 2. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.

- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - m. Paper.
 - n. Cardboard.
 - o. Boxes.
 - p. Plastic sheet and film.
 - q. Polystyrene packaging.
 - r. Wood crates.
 - s. Plastic pails.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste – South Terminal C.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site. Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.

2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- B. Lighting Fixtures: Separate lamps by type and protect from breakage.
- C. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to OAR.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.

5. Remove recyclable waste from property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- F. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Division 32 sections for use of clean sawdust as organic mulch.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from property and legally dispose of them.

END OF SECTION 01 74 19

SECTION 01 74 23 - FINAL CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: final cleaning at completion of work by individual trade and at Substantial Completion.
- B. Environmental Requirements: Final cleaning shall comply with Green Seal Standard GS 42.
- C. Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.
- D. Sustainable Design Requirements: Final cleaning shall comply with the requirement in Section 01 81 13.14 "Sustainable Design Requirements - LEED v4 BD+C".
- E. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
- F. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the material to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. The cleaning products utilized shall be Green Seal complying with one or more of the following standards; by category:
 - a. Green Seal GS-37, for general-purpose, bathroom, glass and carpet cleaner use for industrial and institutional purposes
 - 1) Environmental Choice CCD-110, for cleaning and degreasing compounds
 - 2) Environmental Choice CCD-146, for hard-surface cleaners
 - 3) Environmental Choice CCD-148, for carpet and upholstery care.
 - b. Disinfectants, metal polish, floor finishes, strippers or other products not addressed by GS-37 or Environmental Choice CCD-110, 146, or 148 shall meet at least one of the following standards for the appropriate category:
 - 1) Green Seal GS-40, for industrial and institutional floor-care products
 - 2) Environmental Choice CCD-112, for digestion additives for cleaning and odor control
 - 3) Environmental Choice CCD-113, for drain or grease-trap additives

- 4) Environmental Choice CCD-115, for odor-control additives
- 5) Environmental Choice CCD-147, for hard-floor care
- c. California Code of Regulations maximum allowable VOC levels for the specific product category.
- d. The product shall not contain alkyl phenol ethorylates, dibutyl phthalate heavy metals, ozone-depleting compounds or optical brighteners.
- e. The product shall not be tested on animals.
- f. Cleaning materials and agents shall be in accordance with manufacturers recommendations. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

2.2 PROHIBITED PRODUCTS

- A. The following products shall not be utilized within the Work:
1. Diversey Care a division of Sealed Air; Bravo Heavy-Duty Low Odor Stripper.
 2. Diversey Care a division of Sealed Air; BreakDown XC 40 Odor Eliminator Concentrate Fresh.
 3. Diversey Care a division of Sealed Air; Alpha-HP Multi-Surface Cleaner.
 4. Diversey Care a division of Sealed Air; Crew Clinging Toilet Bowl Cleaner.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final-cleaning operations. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- B. Cleaning Operations: Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.
1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.
 2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 3. Broom clean concrete floors in unoccupied spaces.
 4. Remove petrochemical spills, stains, and other foreign deposits.
 5. Remove tools, construction equipment, machinery, and surplus material from the site.
 6. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
 7. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

8. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.
 9. Remove marks, stains, fingerprints, and other soils or other dirt from painted, decorated, and natural finished woodwork and other Work.
 10. Clean cabinet work removing stains, paint, dirt and dust.
 11. Remove spots, plaster, soil and paint from ceramic tile, marble, and other finished materials, and wash or wipe clean.
 12. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 13. Clean flooring materials thoroughly, comply with materials manufacturer's instructions and recommendations.
 14. Remove labels that are not permanent labels.
 15. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - a. All restoration efforts shall be in strict accordance with LEED v4 requirements for Low Emitting Materials.
 - b. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 16. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
 17. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 18. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 19. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
 20. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 21. Clean ductwork, blowers, and coils of units that were operated during construction.
 22. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 23. Leave the Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.
- D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

- E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.
 - 1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the OAR.
 - 2. The Contractor shall not dispose of debris or waste materials on the Owner's property without the prior approval of the Owner.
- F. Maintenance: Provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

3.2 PROTECTIONS

- A. General: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 - 1. Excessive static or dynamic loading.
 - 2. Excessive internal or external pressures.
 - 3. Excessively high or low temperatures.
 - 4. Thermal shock.
 - 5. Excessively high or low humidity.
 - 6. Air contamination or pollution.
 - 7. Water or ice.
 - 8. Solvents.
 - 9. Chemicals.
 - 10. Light.
 - 11. Radiation.
 - 12. Puncture.
 - 13. Abrasion.
 - 14. Heavy traffic.
 - 15. Soiling, staining, and corrosion.
 - 16. Bacteria.
 - 17. Rodent and insect infestation.
 - 18. Combustion.
 - 19. Electrical current.
 - 20. High-speed operation.
 - 21. Improper lubrication.
 - 22. Unusual wear or other misuse.
 - 23. Contact between incompatible materials.
 - 24. Destructive testing.
 - 25. Misalignment.
 - 26. Excessive weathering.
 - 27. Unprotected storage.
 - 28. Improper shipping or handling.
 - 29. Theft.

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FINAL CLEANING
Section 01 74 23

END OF SECTION 01 74 23

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Closeout is defined to include general submittal requirements in preparation for Substantial Completion, occupancy by Owner and Final Completion of the Work. Specific requirements for individual units of Work are specified in other Sections.

1.2 SUBSTANTIAL COMPLETION

- A. General: Refer to the General Conditions of the Design/Build Contract for Construction.
- B. Substantial Completion:
 - 1. Thirty (30) days prior to requesting inspection for the certification of Substantial Completion, prepare and submit the preliminary LEED Closeout Matrix for acceptance (see specification Section 01 33 29, Sustainable Material Content Forms). Matrix shall identify all relevant specification sections.
 - 2. Five (5) business days prior to requesting inspection for certification of Substantial Completion, prepare and submit to the OAR the following:
 - a. The Contractor's prepared comprehensive punch list of items to be completed or corrected. The punch list shall include all incomplete Work items and the schedule to complete each item.
 - b. Draft Operation and Maintenance (O&M) Manuals for review by the OAR for conformance with the Contract documents. These will be returned to the Contractor.
 - c. As-Built Documents (from Contractor) for review by the OAR for conformance with the Contract Documents. These will be returned to the Contractor.
 - d. The Substantial LEED Closeout Matrix with all available documentation and final documentation delivery status
 - 3. The Contractor shall request a preliminary inspection from the OAR for the determination that the Project is ready for the Substantial Completion Inspection. The Contractor will prior to the request:
 - a. Complete its punch list and provide a copy to the OAR.
 - b. Schedule inspections from the Authorities Having Jurisdiction and provide the time and date of each such inspection to the OAR.
 - 4. If the OAR's preliminary inspection discloses any item that is not in accordance with the requirements of the Contract Documents, whether or not included on the Contractor's punch list, the OAR shall so notify the Contractor and the Contractor shall add the items to its punch list. The Contractor shall proceed to complete or correct every item on the revised punch list and request re-inspection from the OAR.
 - 5. If the OAR determines that the Work is ready, the Substantial Completion Inspection will be scheduled at a minimum of three (3) business days after the OAR's preliminary inspection.
 - 6. Form #008 Substantial Completion Acceptance (SCA) will be used to: document the time and place of the project closeout inspections, establish the participants

- to be involved in the inspections, establish the date of Substantial Completion, document the acceptance of the Substantial Completion punch list, document the date all Substantial Completion punch list items were completed and document the date of Final Completion.
7. The following parties will attend the Substantial Completion inspection: the OAR, the Contractor, the Contractor's Designers and the DCC. The following Owner representatives may attend: GOAA ARFF, GOAA Construction, GOAA Engineering, GOAA Environmental, GOAA IT, GOAA Maintenance, GOAA Operations, GOAA Properties, GOAA Risk Management, and any involved tenant(s).
 8. Following the inspection, the OAR and DCC will determine if the Work is substantially complete. If it is determined to be Substantially Complete, the OAR will use this date in the preparation of Form #007 Certificate of Substantial Completion (CoSC) and the Contractor in the preparation of the written warranties. The following will be used in the determination of the Substantial Completion date:
 - a. Certificate of Occupancy/Certificate of Completion (CofO) or Agency Sign Off (as required). The date of the CofO does not establish the date for Substantial Completion.
 - b. Recommendation from the Designer, OAR and DCC that the Project is Substantially Complete.
 - c. Acceptance from the Contractor and OAR that the preliminary Substantial Completion punch lists represent most of the items required for completion of the Work. The OAR shall distribute the preliminary Substantial Completion punch lists to the Contractor within a maximum of seven (7) business days after the date of Substantial Completion.
 - d. Acceptance by the OAR of the draft warranties.
 - e. Acceptance by the OAR of the draft Operation & Maintenance Manuals.
 - f. Agreement from the Contractor and OAR that the Owner will have complete use or occupancy and may use, operate, and maintain the Project in all respects, for its intended purpose and without undue interference by the Contractor's Final Completion efforts.
 - g. If any of the above items are not accepted or incomplete the Contractor shall correct any items found not to be in accordance with the requirements of the Contract Documents and once the items have been corrected, the Contractor shall provide a written request for re-review and or re-inspection.
 9. When the Project is determined to be Substantially Complete the OAR will prepare a typed Substantial Completion punch list which includes any items from the preliminary Substantial Completion punch list that have not yet been completed plus all punch list items from the Designer, OAR, DCC, Owner and others, and Form #007 Certificate of Substantial Completion (CoSC) within a maximum of fifteen (15) business days from the date of Substantial Completion and will schedule a meeting with the Contractor, Designer, DCC and any Owner's representatives to:
 - a. Review Form #007 CoSC, all of its requirements and submit to the Contractor for appropriate acceptance and signature.

- b. Review the attachments: Form #008 SCA, Substantial Completion punch list and the CofO.
- c. Establish the date for the completion of the Substantial Completion punch list items.
- d. Establish the responsibilities of the Owner and Contractor for security, maintenance, operations, cleaning and housekeeping, heating and cooling, utilities, damage to the Work and insurance.
- e. Review and accept the Contractor's written warranties and guarantees from its Subcontractors and Suppliers bearing the date of Substantial Completion stating the period of warranty as required by the Contract Documents, the Final Operation & Maintenance Manuals, and As-built Documents.

1.3 PARTIAL OCCUPANCY OR USE

- A. General: Refer to the General Conditions of the Design/Build Contract for Construction.
- B. The Owner may occupy or use any completed or partially completed portion of the Work at any stage and, if the Owner chooses such partial occupancy, the Contractor and Owner shall designate by a Partial Occupancy and Use Agreement (POUA), provided such occupancy or use is consented to by the Owner's insurer and authorized by public authorities having jurisdiction over the Work.
 1. Such partial occupancy or use may commence whether or not the portion is Substantially Complete.
- C. Procedures to achieving partial occupancy or use:
 1. The Owner will request the OAR to coordinate with the Contractor for a partial occupancy or use of a portion of the Work.
 2. If the OAR determines that the Work is ready, a POUA inspection will be scheduled at a minimum of three (3) business days after the OAR's preliminary inspection.
 3. Immediately prior to such POUA inspection, the Owner, OAR, Contractor, Designer and DCC shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.
 - a. The following parties will attend the POUA inspection: the OAR, the Contractor, the Designer and the DCC. The following Owner representatives may attend: GOAA Construction, GOAA Engineering, GOAA Environmental, GOAA Maintenance, GOAA Operations, GOAA Properties, GOAA Risk Management, GOAA ARFF, and any involved Tenant(s).
 4. Following the inspection, the OAR and DCC will determine if the Work is ready for partial occupancy or use. If it is determined to be ready, the OAR will use this date in the preparation of Form #009 Partial Occupancy/Use (POUA) and the Contractor in preparation of any agreed upon written warranties. The following will be used in the determination of the POUA date:
 - a. Certificate(s) of Occupancy (CofO) / Agency Sign Off (as required) for the area being occupied.
 - b. Recommendation from the OAR, Designer and DCC that determine the Project is ready for partial occupancy or use.

- c. Acceptance from the Contractor and OAR that the preliminary punch lists represent most of the items required for completion of the Work. The OAR shall distribute the preliminary punch lists to the Contractor within a maximum of three (3) business days after the date of the POUA.
 - d. Acceptance by the OAR of the draft warranties if requested.
 - e. Acceptance by the OAR of the draft Operation & Maintenance Manuals if requested.
 - f. Agreement from the Contractor that the Owner will have complete occupancy or use and may use, operate, and maintain the Project in all respects, for its intended purpose and without undue interference by the Contractor's Final Completion efforts.
 - g. Agreement that partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work which is not in conformance with the requirements of the Contract Documents.
5. When the Project is determined to be ready for partial occupancy or use, the OAR will prepare a typed punch list which includes any items from the preliminary Substantial Completion punch list that have not yet been completed plus all punch list items from the Designer, OAR, DCC, Owner and others, and Form #009 Partial Occupancy/Use (POUA) within a maximum of fifteen (15) business days of the date of POUA and will schedule a meeting with the Contractor, Designer, DCC and any Owner's representatives to:
- a. Review Form #009 POUA, all of its requirements and submit to the Contractor for appropriate acceptance and signature.
 - b. Review the attachments: punch list and the CofO.
 - c. Establish the date for the completion of the punch list items.
 - d. Establish the responsibilities of the Owner and Contractor for security, maintenance, operations, cleaning and housekeeping, heating and cooling, utilities, damage to the Work and insurance.
 - e. Review and accept the requested Contractor's written warranties and guarantees from its Subcontractors and Suppliers bearing the date of the POUA stating the period of warranty as required by the Contract Documents.

1.4 FINAL COMPLETION

- A. General: Refer to the Agreement/Provisions of the Contract for Construction.
- B. Procedures: Complete the following.
 1. Before requesting final inspection for certification of Final Completion and final payment, prepare and submit to the OAR the following:
 - a. Contractor's certified copy of the Substantial Completion punch list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by the OAR.
 - b. Final meter readings for utilities, and similar data as of the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the Work.
 - c. Closeout Documentation Manual.

2. If the OAR determines that the Work is ready, the Final Completion Inspection will be scheduled at a minimum of three (3) business days after the OAR's preliminary inspection.
 3. The following parties will attend the Final Completion inspection: the OAR, the Contractor, the Designer and the DCC. The following Owner representatives may attend: GOAA ARFF, GOAA Construction, GOAA Engineering, GOAA Environmental, GOAA IT, GOAA Maintenance, GOAA Operations, GOAA Properties, GOAA Risk Management, and any involved tenant(s).
 4. Upon acceptance of the Final Completion Inspection, the Designer, OAR, DCC and GOAA Maintenance are to sign off on Part IV of Form #008 SCA and provide the final inspection date. The OAR is to provide the Contractor's completed punch list which will be field verified and each item initialed complete by the DCC and the OAR. The OAR is to provide documentation of FAA/FDOT final inspections, as required. Part IV of Form #008 SCA must be completed prior to processing the Contractor's final pay application.
- C. If necessary, re-inspection will be repeated at the Contractor's expense. Re-inspection Procedure: The OAR, Designer and DCC will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the OAR and DCC. Repeat Final Completion Procedures above until Final Completion is accepted.

1.5 CLOSEOUT DOCUMENTATION MANUAL

- A. Description: Submit the manual in a vinyl covered, 3-ring binder; white, with hard cover, with clear vinyl pockets on front (sized to hold 8-1/2" x 11" sheets) and spine (minimum spine size 1", maximum 3"). Binder shall be "View Binder" as manufactured by Avery Consumer Products, AVE 0560 series, or approved equal. Each section shall be divided by an 8-1/2" x 11" reinforced, clear ring binder index, 5 tabs, as manufactured by Wilson Jones, Stock No. WJ-54125, or approved equal.
1. Full size, machine lettered labels shall be inserted into the front, back, and spine pockets. Labels shall be on white paper with black print, and shall clearly identify the following:

GREATER ORLANDO AVIATION AUTHORITY
ORLANDO INTERNATIONAL AIRPORT
(PROJECT TITLE & NUMBER)
(Manual Title)
(Date)
 2. Contents of the Manual shall include:
 - a. First page shall be a Cover Page, identifying:

GREATER ORLANDO AVIATION AUTHORITY
ORLANDO INTERNATIONAL AIRPORT
(PROJECT TITLE & NUMBER)
(Manual Title)
(Date)
 - b. Second page shall be a Table of Contents.

- c. The next section shall list the Names, Addresses, Contacts, and Phone Numbers for the following:
 - 1) OAR
 - 2) DCC
 - 3) Designer(s)
 - 4) Contractor
 - 5) Subcontractors (first-tier)
- d. Change Order Summary (prepared by GOAA)
- e. Summary of Disbursements (prepared by GOAA)
- f. Receipt/Acceptance Form for As-Built Documents
 - 1) Progress and As-Built Drawing Certification(s) for each applicable Subcontractor (Exhibit D; prepared by Contractor)
 - 2) GOAA Construction Form # 011 (prepared by OAR) with Transmittal to GOAA ENGINEERING (signed by GOAA Engineering)
- g. Receipt Form for O&M Manuals (GOAA Construction Form # 012; prepared by OAR) with Transmittal to GOAA MAINTENANCE (signed by GOAA Maintenance)
- h. Parking Permit Office Release Form (GOAA Construction Form # 001; prepared by Contractor) (signed by GOAA Ground Transportation)
- i. Badge & I.D. Office Release Form (GOAA Construction Form # 002; prepared by Contractor) (signed by GOAA Access Control)
- j. Key Shop Release Form (GOAA Construction Form # 003; prepared by Contractor) (signed by GOAA Lockshop)
- k. Environmental Group Letter of Concurrence for Closeout (if applicable; prepared by GOAA)
- l. Certificate(s) of Substantial Completion (GOAA Construction Form # 007; prepared by OAR)
 - 1) Substantial Completion Acceptance with Final Substantial Completion Punch list initialed and dated by Contractor (GOAA Construction Form # 008; prepared by OAR)
 - 2) Partial Occupancy / Use Agreement(s), or POUA (GOAA Construction Form # 009; prepared by OAR)
 - 3) FAA / FDOT Final Inspection(s) (if applicable; if project has FAA and/or FDOT funding, provide documentation of the invitation to FAA / FDOT and/or the appropriate sign off)
- m. Certificate(s) of Occupancy / Agency Sign Off (furnished by Contractor)
- n. Current Certificate of Insurance: (furnished by Contractor)
 - 1) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days prior written notice has been given to the Owner: and
 - 2) a written statement that the Contractor knows no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents
- o. Consent of Surety to Final Payment with Power of Attorney (AIA Form # G707; furnished by Contractor) (original)
- p. Final Release Form from Contractor (Specification Section 00 65 19.29; prepared by Contractor) (original, notarized with corporate seal)

- q. Final Release Form(s) from Subcontractors / Suppliers (Specification Section 00 65 19.33; prepared by Subcontractor)
- r. Final Payment Application (2 originals, signed and notarized by Contractor and signed by DCC and OAR (DBE/MWBE/LDB Disbursement Page completed with Subcontractor performance rating and total payment)
- s. Executed Originals of Warranties/Guarantees.

1.6 AS-BUILT DOCUMENTS

- A. General: Do not use as-built documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to as-built documents for the OAR's reference during normal working hours.
 - 1. Submit all As-Built Documents to the OAR as specified in Paragraph 1.3.B.
 - 2. Include fire alarm and building control system(s) drawings and specifications.
- B. As-Built Documents: As-Built Documents include Drawings, Specifications, Addenda, Change Orders, and other Modifications. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
 - 1. Mark As-Built sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
 - 2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
 - 3. Note related Change Order numbers where applicable.
 - 4. Organize As-Built drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
 - 5. Mark EVERY PAGE of the Drawings with "As-Built".
- C. Accurate as-built documents are very important for the Owner and serve several important functions. The Owner utilizes the as-built documents for operation and maintenance, and future modifications, renovations, and particularly for mechanical, plumbing and electrical systems, which are mostly hidden from view.
 - 1. The working as-built shall show, but shall not be limited to, the following:
 - a. All concealed and underground utilities, equipment, foundations or other permanent conditions shall be surveyed and documented. This includes all discovered conditions. All shall be tied to permanent benchmarks showing horizontal and vertical data including but not limited to: beginning/end points, changes in direction points, inverts, grades of drainage, depths below the surface, all surface or underground components such as valves, manholes, drop inlets, clean outs, meters, corner points, etc. Each of the above shall also include a description of: actual quantity, size, and material. GPS coordinates are to be provided for all.

- b. The location and dimensions of any changes within the building structure and architectural components. The dimensions shall be actual field measurements.
- c. Correct dimensions and details transferred from shop drawings.
- d. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.
- e. Actual location of anchors, construction and control joints, etc., in concrete.
- f. Changes in location of equipment and architectural features.
- g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints. Cross out such words and phrases as "optimal requirement," "or approved substitution," etc., and list specifically the items of material provided.
- h. Unusual or uncharted obstructions that are encountered in the contract work area during construction.
- i. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.
- j. If borrow material for this project is from sources on the Owner's property, or if Owner's property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.
- k. Layout and schematic drawings of electrical circuits and piping. See the Electrical Specifications for the level of detail required to be accurately documented.
- l. Layout and schematic drawings of mechanical and plumbing systems and piping. All shall be tied to permanent benchmarks showing horizontal and vertical data of primary and secondary branches.
- m. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems. All shall be tied to permanent benchmarks showing horizontal and vertical data of primary and secondary branches.
- n. Changes or modifications that result from the final inspection.

1.7 RECORD DRAWINGS

- A. After completion of construction and after the OAR's acceptance of the As-Built Documents, the Contractor's Designers shall incorporate all the changes defined on these as-built drawings and documents onto the Conformed Documents to produce a complete set of drawings and documents which reflect the as-built condition of the Work. Project Manual documents are to be submitted to the Owner in MSWord and PDF format on the final CD-ROM. The Designers shall submit the completed Record Documents to the Owner in CADD and PDF electronic formats CD-ROM or DVD. The Contractor's Redlined As-Built Drawings are to be turned back over to the Owner with this package.
- B. After submittal to the OAR, the OAR and DCC will review the Record Documents against the As-Built Documents for completeness, accuracy and compliance with

CADD/BIM requirements. If not acceptable, the Record Documents will be returned to the Contractor for correction.

1.8 OPERATION & MAINTENANCE MANUALS

- A. General: If all specified information can be submitted in a single binder without being overfilled, submit two (2) copies in a white binder with white labels.
1. If all of the information cannot be submitted in a single binder, submit two (2) per design discipline as follows:
 - a. Architectural; submit in a white binder with white labels.
 - b. Mechanical; submit in a white binder with green labels.
 - c. Fire Protection & Other Systems; submit in a white binder with red labels.
 - d. Electrical; submit in a black binder with white labels.
 - e. Civil; submit in a white binder with yellow labels.
- B. Description: Submit the manual in a vinyl covered, 3-ring binder; with hard cover, with clear vinyl pockets on front (sized to hold 8-1/2" x 11" sheets) and spine (minimum spine size 1", maximum 3"). Binder shall be "View Binder" as manufactured by Avery Consumer Products, AVE 0560 series, or approved equal. Provide additional binders if a single 3-inch binder is insufficient to contain all closeout information. Each section shall be divided by an 8-1/2" x 11" reinforced, clear ring binder index, 5 tabs, as manufactured by Wilson Jones, Stock No. WJ-54125, or approved equal.
1. Full size, machine lettered labels shall be inserted into the front, back, and spine pockets. Labels shall be on paper in color(s) specified with black print, and shall clearly identify the following:

GREATER ORLANDO AVIATION AUTHORITY
ORLANDO INTERNATIONAL AIRPORT
(PROJECT TITLE & NUMBER)
(Manual Title)
(Date)
 2. Contents of the Manual shall include:
 - a. First page shall be a Cover Page, identifying:

GREATER ORLANDO AVIATION AUTHORITY
ORLANDO INTERNATIONAL AIRPORT
(PROJECT TITLE & NUMBER)
(Manual Title)
(Date)
 - b. Second page shall be a Table of Contents indicating the contents of the binder(s).
 - c. The third page shall list the Names, Addresses, Contacts, and Phone Numbers for the following:
 - 1) OAR
 - 2) DCC
 - 3) Designer(s)

- 4) General Contractor
 - 5) Subcontractors
 - 6) Sub-subcontractors
 - 7) Suppliers
- d. The remaining portions of the manual shall be separated by each major division of work as identified by the Contract Documents.
- 1) PROJECT INFORMATION (Exhibit A).
 - 2) Within each major division of work, each section shall be individually identified by a typed index/tab. For each specification requirement, submit the following information in the order outlined below:
 - a) Copies of all warranties/guarantees, as specifically required by the specification section, and Letters of Certification. Executed original warranties/guarantees shall be included in the appropriate section of the Closeout Manual(s).
 - b) Copies of the "Approved" Shop Drawing/Submittals/ Equipment Manufacturer's Schematics. Oversized drawings shall be folded and inserted in clear vinyl pockets or, for large sets of drawings, provide an insert page stipulating that the drawings are stored at GOAA ENGINEERING. All copies shall be stamped with the appropriate review stamp, marked, signed, and dated.
 - c) Operation and Maintenance Instructions, including but not limited to:
 - ◆ Manufacturer's Recommended Care and Cleaning
 - ◆ Installation Instructions
 - ◆ Parts Lists
 - ◆ Lubrication Checklists
 - ◆ Equipment Supplier Lists
 - ◆ Special Instructions
 - ◆ Preventive Maintenance Instructions.
 - d) Service and Maintenance Contracts: Include Name, address, and phone number and contact of Manufacturer's authorized repair company.
 - e) Completed GOAA Turnover Forms:
 - ◆ Performance Verification and Demonstration to Owner (Exhibit B) signed by Contractor and GOAA representative
 - ◆ Voltage and amperage Readings (Exhibit C) signed by Contractor, Designer and OAR
 - ◆ Motor Test Information (Exhibit D) signed by Contractor and OAR
 - ◆ Check-out Memo (Exhibit E) signed by Contractor and Manufacturer's representative

- f) Equipment and/or Systems Test Data and Conductor Insulation Resistance Test Data Sheets by installer and/or manufacturer where required. Form(s) to be provided by the installer and/or manufacturer performing the test [Exhibits G, H (signed by Contractor, Designer and GOAA representative), I (signed by Contractor, Subcontractor and GOAA), J (signed by Contractor and OAR) and K (signed by Contractor, Designer and OAR)].
 - g) Copies of electrical panel schedules and directories.
- C. Submit one copy of the O&M manual in PDF format on CD-ROM. Create a PDF file for each section of the manual. PDF files shall be named *BPXXX OM Sec XXXXX.pdf*

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. Operation and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
1. Operation and Maintenance manuals.
 2. As-Built Documents.
 3. Spare parts and materials.
 4. Tools.
 5. Lubricants.
 6. Fuels.
 7. Identification systems.
 8. Control sequences.
 9. Hazards.
 10. Cleaning.
 11. Warranties and bonds.
 12. Maintenance agreements and similar continuing commitments.
- B. As part of instruction for operating equipment, demonstrate the following procedures:
1. Start-up.
 2. Shutdown.
 3. Emergency operations.
 4. Noise and vibration adjustments.
 5. Safety procedures.

3.2 CLEANING

- A. General: General cleaning during construction is required.
- B. Final Cleaning: Refer to Section 01 74 23, Final Cleaning.

3.3 ATTACHMENTS

- A. The following information sheets have been included in this Section:
1. Exhibit A: Project Information
 2. Exhibit B: Performance Verification and Demonstration to Owner
 3. Exhibit C: Voltage and Amperage Readings
 4. Exhibit D: Motor Test Information
 5. Exhibit E: Check-Out Memo
 6. Exhibit F: Progress and As-Built Document Certification
 7. Exhibit G: D-C High Voltage Cable Test Report
 8. Exhibit H: Ground Test Information
 9. Exhibit I: Spare Parts Certification Memo
 10. Exhibit J: Existing Facilities Investigation Memo
 11. Exhibit K: Conductor Insulation Resistance Test Memo
 12. Example: Description Sheet – Cover
 13. Example: Description Sheet - Spine

END OF SECTION 01 78 00

ORLANDO INTERNATIONAL AIRPORT
SOUTH TERMINAL C
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Section 01 78 00

EXHIBIT A
PROJECT INFORMATION
Orlando International Airport

Contractor shall fill in the blanks below and insert in the Operation and Maintenance Manuals.
Submit one (1) sheet for each major division of Work.

Project Name: _____

Specification Division Number & Name: _____

Subcontractor: _____

Contact: _____ Phone: _____

Date Project Bid: _____

Project Start Date: _____

Days allowed for Construction: _____

Target Completion: _____

Substantial Completion Certification Date: _____

	<u>Date Submitted</u>	<u>Date Provided</u>
Close-out Documentation Manual:	_____	_____
Operation and Maintenance Manuals:	_____	_____
Owner Performance Verification and Demonstrations:	_____	_____
Manufacturer's Performance Verification Memos:	_____	_____
Manufacturer's Test Data:	_____	_____
Record Documents:	_____	_____

EXHIBIT B
PERFORMANCE VERIFICATION AND DEMONSTRATION TO OWNER
Orlando International Airport

This form verifies that the Owner has been given a demonstration of the proper operation on the equipment or systems noted below as required in Section 01 79 00 "Demonstration and Training".

Project Name: _____

Specification Division Number & Name: _____

Equipment/Systems Demonstrated: _____

Along with a complete demonstration of the equipment/system, these items have been reviewed at this demonstration and shall be included in the Operation and Maintenance Manuals, under the appropriate specification section:

- 1) Written operating instructions.
- 2) Test data and performance verification information as required by the installer and/or manufacturer.
- 3) Maintenance information published by manufacture's representative.
- 4) Check-out Memo signed by manufacturer's representative.
- 5) Printed warranties by manufacturer of equipment.
- 6) Explanation of the warranty/guarantee on the system.
- 7) Prints showing actual "As-Built" conditions.

(Name of Contractor)

(Signature, Title, Date)

(Name of Subcontractor)

(Signature, Title, Date)

(Name of Contractor's Designer)

(Signature, Title, Date)

A demonstration of the system/equipment in operation and of the maintenance procedures has been successfully completed.

(Name of OAR)

(Signature, Title, Date)

GREATER ORLANDO AVIATION AUTHORITY

(Signature, Date)

(GOAA Department)

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EXHIBIT C
VOLTAGE AND AMPERAGE READINGS
Orlando International Airport

Project Name: _____

Switchgear/Panelboard: _____

Full Load Amperage Readings: Date: _____ Time: _____

Phase A: _____

Phase B: _____

Phase C: _____

Neutral: _____

Ground: _____

Full Load Voltage Readings: Date: _____ Time: _____

Phase: A to N _____

A to B _____

B to N _____

A to C _____

C to N _____

B to C _____

Voltage at the End of the Longest Branch: _____

Type of Load: _____

No Load Voltage Readings: Date: _____ Time: _____

Phase: A to N _____

A to B _____

B to N _____

A to C _____

C to N _____

B to C _____

(Name of Contractor)

(Signature, Title, Date)

(Name of Subcontractor)

(Signature, Title, Date)

(Name of Contractor's Designer)

(Signature, Title, Date)

(Name of OAR)

(Signature, Title, Date)

EXHIBIT D
MOTOR TEST INFORMATION
Orlando International Airport

Project Name: _____

Description of Motor: _____

Checked By: _____ Date Checked: _____

a) Name and Identifying Mark of Motor (Indicate at existing): _____

b) Manufacturer: _____

c) Model Number: _____

d) Serial Number: _____

e) RPM: _____

f) Frame Size: _____

g) Code Letter: _____

h) Horsepower: _____

i) Nameplate, Voltage and Phase: _____

j) Nameplate Amps: _____

k) Actual Voltage: _____

l) Actual Amps: _____

m) Starter Manufacturer: _____

n) Starter Size: _____

o) Heater Size, Catalog No. and Amp Rating: _____

p) Manufacturer of Dual-Element Fuse: _____

q) Amp Rating of Fuse: _____

r) Power Factor: _____

(Name of Contractor)

(Signature, Title, Date)

(Name of Subcontractor)

(Signature, Title, Date)

(Name of Contractor's Designer)

(Signature, Title, Date)

(Name of OAR)

(Signature, Title, Date)

ORLANDO INTERNATIONAL AIRPORT
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EXHIBIT E
CHECK-OUT MEMO
Orlando International Airport

This form shall be completed and a copy provided to the Owner at the Owner's Performance Verification and Demonstration meeting. A copy shall also be included in the specification section of the Operation and Maintenance Manual for the equipment checked.

Project Name: _____

Type of Equipment Checked: _____

Equipment Number: _____

Name of Equipment Manufacturer: _____

Signature below by the Manufacturer's authorized representative signifies that the equipment has been satisfactorily tested and checked out on the job by the manufacturer.

1. The attached Test Data and Performance Verification information was used to evaluate the equipment installation and operation.
2. The equipment is properly installed, has been tested by the manufacturer's authorized representative, and is operating satisfactorily in accordance with all requirements, except for items noted below. *
3. Written operating and maintenance information has been presented to the Contractor, and gone over with him in detail.
4. Sufficient copies of all applicable operating and maintenance information, part lists, lubrication checklists, and warranties have been furnished to the Contractor for insertion in the Operation and Maintenance Manuals.

Manufacturer's Representative: _____
(Print or Type Name and Title)

(Print or Type Address and Phone Number)

Signature of Manufacturer's Representative: _____
Date Checked

Witnessed By: _____
(Signature and Title of Contractor's Representative)

Witnessed By: _____
(Signature and Title of Contractor's Designer)

Witnessed By: _____
(Signature and Title of OAR)

*Exceptions Noted at Time of Check-Out: (Use additional pages if necessary.)

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EXHIBIT F
PROGRESS AND AS-BUILT DRAWING CERTIFICATION
Orlando International Airport

This form shall be completed and submitted with the As-Built Documents. Submit one form for each contractor/subcontractor providing as-built information. Include a copy of this form in the Close-out Documentation Manual.

Project Name: _____

Specification Division Number & Name: _____

The Contractor's and Subcontractor's signatures below certify that the attached drawings and specifications were marked and revised as items were installed/changed during the course of construction, and that these documents represent and accurate "As-Built" condition of the work as actually installed.

(Name of Contractor)

(Signature, Title, Date)

(Name of Subcontractor)

(Signature, Title, Date)

(Name of Contractor's Designer)

(Signature, Title, Date)

(Name of OAR)

(Signature, Title, Date)

EXHIBIT G
D-C HIGH VOLTAGE CABLE TEST REPORT

Project Name: _____

Location: _____

Description: _____

Rated Voltage: _____

TEST DATA

Set Leakage at Test Voltage _____ ma Variac _____

Pri. Voltage _____ Sphere Gap _____ Inches

Duct Temp. _____ Ambient Temp. _____ Weather _____

Cable Status _____ 1 hour prior to test.

TEST RESULTS

Phase or Conductor	<u>A</u>	<u>B</u>	<u>C</u>	Remarks
--------------------	----------	----------	----------	---------

Starting Time

MA MA MA

0	_____	_____	_____	
15 sec.	_____	_____	_____	
30 sec.	_____	_____	_____	
45 sec.	_____	_____	_____	
1 min.	_____	_____	_____	
2 min.	_____	_____	_____	
3 min.	_____	_____	_____	
4 min.	_____	_____	_____	
5 min.	_____	_____	_____	

Final Test Voltage: _____ Time Finish: _____

KV DC After 1 Min.: Test Procedure _____ No. of Terminals _____

Joints _____

(Name of Person Performing Test)

(Signature, Title, Date)

(Name of Contractor)

(Signature, Title, Date)

(Name of Subcontractor)

(Signature, Title, Date)

(Name of Contractor's Designer)

(Signature, Title, Date)

(Name of OAR)

(Signature, Title, Date)

ORLANDO INTERNATIONAL AIRPORT
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EXHIBIT H
GROUND TEST INFORMATION
(Refer to Specification Section 26 00 10)

Project Name: _____

Ground Type: _____

Test By: _____

Date of Test: _____

Ground Location: _____

Ground Type (rod, water pipe, etc.): _____

Prior to Connection to System: Ground: _____(OHMS)

After Connection to System: Ground: _____(OHMS)

Weather Conditions (Wet/Dry): _____ Soil Conditions (Wet/Dry): _____

(Name of Person Performing Test)

(Signature, Title, Date)

(Name of Contractor)

(Signature, Title, Date)

(Name of Subcontractor)

(Signature, Title, Date)

(Name of Contractor's Designer)

(Signature, Title, Date)

(Name of OAR)

(Signature, Title, Date)

EXHIBIT I
SPARE PARTS CERTIFICATION MEMO
(Refer to Division 26 Specifications)

This form shall be completed and a copy provided to the Owner at the Owner's Performance Verification and Demonstration meeting. A copy shall also be included in the specifications section of each Operation and Maintenance Manual for the equipment checked.

Name of Project: _____

Type of Spare Parts: _____

Specification Reference: _____

Quantity of Spare Parts: _____

Signature below by the Contractor and subcontractor signifies that the spare parts required by the drawings and/or specifications have been turned over to the Owner. Signature by the Owner acknowledges receipt of the same spare parts.

Name of Contractor: _____

Authorized Signature and Title: _____

Date: _____

Name of Subcontractor: _____

Authorized Signature and Title: _____

Date: _____

Name of OAR: _____

Authorized Signature and Title: _____

Date: _____

Name of Owner: _____

Authorized Signature and Title: _____

Date: _____

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EXHIBIT J (NOT USED)

EXHIBIT K
CONDUCTOR INSULATION RESISTANCE TEST MEMO
(Refer to Division 26 Sections)

NAME OF PROJECT: _____
Conductor Location _____ From: _____ To: _____
Size of Conductor _____
Insulation Type _____ Insulation Voltage Rating _____
Date of Test _____ Time of Test _____
Weather Conditions _____
Test Voltage (DC) _____ Range _____
Megger Instrument/Serial Number _____
Testing Methodology _____

INSULATION RESISTANCE MEASUREMENT
(Acceptable Measurement not to be less than one (1) Megohm)

Phase A to Ground _____
Phase B to Ground _____
Phase C to Ground _____
Neutral to Ground _____
Isolated Ground to Ground _____

_____ (Name of Person Performing Test)	_____ (Signature, Title, Date)
_____ (Name of Contractor)	_____ (Signature, Title, Date)
_____ (Name of Subcontractor)	_____ (Signature, Title, Date)
_____ (Name of Contractor's Designer)	_____ (Signature, Title, Date)
_____ (Name of OAR)	_____ (Signature, Title, Date)

ORLANDO INTERNATIONAL AIRPORT
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EXAMPLE - Description Sheet - Cover

**GREATER ORLANDO
AVIATION AUTHORITY**

**ORLANDO
INTERNATIONAL
AIRPORT**

BID PACKAGE NO. 000

[DESCRIPTION OF PROJECT]

OPERATION AND MAINTENANCE MANUAL

EXAMPLE - Description Sheet - Spine

G.O.A.A.

O.I.A.

B.P. #000

[DESCRIPTION OF PROJECT]

ELECTRICAL

**OPERATION
AND
MAINTENANCE
MANUAL**

G.O.A.A.

O.I.A.

B.P. #000

[DESCRIPTION OF PROJECT]

SYSTEMS

**OPERATION
AND
MAINTENANCE
MANUAL**

SECTION 01 78 10 – WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes sample warranties to be executed by the Contractor and Subcontractors.

1.2 GENERAL REQUIREMENTS

- A. Forms:
 - 1. Subcontractor Warranty (FORM 01 78 10-1)
 - 2. Contractor Warranty (FORM 01 78 10-2)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 78 10

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FORM 01 78 10-1

SUBCONTRACTOR WARRANTY

PROGRAM: South Terminal C – Tenant and Airline Buildout Project

PROJECT NAME: _____

PROJECT NUMBER: BP-_____

OWNER: The Greater Orlando Aviation Authority

DCC: SchenkelShultz

CONTRACTOR: _____

SCOPE OF WORK: _____

LENGTH OF WARRANTY (YEARS): _____

STARTING DATE: _____ (Substantial Completion Date)

All materials and/or equipment furnished, or Work performed by _____ (hereafter called "Subcontractor") in connection with BP-S00xxx, _____ (hereafter called "Project") under the Subcontract or Purchase Agreement between _____ (hereafter called "Contractor") and the Subcontractor fully conforms to all requirements of the Contract Documents and is free of any defect in equipment, material, design furnished, or workmanship performed by the Subcontractor. This warranty shall continue for a period of ___ years commencing on the Substantial Completion Date for the aforementioned Project as determined by The Greater Orlando Aviation Authority, (hereafter called "Owner"), except to the extent any longer warranty period is called for by the Contract Documents with respect to equipment, material, design furnished, or workmanship performed by the Subcontractor. Work not conforming to these requirements including substitutions not properly approved and authorized may be considered defective. The Subcontractor agrees to promptly make good, without cost to the Contractor or the Owner, any and all defects due to faulty equipment, material, design furnished, or workmanship performed by the Subcontractor, which may appear within the established warranty period. Failure to make good such defects within thirty (30) calendar days after notification may cause the corrective work to be performed by others at the Subcontractor's expense, except in cases where failure to immediately correct the work is causing negative impacts to Owner's operations, in which case Owner may correct the defect immediately if Subcontractor is not able to do so, and then backcharge the Subcontractor for the reasonable cost of the correction. All expenses necessary to replace or repair work will be the Subcontractor's responsibility including that damaged or disturbed by making replacement or repairs. This warranty is in addition to and not in lieu of all other guarantees, warranties and rights contained in the Contract Documents or applicable law. In the event that an equipment, material, design

furnished, or workmanship performed by the Subcontractor is repaired or replaced pursuant to these warranty provisions, the Subcontractor shall extend the warranty period with respect to the equipment, material, design furnished, or workmanship performed by the Subcontractor so repaired or replaced for any additional period of time after Owner approval of the repair or replacement specified in the Contract Documents. The Subcontractor hereby acknowledges that this warranty is given for the benefit of the Owner and Contractor and agrees to honor requests or directives issued to the Subcontractor by the Owner or Contractor for enforcement of this warranty. The Subcontractor further hereby assigns to the Owner all warranties, express or implied, issued by the Subcontractor and by manufacturers, suppliers, or subcontractors to the Subcontractor for equipment, material, design furnished, or workmanship performed by the Subcontractor in connection with the Work.

IN WITNESS WHEREOF, THE Subcontractor has caused this instrument to be signed and executed this _____ day of _____, _____.

FIRM:

BY:

TITLE:

State of _
County of _

} SS.

On _____ (*enter date*) before me, _____ (*enter Notary's Name here*),
Notary Public, personally appeared _____ (*here insert name and title of person signing the instrument*) who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of that the foregoing paragraph is true and correct.
WITNESS my hand and official seal.

Signature:

(Seal)

My Commission Expires:

FORM 01 78 10-2

CONTRACTOR WARRANTY

PROGRAM: South Terminal C – Tenant and Airline Buildout Project

PROJECT NAME: _____

PROJECT NUMBER: BP-_____

OWNER: The Greater Orlando Aviation Authority

Architect of Record: SchenkelShultz

CONTRACTOR: _____

SCOPE OF WORK: _____

LENGTH OF WARRANTY (YEARS): _____

STARTING DATE: _____ (Substantial Completion Date)

All materials and/or equipment furnished, or work performed by _____, (hereafter called "Contractor") in connection with BP-S00xxx, _____, (hereafter called "Project") under the Agreement between The Greater Orlando Aviation Authority (hereafter called "Owner") and the Contractor fully conforms to all requirements of the Contract Documents and is free of any defect in equipment, material, design furnished, or workmanship performed by the Contractor. This warranty shall continue for a period of _____ years commencing on the Substantial Completion Date for the aforementioned Project as determined by the Owner, except to the extent any longer warranty period is called for by the Contract Documents with respect to equipment, material, design furnished, or workmanship performed by the Contractor. Work not conforming to these requirements including substitutions not properly approved and authorized may be considered defective. The Contractor agrees to promptly make good, without cost to the Owner, any and all defects due to faulty equipment, material, design furnished, or workmanship performed by the Contractor, which may appear within the established warranty period. Failure to make good such defects within thirty (30) calendar days after notification may cause the corrective work to be performed by others at the Contractor's expense, except in cases where failure to immediately correct the work is causing negative impacts to Owner's operations, in which case Owner may correct the defect immediately if Subcontractor is not able to do so, and then backcharge the Subcontractor for the reasonable cost of the correction. . All expenses necessary to replace or repair work will be the Contractor's responsibility including that damaged or disturbed by making replacement or repairs. This warranty is in addition to and not in lieu of all other guarantees, warranties and rights contained in the Contract Documents or applicable law. In the event that equipment, material, design furnished, or workmanship performed by the Contractor is repaired or replaced pursuant to these warranty provisions, the Contractor shall

extend the warranty period with respect to the equipment, material, design furnished, or workmanship performed by the Contractor so repaired or replaced for any additional period of time after Owner approval of the repair or replacement specified in the Contract Documents. The Contractor hereby acknowledges that this warranty is given for the benefit of the Owner and agrees to honor requests or directives issued to the Contractor by the Owner for enforcement of this warranty. The Contractor further hereby assigns to the Owner all warranties, express or implied, issued by the Contractor and by manufacturers, suppliers, or subcontractors to the Contractor for equipment, material, design furnished, or workmanship performed by the Contractor in connection with the Project.

IN WITNESS WHEREOF, THE Contractor has caused this instrument to be signed and executed this _____ day of _____, _____.

FIRM:

BY:

TITLE:

State of_
County of_

} ss.

On _____ (enter date) before me, _____ (enter Notary's Name here),
Notary Public, personally appeared _____ (here insert name and title of person
signing the instrument) who proved to me on the basis of satisfactory evidence to be the
person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me
that he/she/they executed the same in his/her/their authorized capacity(ies), and that by
his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the
person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of that the foregoing
paragraph is true and correct.

WITNESS my hand and official seal.

Signature:

(Seal)

My Commission Expires:

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel where indicated in other sections, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Owner.
 - d. Name of Architect.
 - e. Name of Construction Manager.
 - f. Name of Contractor.
 - g. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use prepared in same format required for operation and maintenance manuals specified in Section 01 78 00 "Closeout Submittals".

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 45 00 "Quality Control", experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 19 "Project Meetings". Review methods and procedures related to demonstration and training including, but not limited to, the following:

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- a. System, subsystem, and equipment descriptions.
- b. Performance and design criteria if Contractor is delegated design responsibility.
- c. Operating standards.
- d. Regulatory requirements.
- e. Equipment function.
- f. Operating characteristics.
- g. Limiting conditions.
- h. Performance curves.
2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.

7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module.
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
 - 1. Submit video recordings on CD-ROM or thumb drive.
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 79 00

SECTION 01 81 13.14 - SUSTAINABLE DESIGN REQUIREMENTS - LEED V4 BD+C

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements and procedures for compliance with certain prerequisites and credits needed for the Project to obtain "LEED Version 4 Building Design and Construction" (LEED v4 BD+C) certification. Certification criteria is based on the USGBC's LEED v4 BD+C scorecard provided in Specification Section 01 33 29 – Sustainable Material Content Forms
 - 1. Individual material requirements for LEED compliance are also included within the individual Specification Sections and will reference back to this section for the compliance criteria.
 - 2. Some LEED prerequisites and credits needed to obtain the indicated LEED certification depend on design and construction by others and other aspects of Project that are not part of the Work of the Contract.
 - 3. Compliance with the targeted construction credits (as outlined in Specification Section 01 33 29 – Sustainable Material Content Forms) have been captured within the Design Criteria Package (DCP) documents. Achievement of those credits relies on the Contractor's successful implementation and oversight of those requirements.
 - 4. Compliance with the requirements needed to obtain LEED prerequisites and credits will be used as one of the criterion needed to evaluate substitution requests and comparable product requests.

1.2 DEFINITIONS

- A. LEED: USGBC's "LEED Version 4 Building Design and Construction."
 - 1. Below are some of the Definitions and terminology included within "LEED Version 4 Building Design and Construction" (LEED v4 BD+C) for reference.
- B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001. Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- C. Chemical Abstract Service Registration Number (CASRN): CAS Registry Numbers are unique numerical identifiers assigned by the Chemical Abstracts Service to every chemical described in the open scientific literature (currently including those described from at least 1957 through the present) and including elements, isotopes, organic and inorganic compounds, ions, organometallics, metals, non-structural materials (aka 'UVCB's- i.e., materials of Unknown, Variable Composition, or Biological origin).[2] They are also referred to as CAS RNs, CAS Numbers, etc.

- D. Cradle-to-gate: Cradle-to-gate assessment analysis of a product's partial life cycle, from resource extraction (cradle) to the factory gate (before it is transported for distribution and sale). It omits the use and the disposal phases of the product.
- E. Cradle to Cradle Certification: The Cradle to Cradle Certified™ Product Standard guides designers and manufacturers through a continual improvement process that looks at a product through five quality categories —material health, material reutilization, renewable energy and carbon management, water stewardship, and social fairness. A product receives an achievement level in each category — Basic, Bronze, Silver, Gold, or Platinum — with the lowest achievement level representing the product's overall mark.
- F. CDPH Emissions Testing: Standard Method for the Testing & Evaluation of VOC Emissions CDPH/EHLB/Standard Method V1.1. (February 2010) Page 4 of 52 Author/Acknowledgements The California Department of Public Health (CDPH), Indoor Air Quality (IAQ) Section, prepared this document, and CDPH approved its release on March 4, 2010.
- G. EPD: An EPD® (*Environmental Product Declaration*) is a verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of a product.
- H. Extended Producer Responsibility: Extended Producer responsibility measures undertaken by the maker of a product to accept its own and sometimes other manufacturers' products as postconsumer waste at the end of the products' useful life. Producers recover and recycle the materials for use in new products of the same type. To count toward credit compliance, a program must be widely available. For carpet, extended producer responsibility must be consistent with NSF/ANSI 140–2007. Also known as closed-loop program or product take-back.
- I. GBCI: Green Business Certification Inc. is an American organization that provides third-party credentialing and verification for several rating systems relating to the built environment.
- J. Health Product Declaration: Health Product Declaration (HPDs) provide a full disclosure of the potential chemicals of concern in products by comparing product ingredients to a wide variety of "hazard" lists published by government authorities and scientific associations.
- K. Regional Materials: Materials that have been extracted (recycling location can serve as the material harvest location), harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- L. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. Postconsumer material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
 2. Pre-consumer material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials, such as rework, regrind, or scrap, generated in a process and capable of being reclaimed within the same process that generated it.
- M. Pilot Credit: Pilot Credits are potential LEED credits created by U.S. Green Building Council and included within the Pilot Credit Library as an opportunity to "test drive" LEED credits before member's vote to include in the next full-version iteration of the LEED rating system.
- N. Product/Material: A Product or material permanently installed within the building. An item that arrives on the project site either as a finished element ready for installation or as a component to another item assembled on-site. The product unit is defined by the functional requirement for use in the project; this includes the physical components and services needed to serve the intended function of the permanently installed building product. In addition, similar product within a specification, each contributes as a separate product.
- O. Volatile Organic Compounds (VOCs): VOCs are a class of chemicals that are volatile (evaporate easily) and are organic compounds (contain carbon atoms). Some common VOCs include acetone and automotive gasoline.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Meeting/Conference: Conduct a Sustainable Requirement conference(s) at Project site to review LEED requirements and action plans for meeting requirements. Meeting/conference can be included as part of the pre-installation meeting agenda

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Respond to Contractor related questions and requests from the DCC, USGBC, GBCI and the LEED Facilitation Team. Question and response information may be asked post project completion. Contractor shall be required to gather and respond to all requests until the GBCI/USGBC review has been completed and determination on the Project's LEED certification application has been finalized. Document responses as informational submittals.
- B. Submit Contractor related documentation and submittals to the project Architect, USGBC, GBCI and the LEED Facilitation Team, as indicated. LEED Question and response information may be asked post project completion. Contractor shall be required to gather and respond to all requests until the final GBCI/USGBC review has been completed and determination on the Project's LEED certification application has been finalized.

1. Document correspondence with USGBC as informational submittals.
2. Utilize Reporting Forms provided in Specification Section 01 33 29 – Sustainable Material Content Forms

1.5 ACTION SUBMITTALS

- A. General: Provide any and all Sustainable Design submittals required by this section and other Specification Sections as indicated.
- B. Sustainable design submittals are in addition to other submittals.
 1. If a submitted item is identical to that submitted to comply with other submittal requirements, include an additional copy of the information along with the applicable Submittal Data form (see Specification Section 01 33 29 – Sustainable Material Content Forms).
- C. Sustainable Design Documentation Submittals (see materials section below for requirement criteria).
 1. Documentation for Environmental Product Declarations
 2. Documentation for Products with Multi-attribute optimization.
 3. Documentation for Products with Raw Material Source & Extraction Reporting
 4. Documentation for products with Leadership Extraction Practices
 5. Documentation on Material Ingredient Reporting
 6. Documentation on Material Ingredient Optimization
 7. Documentation of Product Manufacturer Supply Chain Optimization
 8. Documentation and plan as outlined in Specification Section 01 74 19 "Construction Waste Management and Disposal."
 9. Documentation on Low Emitting Materials
 10. Construction Indoor-Air-Quality (IAQ) Management Plan outlined in Specification Section 01 35 46.
 11. IAQ Assessment Documentation and Testing as outlined in specifications Specification Section 01 35 46

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LEED coordinator.
- B. Provide Materials Cost Data for all scopes of work as indicated in specifications section 01 29 73 "Schedule of Values". Material costs shall exclude labor, overhead, and profit.
- C. Sustainable Design Action Plans: Provide preliminary submittals within 30 days of date established for commencement of the Work. Plan shall indicate how the following requirements will be met:
 1. Submittal log indicating all Sustainable Design submission requirements outlined. (see Specification Section 01 33 23 Shop drawings product data and samples and 01 78 00 Closeout Submittals for additional guidance)
 2. Project Specific Waste Management Plan complying with Section 01 74 19 "Construction Waste Management and Disposal."

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3. Construction IAQ Management Plan complying with Specification Section 01 35 46.
 4. No Smoking Plan indicating designated smoking areas, implementation and oversight.
 5. Commissioning Implementation Plan complying with Specification Section 01 91 13 General Commissioning and 01 91 15 Facility Exterior Enclosure Commissioning.
 6. Clean Construction Tracking Plan: See Clean Construction requirement included elsewhere within this section.
- D. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit monthly status report provided in Specification Section 01 33 29

1.7 QUALITY ASSURANCE

- A. LEED Coordinator: Engage an experienced LEED-accredited professional to coordinate LEED requirements. LEED coordinator must have practical related experience from at least one LEED BD & C project. LEED Coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide products and procedures necessary to obtain the LEED construction credits as required within this Specification Section, other Specification Sections and throughout the contract documents as outlined in the following:
1. Documentation for Environmental Product Declarations
 - a. Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope are valued as one quarter (1/4) of a product for the purposes of credit achievement calculation.
 - b. Environmental Product Declarations which conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - 1) Industry-wide (generic) EPD -- Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator are valued as one half (1/2) of a product for purposes of credit achievement calculation.
 - 2) Product-specific Type III EPD - Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator are valued as one whole product for purposes of credit achievement calculation.
 2. Documentation for Products with Multi-attribute optimization.

- a. Third party certified products that demonstrate impact reduction below industry average in at least three of the following categories are valued at 100% of their cost for credit achievement calculations. ° global warming potential (greenhouse gases), in CO₂e; ° depletion of the stratospheric ozone layer, in kg CFC-11; ° acidification of land and water sources, in moles H⁺ or kg SO₂; ° eutrophication, in kg nitrogen or kg phosphate; ° formation of tropospheric ozone, in kg NO_x or kg ethene; and depletion of nonrenewable energy resources, in MJ. · USGBC approved program
- b. Include documentation for regional material compliance. Documentation should indicate location of the material manufacturer, material extraction point, harvest, or recovery for each raw material including their and distance from the Project Site. Provide costs for all materials.
3. Documentation for Products with Raw Material Source & Extraction Reporting
 - a. Raw Material Reporting: Products that have publicly released a report from their raw material suppliers which include raw material supplier extraction locations, a commitment to long-term ecologically responsible land use, a commitment to reducing environmental harms from extraction and/or manufacturing processes, and a commitment to meeting applicable standards or programs voluntarily that address responsible sourcing criteria.
 - b. CSR Products sourced from manufacturers with self-declared reports are valued as one half (1/2) of a product for credit achievement. · Third-party verified corporate sustainability reports (CSR) which include environmental impacts of extraction operations and activities associated with the manufacturer's product and the product's supply chain.
 - c. All Reports must be published within one year of the project's LEED registration date.
 - d. A compliant report must be issued by either the manufacturer or the raw material supplier and cover at least the criteria listed in the rating system requirements.
 - e. At least 90% of the contents of each product must be from raw materials covered by a compliant report; no partial credit is allowed for products that do not meet this threshold.
 - f. Reports obtained directly from raw material suppliers must verify the use of the raw material in products purchased for the project building. A manufacturer's report must trace activities to the source of extraction of the product's raw materials. In either case, acceptable frameworks for raw material reporting include the following:
 - 1) Global Reporting Initiative (GRI) Sustainability Report
4. Documentation for products with Leadership Extraction Practices
 - a. Extended producer responsibility - Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended producer responsibility. Products meeting extended producer responsibility

- criteria are valued at 50% of their cost for the purposes of credit achievement calculation.
- b. Bio-based materials - Bio-based products must meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country. Exclude hide products, such as leather and other animal skin material. Products meeting bio-based materials criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
 - c. Wood products - Wood products must be certified by the Forest Stewardship Council or USGBC-approved equivalent. Products meeting wood products criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
 - d. Materials reuse - Reuse includes salvaged, refurbished, or reused products. Products meeting materials reuse criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
 - e. Recycled Content - Recycled content is the sum of postconsumer recycled content plus one-half the pre-consumer recycled content, based on cost.
 - f. Products meeting Leadership Extraction Practice Criteria above shall report regional material information. Information should include extraction (recycling location can serve as the material harvest location), harvest, or recovery locations, as well as manufacturing locations that are within 100 miles of Project site.
5. Documentation on Material Ingredient Reporting
- a. Demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm) using one of the following:
 - 1) Manufacturer Inventory - The manufacturer has published complete content inventory for the product following these guidelines: ° A publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN)
 - 2) Health Product Declaration - The end use product has a published, complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard.
 - 3) Cradle to Cradle - The end use product has been certified at the Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level.
6. Documentation on Material Ingredient Optimization
- a. Use products that document their material ingredient optimization using the paths below:
 - 1) GreenScreen v1.2 Benchmark. Products that have fully inventoried chemical ingredients to 100 ppm that have no Benchmark 1 hazards

- 2) Cradle to Cradle Certified. End use products are certified Cradle to Cradle. Products will be valued as follows: ° Cradle to Cradle v2 Gold: 100% of cost ° Cradle to Cradle v2 Platinum: 150% of cost ° Cradle to Cradle v3 Silver: 100% of cost ° Cradle to Cradle v3 Gold or Platinum: 150% of cost
 - 3) International Alternative Compliance Path – REACH Optimization. End use products and materials that do not contain substances that meet REACH criteria for substances of very high concern.
7. Documentation of Product Manufacturer Supply Chain Optimization
 - a. Products sourced from product manufacturers who engage in validated and robust safety, health, hazard, and risk programs which at a minimum document at least 99% (by weight) of the ingredients used to make the building product or building material, and
 - b. Products sourced from product manufacturers with independent third party verification of their supply chain that at a minimum verifies:
 - 1) Processes are in place to communicate and transparently prioritize chemical ingredients along the supply chain according to available hazard, exposure and use information to identify those that require more detailed evaluation
 - 2) Processes are in place to identify, document, and communicate information on health, safety and environmental characteristics of chemical ingredients ° Processes are in place to implement measures to manage the health, safety and environmental hazard and risk of chemical ingredients ° Processes are in place to optimize health, safety and environmental impacts when designing and improving chemical ingredients ° Processes are in place to communicate, receive and evaluate chemical ingredient safety and stewardship information along the supply chain ° Safety and stewardship information about the chemical ingredients is publicly available from all points along the supply chain
 8. Documentation complying with Section 01 74 19 "Construction Waste Management and Disposal."
 9. Documentation on Low Emitting Materials
 - a. Product data for adhesives and sealants used inside the weatherproofing system. Products shall indicate VOC content and laboratory test reports showing compliance with requirements for low-emitting materials including the requirements of the California Department of Public Health (CDPH) Standard Method v1.1–2010, and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers. Contractor shall provide documentation on VOC amounts for all materials used in the Work.
 - 1) All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD

Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

- 2) Wood Glues: 30 g/L.
- 3) Metal-to-Metal Adhesives: 30 g/L.
- 4) Adhesives for Porous Materials (Except Wood): 50 g/L.
- 5) Subfloor Adhesives: 50 g/L.
- 6) Plastic Foam Adhesives: 50 g/L.
- 7) Carpet Adhesives: 50 g/L.
- 8) Carpet Pad Adhesives: 50 g/L.
- 9) VCT and Asphalt Tile Adhesives: 50 g/L.
- 10) Cove Base Adhesives: 50 g/L.
- 11) Gypsum Board and Panel Adhesives: 50 g/L.
- 12) Rubber Floor Adhesives: 60 g/L.
- 13) Ceramic Tile Adhesives: 65 g/L.
- 14) Multipurpose Construction Adhesives: 70 g/L.
- 15) Fiberglass Adhesives: 80 g/L.
- 16) Contact Adhesives: 80 g/L.
- 17) Structural Glazing Adhesives: 100 g/L.
- 18) Wood Flooring Adhesives: 100 g/L.
- 19) Structural Wood Member Adhesives: 140 g/L.
- 20) Single-Ply Roof Membrane Adhesives: 250 g/L.
- 21) Special-Purpose Contact Adhesives (That Are Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
- 22) Top and Trim Adhesives: 250 g/L.
- 23) Plastic Cement Welding Compounds: 250 g/L.
- 24) ABS Welding Compounds: 325 g/L.
- 25) CPVC Welding Compounds: 490 g/L.
- 26) PVC Welding Compounds: 510 g/L.
- 27) Adhesive Primer for Plastic: 550 g/L.
- 28) Sheet-Applied Rubber Lining Adhesives: 850 g/L.
- 29) Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
- 30) Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
- 31) Special-Purpose Aerosol Adhesives (All Types): 70 percent by weight.
- 32) Other Adhesives: 250 g/L.
- 33) Architectural Sealants: 250 g/L.
- 34) Nonmembrane Roof Sealants: 300 g/L.
- 35) Single-Ply Roof Membrane Sealants: 450 g/L.
- 36) Other Sealants: 420 g/L.
- 37) Sealant Primers for Nonporous Substrates: 250 g/L.
- 38) Sealant Primers for Porous Substrates: 775 g/L.
- 39) Modified Bituminous Sealant Primers: 500 g/L.

- 40) Other Sealant Primers: 750 g/L.
- b. Product data for paints and coatings used inside the weatherproofing system. Products shall indicate VOC content and laboratory test reports showing compliance with requirements for low-emitting materials, including the requirements of the California (?) Department of Public Health (CDPH) Standard Method v1.1–2010, and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers. Also:
- 1) All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011
 - 2) Flat Paints and Coatings: 50 g/L.
 - 3) Non-flat Paints and Coatings: 50 g/L.
 - 4) Dry-Fog Coatings: 150 g/L.
 - 5) Primers, Sealers, and Undercoaters: 100 g/L.
 - 6) Rust-Preventive Coatings: 100 g/L.
 - 7) Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 8) Pretreatment Wash Primers: 420 g/L.
 - 9) Clear Wood Finishes, Varnishes: 275 g/L.
 - 10) Clear Wood Finishes, Lacquers: 275 g/L.
 - 11) Floor Coatings: 50 g/L.
 - 12) Shellacs, Clear: 730 g/L.
 - 13) Shellacs, Pigmented: 550 g/L.
 - 14) Stains: 100 g/L.
- c. Laboratory test reports for flooring, indicating compliance with the requirements of the California Department of Public Health (CDPH) Standard Method v1.1–2010, and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.
- 1) Laboratory test reports for products containing composite wood, agrifiber products or wood glues. Composite wood, as defined by the California Air Resources Board, Airborne Toxic Measure to Reduce Formaldehyde Emissions from Composite Wood Products Regulation, must be documented to have low formaldehyde emissions that meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.
 - 2) Laboratory test reports for ceilings, walls, and thermal insulation (both interior and exterior), indicating compliance with the requirements of the California Department of Public Health (CDPH) Standard Method v1.1–2010, and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.

PART 3 - EXECUTION

3.1 NONSMOKING BUILDING

- A. Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes. Comply with Specification Section 01 35 46

3.2 CONSTRUCTION WASTE MANAGEMENT

- A. Comply with Section 01 74 19 "Construction Waste Management and Disposal."

3.3 CONSTRUCTION IAQ MANAGEMENT

- A. Comply with Specification Section 01 35 46 "Indoor Air Quality".

3.4 IAQ ASSESSMENT AND TESTING

- A. Comply with Specification Section 01 35 46 "Indoor Air Quality".

END OF SECTION 01 81 13.14

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Division 01 Section 01 81 13.14 Sustainable Design Requirements – LEED v4 BD+C for additional LEED v4 requirements related to commissioning.
- C. ASHRAE standard 90.1-2010, ASHRAE Guidelines 0-2013 (The Commissioning Process) and 1.1-2007 (The HVAC Commissioning Process), ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems, and NIBS Guideline 3-2012 Building Enclosure Commissioning Process.
- D. The South Terminal C Program Commissioning Plan (Cx Plan) (Construction Phase) will be developed by the CMARs and the Owner. The Cx Plan is a live document that is maintained by the Cx Authority; updated periodically during the course of the project, as required.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Commissioning is systematic processes to provide documented confirmation that building systems perform according to the criteria set forth in the Design Criteria Package (DCP) and as required to satisfy the Owner's operational needs. This is achieved by the Contractor beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. The Commissioning process shall comply with ASHRAE Guidelines 0-2013 and 1.1-2007.
- C. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify 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 proper performance of equipment and systems.
 - 3. Verify that O&M documentation left on site is complete.
 - 4. Verify that the Owner's operating personnel are adequately trained.

- D. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.
- E. Abbreviations. The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan*. Definitions are found in Section 1.3.

A/E-	Contractor's Architect and Design Engineers	FPT-	Functional Performance Test
BoD-	Basis of Design	MC-	Mechanical Contractor
BECxA-	Building Envelope Cx Authority	OPR-	Owner's Project Requirements
CxA-	Commissioning Authority	OAR-	Owner's Authorized Representative
CxC-	CMAR's Commissioning Coordinators	VC-	Verification checklist (CVC)
GC	Contractor	PM-	Project Manager (of the Owner)
Cx-	Commissioning	Subs-	Subcontractors to Contractor
GOAA-	Greater Orlando Aviation Authority (Owner)	RFI-	Requests for Information
CC-	Controls Contractor	OIA-	Orlando International Airport
CMARS-	Owner's Construction Managers at Risk		
Cx Plan-	Commissioning Plan document	TAB-	Test and Balance contractor
DCC-	Design Criteria Consultant		
EC-	Electrical contractor	LEED AP	USGBC LEED Administrator

F. Related Sections:

1. Division 01 Section on "Design Submittals, Shop Drawings, Products and Samples" which defines documentation (product data, shop drawings, samples, etc.) to be submitted for review and approval. GC shall forward copies of all submittals related to commissioned systems to the CxA through the OAR.
2. Division 01 Sections on "Field Test for Water Leakage" and "Structural Testing and Inspections" which define specific tests to be performed or witnessed by the Building Envelope Cx Authority (BECxA).
3. Division 01 Section on "Closeout Submittals" which defines substantial completion and functional completion, relative to commissioning. Contractor shall forward copies of final Test and Balance Report, completed Verification Checklists, as-build control (BAS) drawings, and approved fire alarm system testing report to the CxA through the OAR.
4. Division 01 Section on "Demonstration and Training" defines Contractor's training requirements for the Owner's O&M and Facilities' personnel. GC shall forward copies of the training syllabuses and attendee sign-in sheets for each training session scheduled for the commissioned equipment and systems on the project to the CxA through the OAR.
5. Division 01 Section on "Sustainable Design Requirements – LEED v4 BD+C" defines the Contractors requirements for complying with sustainable practices, including LEED requirements.

6. Division 01 Section "Facility Exterior Enclosure Commissioning" defines the Contractor's requirements for commissioning activities associated with the building envelope; wall and roof assemblies, materials, and components.
7. Division 21 Section "Commissioning of Fire Suppression Systems" defines the Contractor's requirements for commissioning process activities for fire suppression systems, assemblies, equipment, and components, including, but not limited to, fire pumps, jockey pumps, standpipes and sprinkler systems.
8. Division 22 Section "Commissioning of Plumbing Systems" defines the Contractor's requirements for commissioning process activities for plumbing systems, assemblies, equipment, and components.
9. Division 23 Section "Commissioning of HVAC Systems" defines the Contractor's requirements for commissioning process activities for HVAC systems, assemblies, equipment, and components.
10. Division 26 Section "Commissioning of Electrical Systems" defines the Contractor's requirements for commissioning process activities for electrical systems, assemblies, equipment, and components.
11. Division 28 Section "Commissioning of Life Safety and Security Systems" defines the Contractor's requirements for commissioning process activities for fire detection and alarm, smoke control and stair pressurization, elevator recall and override, and security systems.

1.3 DEFINITIONS

- A. Acceptance Phase. Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.
- B. Approval. Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
- C. Architect/Engineer (A/E): The Contractor's prime consultant (Designer) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.
- D. BECxA: Building Envelope Commissioning Authority. An independent agent, not otherwise associated with the A/E team members or the GC, hired by the Owner. The BECxA directs and coordinates the day-to-day commissioning activities associated with the building envelope components; such as, waterproofing, curtain wall, glazing, and roofing. The BECxA does not take an oversight role like the GC. The CxA is part of the Owner's Authorized Representative (OAR) team or shall report directly to the Owner.
- E. BoD: Basis of Design. A document prepared by the A/E that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

- F. CxA: Commissioning Authority. An independent agent, not otherwise associated with the A/E team members or the GC, hired by the Owner. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the CM. The CxA is part of the Owner's Authorized Representative (OAR) team or shall report directly to the Owner.
- G. Cx Plan: Commissioning Plan: A document prepared by the CxA that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process
- H. Datalogging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
- I. Deferred Functional Tests : FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.
- J. Deficiency : A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent)
- K. Design Intent: A dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.
- L. Design Narrative or Design Documentation: Sections of either the Design Intent or Basis of Design.
- M. Factory Testing: Testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
- N. Functional Performance Test (FPT) or (FT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after pre-functional checklists and start-up are complete.

- O. Contractor (GC): See definitions in the General Conditions of the Design-Build Contract for Construction.
- P. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed
- Q. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- R. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
- S. Non-Compliance: See Deficiency.
- T. Non-Conformance: See Deficiency.
- U. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also "Simulated Signal."
- V. OPR: Owner's Project Requirements. The Design Criteria Package, which details the functional requirements of a project and the expectations of how it will be used and operated. Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information may also be included.
- W. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- X. Seasonal Performance Tests: FT that are deferred until the system(s) will experience conditions closer to their design conditions.
- Y. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
- Z. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- AA. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- BB. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.

- CC. Subs: The subcontractors to the GC who provide and install building components and systems.
- DD. Test Procedures: The step-by-step process which must be executed by the Contractor to fulfill the test requirements. The test procedures are developed by the CxA.
- EE. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents
- FF. Trending: Monitoring using the building control system.
- GG. Vendor: Supplier of equipment.
- HH. Verification Checklist (VC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the GC & Subs. Verification checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor). Verification checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the verification checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the verification checklisting, except for larger or more critical pieces of equipment.
- II. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.4 COORDINATION

- A. Commissioning Team: The members of the commissioning team consist of the Commissioning Authority (CxA), the Building Envelope Commissioning Authority (BECxA), the OAR, the DCC, the designated representative of the Contractor (GC), the CxC, the A/E (particularly the Mechanical and Electrical Engineers), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB contractor, the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or operator/engineer is also a member of the commissioning team.

- B. Management: The CxA is hired by the Owner directly. The CxA directs and coordinates the commissioning activities and the reports to the OAR. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
- C. Scheduling: The CxA will work with the Contractor (GC) according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
- D. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The *Commissioning Plan—Construction Phase* provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

1.5 COMMISSIONING PROCESS

- A. Commissioning Plan: The *Commissioning Plan – Construction Phase* will be developed and provided by the CxA prior to the start of construction. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting, the CxA will update the plan which is then considered the “final” plan, though it will continue to evolve and expand as the project progresses. The *Specifications* will take precedence over the *Commissioning Plan*.
- B. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
 1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the OAR, the A/E, the DCC, the GC and the Subcontractors.
 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.
 4. The CxA works with the GC and the Subs in developing startup plans and startup documentation formats, including providing the GC and the Subs with Verification Checklists to be completed, prior to the startup process.
 5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with Verification Checklists being completed before functional testing.
 6. The Subcontractors, under the direction of GC, execute and document the Verification Checklists and perform startup and initial checkout. The CxA

documents that the VC and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.

7. The CxA develops specific equipment and system Functional Performance Test procedures. The OAR, the DCC, the A/E, the GC and the Subs review the test procedures.
8. The procedures are executed by the GC and the Subs, under the direction of, and documented by the CxA.
9. Items of non-compliance in material, installation or setup are corrected at the Sub's expense and the system retested.
10. The CxA and the A/E review the O&M documentation for completeness prior to submittal to the OAR.
11. Commissioning is completed before Substantial Completion.
12. The CxA, the OAR, the DCC and the A/E review, pre-approves and coordinates the training provided by the GC and the Subs and verifies that it was completed.
13. Deferred testing is conducted, as specified or required.

C. Cloud-based Web Application Software

1. For this project, the Cx Authority will be utilizing a cloud-based web application for managing the commissioning documentation associated with the project. A dedicated project site will be established and this web application will provide real time data and a single interface for all project team members to share information and collaborate effectively.
2. Commissioning documentation will be maintained on this site and secure access will be provided to all team members. Cx documentation will be maintained in an electronic format, with automatic synchronization with the cloud as it is updated. However, provisions will be provided to create PDF versions of select Cx files for printing.
3. Team members will be notified of updates to the site through e-mails on a regular basis (typically daily). Discrete commissioning files will not be e-mailed to the team. This system will require contractors and subcontractors to monitor Cx activities and documentation through the site, and will allow the use of tablet (or laptop) PCs when completing the checklists and addressing issues in the field, if desired. Tablets and/or laptop PCs will be the responsibility of the individual team members. Alternately, contractors may print paper versions of the checklists and forms for completion in the field. If paper forms are utilized, it will be the responsibility of the contractor to accurately update the system with the information gathered in the field on paper forms in a timely manner. Requirements for same (compatible operating systems and browsers) will be provided by the Cx Authority.
4. The Cx Authority will provide initial instruction on the use of this web application and answer questions at a Cx kick-off meeting. Contractor and all subcontractors will be expected to have designated representatives from their firms available for training.

1.6 COMMISSIONING TEAM

- A. Members Appointed by Contractor: Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, the Contractor (GC) and A/E, including Project superintendent, Commissioning coordinators, and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. The OAR
 - 4. The DCC.

1.7 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation with assistance from the OAR to the CxA for development of an OPR document.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by A/E and approved by OAR and DCC, to the CxA for use in developing the; OPR, commissioning specifications, commissioning plan, systems manual, and assist with the operation and maintenance manuals, training plan.
- D. Follow the Commissioning Plan.
- E. Attend commissioning scoping meetings and additional meetings as necessary.

1.8 OWNER'S AUTHORIZED REPRESENTATIVE'S RESPONSIBILITIES

- A. The OAR shall represent the Owner during the commissioning process as follows:
 - 1. Manage the contracts of the GC and its A/E.
 - 2. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the *Commissioning Plan – Construction Phase*.
 - 3. Provide final approval for the completion of the commissioning work.
 - 4. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.
 - 5. Follow the Commissioning Plan.
 - 6. Attend commissioning scoping meetings and additional meetings as necessary.

1.9 CONTRACTOR'S A/E'S RESPONSIBILITIES

- A. The Contractor's A/E shall comply with the fullest extent with the latest edition of the GOAA's Design Guidelines and Standards, including the latest Sustainability Management Plan, including all sections shall apply. The A/E shall participate in and perform commissioning process activities including, but not limited to, the following:
1. Attend the commissioning scoping meeting and selected commissioning team meetings.
 2. Perform normal submittal review and approve of the following documents; submittals, shop drawings, as-built drawing, O&M manual, etc., as contracted.
 3. Provide all design narrative and sequence documentation requested by the CxA. The A/E shall assist (along with the GC) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 4. Respond to design and/or construction issues identified and assigned to them by the CxA and/or BECxA through the cloud-based Cx web application.
 5. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
 6. Review and approve final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals issued by the GC. Issue the approved O & M manuals to the CxA.
 7. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.
 8. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

1.10 CONTRACTOR (GC) RESPONSIBILITIES

- A. The GC shall participate in and perform commissioning process activities including, but not limited to the following:
1. Facilitate the coordination of the commissioning work by the CxA, with complete knowledge of commissioning activities which will be incorporated into the master construction project schedule.
 2. Comply with all fundamental and enhanced commissioning requirements as required under LEED v4 BD+C, including providing input and all required documentation for LEED v4 certification of Cx activities, including, but not limited to: Current Facility Requirements, O&M Plan, Systems Manuals, Ongoing Commissioning Plan, and Final Commissioning Report.
 3. Review and approve the final *Commissioning Plan—Construction Phase*.
 4. Attend a commissioning scoping meeting and other commissioning team meetings.
 5. Issue subcontractor submittals for A/E approval & CxA review.
 6. Furnish a copy of all construction documents, addenda, requests for information, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.

7. Completing verification checklists and responding to issues identified by the CxA and/or BECxA. Note: For this project, the CxA and BECxA will be utilizing a cloud-based Cx web application for managing the commissioning documentation associated with the project.
8. Issue O & M manuals to A/E for approval within 45 days of approved submittals. A/E to issue to the O & M manuals to the CxA through the OAR for review of design compliance.
9. Review and approve the Functional Performance test procedures submitted by the CxA, prior to testing.
10. Review commissioning progress, including: checklist progress, outstanding issues and deficiency reports. Report on status weekly.
11. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
12. Coordinate with the CxA for resolution of issues recorded in the CxA Issues Log.
13. Review and accept construction Verification Checklists provided by the CxA.
14. Complete electronic construction Verification Checklists as work is completed and provide to the CxA. Complete commissioning process test procedures.
15. Include the cost of for coordinating commissioning with the CxA in the total contract price.
16. Coordinate the training of Owner personnel and provide the times and dates of training to the CxA.
17. Execute seasonal or deferred functional performance testing witnessed by the CxA to facilitate the Cx process.
18. Provide a list of final settings, setpoints, ranges, schedules, and / or trend logs required by the CxA.
19. Follow the Commissioning Plan throughout the entire project duration.

1.11 SUBCONTRACTOR'S RESPONSIBILITIES

- A. The GC shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 2. Assist in completing verification checklists and responding to issues identified by the CxA and/or BECxA. Note: For this project, the CxA and BECxA will be utilizing a cloud-based Cx web application for managing the commissioning documentation associated with the project.
 3. Assist in equipment testing per agreements with the GC.
 4. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the GC's Total Contract Price, except for stand-alone data logging equipment that may be used by the CxA.
 5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
 6. Review test procedures for equipment installed by factory representatives.
 7. Follow the Commissioning Plan.

8. Attend commissioning scoping meetings and additional meetings as necessary.
9. From the red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation, and those provided by the vendor as shop drawings, for the BAS, central chilled and hot water systems, domestic HW systems, AHU systems, VAV systems, exhaust systems, fire suppression systems, normal and emergency power systems, and life safety and security systems.

1.12 EQUIPMENT SUPPLIERS' RESPONSIBILITIES

- A. The GC shall assign the equipment suppliers & representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 2. Assist in equipment testing per agreements with the GC and the Subs. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the GC, except for stand-alone datalogging equipment that may be used by the CxA.
 3. Through the GC and the Subcontractors they supply products to, analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.
 4. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
 5. Review test procedures for equipment installed by factory representatives.
 6. Follow the Commissioning Plan.
 7. Attend commissioning scoping meetings and additional meetings as necessary.

1.13 Cx AUTHORITY'S RESPONSIBILITIES

- A. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving, non-conformance or deficiencies, but ultimately that responsibility resides with the GC and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The GC & subcontractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems.
 1. Coordinates and directs the commissioning activities using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

2. Coordinate the commissioning work and, with the GC & subcontractors, ensure that commissioning activities are being scheduled into the master schedule.
3. Revise, as necessary, the *Commissioning Plan—Construction Phase*.
4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
5. Request and review additional information required to perform commissioning tasks, including O&M materials, subcontractor start-up and checkout procedures.
6. Before startup, gather and review the current control sequences and interlocks and work with subcontractors and Design Engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
7. Review and comment on normal GC submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews / approvals.
8. Write and distribute pre-functional tests and checklists.
9. Develop an enhanced start-up and initial systems checkout plan with GC and the Subcontractors.
10. Perform site visits, as necessary, to observe component and system installations. Attends selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
11. Witness representative HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's representative of any deficiencies in results or procedures.
12. Witness representative ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's representative of any deficiencies in results or procedures.
13. Approve pre-functional tests and checklist completion by reviewing pre-functional checklist reports and by selected site observation and spot checking.
14. Approve systems startup by reviewing start-up reports and by selected site observation.
15. Review TAB execution plan.
16. Oversee sufficient functional testing of the control system and approve it to be used for TAB, before TAB is executed.
17. Approve air and water systems balancing by spot testing, by reviewing completed reports and by selected site observation.
18. With necessary assistance and review from the GC and installing subcontractors, write the Functional Performance test procedures for equipment and systems. This may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing. Submit to the A/E, and OAR for review and approval.

19. Analyze any functional performance trend logs and monitoring data to verify performance.
20. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
21. Maintain a master deficiency and resolution log and a separate testing record. Provide the GC with written progress reports and test results with recommended actions.
22. Witness performance testing of smoke control system interfaced with the HVAC systems, by others and all other owner contracted tests or tests by manufacturer's personnel over which the CxA may not have direct control. Document these tests and include this documentation in Commissioning Report.
23. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
24. Oversee and review the training plan by the GC & subcontractors for the Owner's operating personnel.
25. Compile and maintain a commissioning record and building systems book(s).
26. Review the preparation of the O&M manuals, the CxA will issue comments to the A/E, DCC and the OAR.
27. Provide a final commissioning report to the Owner.
28. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
29. Return to the completed project site for a 10 month warranty review, prior to the 12 months warranty period and review with Owners facility staff the current building operation and the condition is performing in compliance with design intent of the project design and to ensure issues related to the original and seasonal commissioning are still intact. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

1.14 SYSTEMS TO BE COMMISSIONED

A. The following checked systems will be commissioned in this project.

Equipment and System	Applicable Specification Sections:	Equipment and System	Applicable Specification Sections:
<u>Building Envelope</u>		Small Capacity Split System Air Conditioners	23 08 00 and 23 81 26.13
Walls, glazing, roof assemblies, waterproofing and expansion joints	01 91 15 and all related sections	Fan Coil Units	23 08 00 and 23 82 19
<u>Conveying Equipment</u>		PCA Units and Specialties	23 08 00 and 23 90 00

ORLANDO INTERNATIONAL AIRPORT
SOUTH TERMINAL C
TENANT AND AIRLINE BUILD-OUT PROJECTS

GENERAL COMMISSIONING REQUIREMENTS
Section 01 91 13

Equipment and System	Applicable Specification Sections:	Equipment and System	Applicable Specification Sections:
Traction Elevators	14 21 00		
Hydraulic Elevators	14 24 00	<u>Fire Suppression Systems</u>	
Escalators	14 31 00	Commissioning of Fire Suppression Systems	21 08 00
<u>HVAC Systems</u>		Fire Suppression Standpipes	21 08 00 and 21 12 00
Common Motor Requirements for HVAC Equipment	23 08 00 and 23 05 13	Wet Pipe Sprinkler Systems	21 08 00 and 21 13 13
Variable Frequency Motor Controllers	23 08 00 and 23 05 14	Dry Pipe Sprinkler Systems	21 08 00 and 21 13 16
Control Wiring	23 08 00 and 23 05 18	Electric Drive, Centrifugal Fire Pumps	21 08 00 and 21 31 13
Meters and Gages for HVAC Piping	23 08 00 and 23 05 19	<u>Plumbing Systems</u>	
General Duty Valves for HVAC Piping	23 08 00 and 23 05 23	Commissioning of Plumbing Systems	22 08 00
Valves for PCA Piping	23 08 00 and 23 05 23.01	Domestic Water Piping and Domestic Water Piping Specialties	22 08 00, and 22 11 16, and 22 11 19
Air Control and Accessories	23 08 00 and 23 05 80	Domestic Water Pumps	22 08 00 and 22 11 23
Testing, Adjusting and Balancing for HVAC	230800 and 23 05 93	Domestic Water Packaged Booster Pumps	22 08 00 and 22 11 23.13
Commissioning of HVAC Systems	23 08 00	Sump Pumps	22 08 00 and 22 14 29
Instrumentation and Control for HVAC	23 08 00 and 23 09 00	Electric Domestic Water Heaters	22 08 00 and 22 33 00
Refrigerant Detection and Alarm	23 08 00 and 23 09 20	Natural Fuel Gas Systems - Plumbing	22 08 00 and 22 70 00
Facility Fuel Oil Piping	23 08 00 and 23 11 13	<u>Electrical Systems</u>	
Hydronic Piping	23 08 00 and 23 21 13	Power Systems Study with Arc Flash Analysis	26 08 00 and 26 05 73
PCA Hydronic Piping	23 08 00 and 23 21 13.01	Commissioning of Electrical Systems	26 08 00
Pre-insulated Underground Piping System	23 08 00 and 23 21 13.15	Demonstration of Completed Electrical Systems	26 08 00 and 26 08 03

ORLANDO INTERNATIONAL AIRPORT
SOUTH TERMINAL C
TENANT AND AIRLINE BUILD-OUT PROJECTS

GENERAL COMMISSIONING REQUIREMENTS
Section 01 91 13

Equipment and System	Applicable Specification Sections:	Equipment and System	Applicable Specification Sections:
Hydronic Piping Specialties	23 08 00 and 23 21 16	Tests and Performance Verification	26 08 00 and 26 08 13
Hydronic Pumps	23 08 00 and 23 21 23	Architectural Lighting Controls for Public Spaces	26 08 00 and 26 09 24
PCA Hydronic Pumps	23 08 00 and 23 21 23.01	Occupancy Sensors	26 08 00 and 26 09 24
HVAC Water Treatment	23 08 00 and 23 25 00	Network Lighting Controls	26 08 00 and 26 09 24
PCA Water Treatment	23 08 00 and 23 25 00.01	Medium Voltage Generator	26 08 00 and 26 32 18
Air Duct Accessories	23 08 00 and 23 33 00	Switchboards	26 08 00 and 26 24 13
Axial HVAC Fans	23 08 00 and 23 34 13	Electrical Metering and Monitoring	26 08 00 and 26 27 13
Centrifugal HVAC Fans	23 08 00 and 23 34 16	Demonstration of Completed Electrical Systems	26 08 00 and 01 79 00
HVAC Power Ventilators	23 08 00 and 23 34 23	Outdoor Engine Generator, Sub-Base Tank	26 08 00 and 26 32 18
Air Curtains	23 08 00 and 23 34 33	Medium Voltage Diesel Engine Driven Generator	26 08 00 and 26 32 18
Air Terminal Units	23 08 00 and 23 36 00	Static Uninterruptible Power Supply	26 08 00 and 26 33 53
Particulate Air Filtration	23 08 00 and 23 41 00	Automatic Transfer Switches	26 08 00 and 26 36 23
Heat Exchangers for PCA	23 08 00 and 23 57 00.01	Lightning Protection System	26 08 00 and 26 41 13
Centrifugal Water Chillers	23 08 00 and 23 64 16	Surge Protective Devices	26 08 00 and 26 43 00
PCA Centrifugal Water Chillers	23 08 00 and 23 64 16.01	Architectural Lighting Fixtures, Lamps, Ballasts for Public Spaces	26 08 00 and 26 50 10
Scroll Water Chiller	23 08 00 and 23 64 23	Interior Lighting	26 08 00 and 26 51 00
Packaged Cooling Towers	23 08 00 and 23 65 00	400- Hertz Frequency Converters	26 08 00 and 26 61 00
Air to Air Energy Recovery Unit	23 08 00 and 23 72 00	<u>Electronic Safety and Security</u>	
Modular Indoor Central-Station Air Handling Units	23 08 00 and 23 73 13	Physical Access Control System (SSI)	28 08 00 and 28 13 00

Equipment and System	Applicable Specification Sections:	Equipment and System	Applicable Specification Sections:
Dedicated Outdoor Air Units	23 08 00 and 23 74 33	Intrusion Detection System (SSI)	28 08 00 and 28 16 00
Computer Room Air Conditioners	23 08 00 and 23 81 23	Video Surveillance System (SSI)	28 08 00 and 28 23 00
Split System Air Conditioners	23 08 00 and 23 81 26	Addressable Fire Detection and Alarm	28 08 00 and 28 31 00

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios shall be provided by the subcontractor.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the Total Contract Price and left on site, except for stand-alone datalogging equipment that may be used by the CxA.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications*. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.
- D. Refer to Section 01 91 13, Part 3.5 E for details regarding equipment that may be required to simulate required test conditions.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Scoping Meeting: To be within 90 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties

by the CxA. Information gathered from this meeting will allow the CxA to revise the *Commissioning Plan* to its "final" version, which will also be distributed to all parties.

- B. Miscellaneous Meetings: Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with GC & Subs. The CxA will plan these meetings and will minimize unnecessary time being spent by the GC & Subs. These meetings will be held monthly, until the final 3 months of construction when they may be held as frequently as one per week.

3.2 REPORTING

- A. The CxA will provide regular reports to the GC and the OAR, with increasing frequency as construction and commissioning progresses. Standard forms are provided and referenced in the *Commissioning Plan*.
- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.
- D. A final summary report (about four to six pages, not including backup documentation) by the CxA will be provided to the GC and the OAR, focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. Verification Checklist, Functional Performance tests and monitoring reports will not be part of the final report, but will be stored in the Commissioning Record in the O&M manuals.
- E. The sample reports included in the Commissioning Plan are to provide the GC and the Subcontractors with an example of a format and an indication of the rigor of the required documentation for various report types.

3.3 SUBMITTALS

- A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning authority. All

documentation requested by the CxA will be included by the Subs in their O&M manual contributions.

1. Requested Submittals:
 - a. Air Handling Units – Modular Central Station
 - b. Air Terminal Units
 - c. Air-to-Air Energy Recovery
 - d. Building Automation System (DDC Temperature Controls)
 - e. Centrifugal Water Chillers
 - f. Computer Room Air Conditioners
 - g. Cooling Tower(s)
 - h. Dedicated Outdoor Air Units
 - i. Domestic Water Heaters - Electric
 - j. Domestic Water Pumps
 - k. Ductwork Insulation
 - l. Elevators and escalators
 - m. Engine Generator(s)
 - n. Fan Coil Units
 - o. Fire Pump
 - p. HVAC Fans
 - q. Hydronic Pumps
 - r. Lift-Net and Power Xpert Systems
 - s. Lift Station
 - t. Lighting Controls, including occupancy sensors
 - u. Particulate Air Filtration
 - v. Pipe Insulation
 - w. Scroll Water Chillers
 - x. Split DX System Air Conditioners
 - y. Sump Pumps
 - z. Testing, Adjusting, and Balancing
 - aa. Transfer Switches (Automatic and Non-Automatic)
 - bb. Unit Heaters
 - cc. Variable Frequency / Variable Speed Drives
 - dd. Water Treatment
 2. Requested Shop Drawings:
 - a. BAS / Temperature Control Shop Drawings
 - b. Campus and Building Distribution Piping
 - c. Ductwork
 - d. Fire Alarm System
 - e. Fire Protection Standpipe and Sprinkler Systems
 - f. Lighting Control System
 - g. Security access control system
 - h. Power Systems Coordination Study and Arc Flash Analysis
 - i. Water treatment systems
 - j. Video Surveillance System
- B. The Commissioning authority will review and provide comment on submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the

equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning authority will notify the GC, OAR, DCC and A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

- C. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.
- D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the GC, though the CxA will review them.
- E. GC responsibility for deviations in submittals from requirements of the Contract Documents is not relieved by the Commissioning Authority's review.

3.4 START-UP, VERIFICATION CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.14, Systems to be Commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PCs and startup.
- B. General. Verification Checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that Functional Performance Testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in the commissioning scoping meeting and in the checklist forms. GC, subcontractors and manufacturer's technicians shall be responsible for executing Functional Performance Tests for their representative equipment and systems.
 - 1. The CxA develops the Verification Checklists for all equipment and/or systems to be commissioned and delivers the VC, (via upload to the cloud-based CxAlloy site) to the GC for completion. These VC indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.

2. These VC and tests are provided by the CxA to the GC. The GC determines which trade is responsible for executing and documenting each of the line item tasks and assigns same to that subcontractor. Each form will have more than one trade responsible for its execution.
 3. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan. The full start-up plan could consist of something as simple as:
 - a. The CxA's Verification Checklists.
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. The manufacturer's normally used field checkout sheets.
 4. The subcontractor submits the full startup plan to the GC & CxA for review and approval.
 5. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
 6. The full start-up procedures and the approval form may be provided to the GC for review and approval, depending on management protocol.
- D. Sensor and Actuator Calibration.
1. All field-installed temperature, relative humidity, CO₂ and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner before-hand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* the unit at the factory with calibration certification provided need not be field calibrated.
 2. All procedures used shall be fully documented on the prefunctional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
 3. Sensor Calibration Methods.
 - a. All Sensors. Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable, are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.
 - b. Sensors Without Transmitters--Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table

- below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.
- c. Sensors With Transmitters--Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
 - d. Critical Applications. For critical applications (process, manufacturing, etc.) more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

Tolerances, Standard Applications

<u>Sensor</u>	<u>Required Tolerance (+/-)</u>	<u>Sensor</u>	<u>Required Tolerance (+/-)</u>
Cooling coil, chilled water temps	0.4°F	Flow rates, water	4% of design
AHU wet bulb or dew point	2.0°F	Relative humidity	4% of design
Hot water coil water temp	1.5°F	Oxygen or CO ₂ monitor	0.1 % pts
Outside air, space air, duct air temps	0.4°F	Barometric pressure	0.1 in. of Hg
Watt-hour, voltage & amperage	1% of design	Pressures, air, water	3% of design
		Flow rates, air	10% of design

- 4. Valve and Damper Stroke Setup and Check.
 - a. EMS Readout. For all valve and damper actuator positions checked, verify the actual position against the BAS readout.
 - b. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- 5. Closure for heating coil valves (NO): Set heating setpoint 20°F above room temperature. Observe valve open. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set heating setpoint to 20°F below room temperature. Observe the valve close. Restore to normal.

6. Closure for cooling coil valves (NC): Set cooling setpoint 20°F above room temperature. Observe the valve close. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set cooling setpoint to 20°F below room temperature. Observe valve open. Restore to normal.
- E. Execution of Verification Checklists and Startup.
1. Four weeks prior to startup, the GC and the Subcontractors and vendors schedule startup and checkout with the CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the GC and the Subcontractor or vendor. When checking off prefunctional checklists, signatures may be required by the GC and/or their Subs for verification of completion of their work.
 2. The CxA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the GC). In no case will the number of units witnessed be less than four, nor less than 20% of the total number of identical or very similar units.
 3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the prefunctional and start-up procedures. The sampling procedures are identified in the commissioning plan.
 4. The GC and the Subcontractors and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
 5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
- F. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
1. The GC and the Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
 2. The CxA reviews the report and submits either a non-compliance report or an approval form to the GC and the Sub. The CxA shall work with the GC and the Subs and vendors to correct and retest deficiencies or uncompleted items. The CxA will involve the GC and the Subs as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the GC and the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the execution of the checklists and startup of each system to the GC using a standard form.

3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party. Refer to Part 3.7 herein for details.

3.5 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. The general list of equipment to be commissioned is found in Section 01 91 13, Part 1.14. The specific system Functional Performance Tests (with required modes and sequences to be tested) will be developed after complete review of the control shop drawings and discussion with the Engineer-of-Record.
- C. The parties responsible to execute each test are GC's installing subcontractors and associated vendors, manufacturer's representatives and technicians.
- D. Objectives and Scope. The objective of Functional Performance Testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
 1. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, no flow, equipment failure, etc. shall also be tested.
 2. Development of Test Procedures. Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. The GC's Sub or vendor responsible to execute a test, shall provide assistance to the CxA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the GC and the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA will submit the tests to the A/E and the OAR for review.
 3. The CxA shall review owner-contracted, factory testing or required owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
 4. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

5. The test procedure forms developed by the CxA shall include (but not be limited to) the following information:
 - a. System and equipment or component name(s)
 - b. Equipment location and ID number
 - c. Unique test ID number, and reference to unique prefunctional checklist and start-up documentation ID numbers for the piece of equipment
 - d. Date
 - e. Project name
 - f. Participating parties
 - g. A copy of the specification section describing the test requirements
 - h. A copy of the specific sequence of operations or other specified parameters being verified
 - i. Formulas used in any calculations
 - j. Required pre-test field measurements
 - k. Instructions for setting up the test.
 - l. Special cautions, alarm limits, etc.
 - m. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
 - n. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
 - o. A section for comments
 - p. Signatures and date block for the CxA
- E. Test Methods.
1. Functional Performance Testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. The final Functional Performance Test protocols, as developed by the CxA, shall specify which methods shall be used for each test. The CxA may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the GC. This may require a change order and adjustment in charge to the Owner. The CxA will determine which method is most appropriate for tests that do not have a method specified.
 2. Note: Commissioning functional performance testing for HVAC and related systems associated with the building automation system (BAS) will NOT be conducted through the Java Application Control Engine (JACE) controller. All Cx functional performance testing will be conducted through the BAS front end under the direction of the Cx Authority and the BAS controls contractor.
 3. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
 4. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test

a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.

5. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
6. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AHU lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout setpoint to be 2°F above the current outside air temperature.
7. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
8. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
9. Sampling. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. The specific recommended sampling rates for each type of equipment will be dictated by the CxA. It is noted that no sampling by GC's & Subs is allowed in prefunctional checklist execution.
 - a. A common sampling strategy referenced in the *Specifications* as the "xx% Sampling—yy% Failure Rule" is defined by the following example.

xx = the percent of the group of identical equipment to be included in each sample.

yy = the percent of the sample that if failing, will require another sample to be tested.
 - b. The example below describes a 20% Sampling—10% Failure Rule.

- 1) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."
 - 2) If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
 - 3) If 10% of the units in the second sample fail, test all remaining units in the whole group.
 - 4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.
- F. Coordination and Scheduling. The GC & Subs shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule Functional Performance Tests through the GC & Subs. The CxA shall direct, witness and document the Functional Performance Tests of all equipment and systems. The GC & Subs shall execute the tests.
1. In general, Functional Performance Testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
- G. Test Equipment. Refer to Section 01 91 13, Part 2 for test equipment requirements.
- H. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC & Subs and A/E.

3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation. The CxA shall witness and document the results of all Functional Performance Tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC for review and approval, the GC shall issue to the Subs for execution. The CxA will include the filled out and executed forms in the O&M manuals.
- B. Non-Conformance.
1. The CxA will record the results of the Functional Performance Test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the GC on a standard non-compliance form.

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the GC.
4. As tests progress and a deficiency is identified, the CxA discusses the issue with the GC & Subs.
 - a. When there is no dispute on the deficiency and the GC & Sub accepts responsibility to correct it:
 - 1) The CxA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CxA submits the non-compliance reports to the GC for signature. A copy is provided to the Sub and CxA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.
 - 2) The CxA reschedules the test and the test is repeated.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - 1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the GC and to the Sub representative assumed to be responsible.
 - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E and the OAR. Final acceptance authority is with the Project Manager.
 - 3) The CxA documents the resolution process.
 - 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 - c. Cost of Retesting.
 - 1) The cost for the *Sub* to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 - 2) For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CxA and GC will direct the retesting of the equipment once at no "charge" to the Subs for their time. However, the CxA's and GC's time for a second retest will be charged to the Subs.
 - 3) The time for the CxA and GC to direct any retesting required because a specific *prefunctional* checklist or start-up test item,

- reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the Subs.
- 4) Refer to the sampling section of Section 01 91 13, Part 3.6 for requirements for testing and retesting identical equipment.
 5. The GC & Subs shall respond in writing to the CxA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 6. The CxA retains the original non-conformance forms until the end of the project.
 7. Any required retesting by any subcontractor shall not be considered a justified reason for a claim of delay or for a time extension by the GC.
- C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the GC or the A. In such case, the GC shall provide the Owner with the following:
1. Within one week of notification from the GC or the OAR, the subcontractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the GC or the OAR within two weeks of the original notice.
 2. Within two weeks of the original notification, the subcontractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
 3. The GC or the OAR will determine whether a replacement of all identical units or a repair is acceptable.
 4. Two examples of the proposed solution will be installed by the subcontractor and the GC will be allowed to test the installations for up to one week, upon which the GC or the OAR will decide whether to accept the solution.
 5. Upon acceptance, the subcontractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- D. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the Functional Performance Test is made later after review by the CxA and by the GC and the OAR. The CxA recommends acceptance of each test to the GC using a standard form. The GC gives final approval on each test using the same form, providing a signed copy to the CxA and the OAR.

3.7 DEFERRED TESTING

- A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the OAR. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.
- B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with Owner facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builts due to the testing will be made by the GC.

3.8 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed. GC shall ensure that certified factory manufactures representatives are present for training of Owners Personnel in the field and classroom setting.
- B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.
 - 1. The CxA shall interview the Owners facility manager and lead Owners operations engineer to determine the special needs and areas where training will be most valuable. The Owner and CxA shall decide the training requirements for each piece of commissioned equipment. The CxA shall communicate the results to the GC & Subs and vendors who have training responsibilities.
 - 2. In addition to these general requirements, the specific training requirements of the Owner's personnel by Subcontractors and vendors, is specified in Divisions 01, 21, 22, 23, 26, and 28.
 - 3. Each Sub and vendor responsible for training will submit a written training plan to the GC, the CxA, and the OAR for review and approval prior to training. The plan will cover the following elements:
 - a. Equipment (included in training)
 - b. Intended audience
 - c. Location of training
 - d. Objectives
 - e. Subjects covered (description, duration of discussion, special methods, etc.)
 - f. Duration of training on each subject
 - g. Instructor for each subject
 - h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
 - i. Instructor and qualifications

- j. For the primary HVAC equipment, the Controls Contractor shall provide a discussion of the control of the equipment during the mechanical or electrical training conducted by others.
4. The CxA develops the overall training plan with assistance from the A/E, the GC and the Subcontractor(s) and coordinates and schedules, with the GC and the Subs for overall training of the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the GC using a standard form. The GC also signs the approval form at one of the training sessions. Video recording of the training sessions will be provided by the subcontractors and or vendors with media cataloged and added to the O&M manuals by the GC.
5. At the Owner's option, at the first training session, the M/E/P/FP Engineers of record shall present the overall systems' design concept & intent and the design concept of each equipment section. This presentation shall be one to two hours in length and include a review of all systems using simplified system schematics (one-line drawings) including chilled water systems, condenser water systems, PCA systems, supply air systems, exhaust air system and outdoor air strategies.

3.9 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals.

1. GC shall submit two draft copies of the complete operating and maintenance manual to the A/E and the CxA for review within 45 calendar days after approval of equipment shop drawings. One approved copy will be returned to the contractor within 30 days after receipt by the A/E.
2. GC shall submit corrected final approved O & M manuals prior to functional performance testing & training of Owners Personnel. Prior to final submittal, the CxA shall review the O&M manuals (in addition to the initial draft O&M manual), and documentation, with redline as-builts, for systems that were commissioned to verify compliance with the specifications. The CxA will communicate, through the GC, deficiencies in the manuals to the subcontractor. Upon a successful review of the corrections, the CxA will recommend approval and acceptance of these sections of the O&M manuals to the GC. The CxA will also review each piece of equipment warranty and verify that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.
3. A/E Contribution. The A/E will include in the beginning of the O&M manuals a separate section describing the systems including:
 - a. The design intent narrative prepared by the A/E and provided as part of the bid documents, updated to as-built status by the A/E.
 - b. Simplified professionally drawn single line system diagrams on 8 ½" x 11" or 11" x 17" sheets. These shall include: the domestic hot water (DHW) system, the chilled water systems, condenser water systems, PCA systems, supply air distribution systems, exhaust air systems and electrical distribution system. These shall show major pieces of

equipment such as chillers, cooling towers, pumps, VAV system, AHU, HX, and control valves, service valves, switchboards, motor control centers, panel boards, VFDs and ATS, etc.

4. The CxA shall review prior to substantial completion, the O&M manuals, documentation and redline as-builds *for systems that were commissioned* to verify compliance with the *Specifications and Design intent*. The CxA will communicate deficiencies in the manuals to the GC, the A/E, and the OR. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the GC, the OAR, and the A/E. The CxA also reviews each piece of equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Commissioning Record in O&M Manuals.

1. The GC and the CxA are responsible to coordinate and compile, organize and index the following O&M, Systems', and commissioning data by systems, both electronically and hard copy; in labeled, indexed and tabbed, three-ring binders and deliver it to the Owner. Two copies of the manuals will be provided. The format of the manuals shall be:

Tab I-1 Commissioning Plan

Tab I-2 Final Commissioning Report (see (B.2) below)

Tab 01 System Type 1 (chilled water system, condenser water system, etc.)

Sub-Tab A Design narrative and criteria, sequences, approvals for Equipment 1

Sub-Tab B Startup plan and report, approvals, corrections, blank pre-functional checklists

Colored Separator Sheets—for each equipment type (AHU, VAV, pumps, etc.)

Sub-Tab C Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended re-commissioning schedule.

Tab 02 System Type 2.....repeat as per System 1

2. Final Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-

compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

3. Other documentation will be retained by the CxA

3.10 WRITTEN WORK PRODUCTS

- A. The commissioning process generates a number of written work products described in various parts of the *Specifications*. The *Commissioning Plan—Construction Phase*, lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

<u>Product</u>	<u>Developed By</u>
1. Develop and maintain a commissioning plan	CxA
2. Issue Cx Specifications	CxA
3. Commissioning milestones coordinated into the construction schedule.	CxA with GC
4. Equipment documentation submittals	GC & Subs
5. Sequence of Operation clarifications	GC, Subs and A/E as needed
5. Develop Verification checklists	CxA
6. Startup and initial checkout plan	GC, Subs and CxA
7. Startup and executed Verification checklist	GC, Subs with witness of CxA & OAR
8. Final TAB report	TAB
9. Develop Master Issues Log (deficiencies)	CxA
10. Commissioning Progress Record	CxA
11. Develop Functional Performance tests	CxA with GC & Subs, TAB contractor, A / E, and OAR
12. Execute the functional performance tests	GC & Subcontractors
13. Issue O&M manuals for approval / review	GC & Subcontractors
14. Issue approved O & M manuals	GC & Subcontractors
15. Current Facility Requirements and Operation and Maintenance Plan	CxA with GC, subcontractors, and Owner's O&M personnel
16. Overall training plan	GC & Subcontractors with Mfgr's. Factory Representatives
17. Execute specific training	GC & Subs
18. Systems manual	CxA with GC, subcontractors, and Owner's O&M personnel
19. Ongoing Commissioning Plan	CxA and Owner's Facility Management and O&M personnel
20. Final commissioning report	CxA

END OF SECTION 01 91 13

SECTION 01 91 15 - FACILITY EXTERIOR ENCLOSURE COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes exterior enclosure commissioning procedures, including substructure, superstructure, exterior enclosure, and roofing construction that protects climate controlled interior space from unconditioned spaces and the exterior environment.
- B. Commissioning
 - 1. A systematic process ensuring that all building enclosure systems perform interactively according to the Design Criteria Package (DCP) and the Contractor's Designer's BOD. This is to be achieved through actual verification of systems performance during the construction period.
 - 2. The commissioning process does not take away from, or reduce the responsibility of, the Contractor and installing subcontractors to provide a finished and fully functioning product.
 - 3. Whole building commissioning includes both MEP commissioning authorities (CxA) and building enclosure commissioning authorities (BECxA). This specification only addresses building enclosure commissioning.
- C. Building Envelope/Enclosure Commissioning Service Procurement: The Owner shall retain a commissioning agent, who will hire a consultant for the Project to provide building enclosure coordination and to oversee the commissioning of all building enclosure components.
- D. Systems to be Commissioned: Sections of work to be commissioned include, but are not limited to, the sections of the building that include materials and assemblies that are responsible for creating environmental separation. All performance values shall be as described within each individual section.
- E. Description: The following describes the steps involved in building enclosure commissioning and the services provided by the Building Envelope Commissioning Authority (BECxA):
 - 1. Pre-Design/Design Phase: The steps included in this phase include the following:
 - a. Attend initial Team Meeting.
 - b. Evaluate design concepts against OPR and Architect's BOD.
 - c. Incorporate commissioning requirements into the Construction Documents via commissioning specification.
 - d. Construction Documents review prior to Bid Set.
 - e. Back check Construction Documents review.
 - 2. Preconstruction Phase: The steps included in this phase include the following:
 - a. Develop functional Test Plan for exterior enclosure.
 - b. Review of pertinent Shop Drawings/Submittals.

- c. Observe construction and testing mockup(s).
 - d. Develop/define the exterior enclosure Commissioning Plan.
 - e. Attend preconstruction conferences.
3. Construction Phase: The steps included in this phase include the following:
- a. Finalize Commissioning Plan.
 - b. Attend pertinent Preconstruction and Progress Meetings (as needed).
 - c. Review mockups and witness all mockup testing.
 - d. Field observations of exterior enclosure installations.
 - e. Observe testing and performance of functional tests.
4. Operations and Maintenance (O&M) Phase: The steps included in this phase include the following:
- a. Finalization of Project commissioning record with Warranties and Closeout Documentation.
 - b. Verify applicable training procedures of building maintenance personnel.

1.2 RELATED DOCUMENTS

- A. This section is only a portion of the Contract Documents. All of the Contract Documents, including General Conditions of the Design-Build Contract for Construction and Division 01 General Requirements (including Section 01 91 13 – General Commissioning Requirements), apply to this section. Refer to Divisions 03 through 14 for requirements specific to each Section.
- B. Owner's Project Requirements (OPR), defined by the DCP, and the Basis of Design (BOD), prepared by the Contractor's Designer, documentation are included by reference for information only.
- C. Division 01 Section 01 81 1308 81 13.14 - Sustainable Design Requirements – LEED v4 BD+C for additional LEED v4 requirements related to commissioning.
- D. ASHRAE standard 90.1 -2010, ASHRAE Guideline 0-2005 (The Commissioning Process), NIBS Guideline 3-2012 Building Enclosure Commissioning Process and ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems.

1.3 COMMISSIONING TEAM MEMBERS

- A. Commissioning Team
 1. Owner (PM) and his/her Consultants.
 2. Owners Authorized Representative (OAR)
 3. Contractor (GC).
 4. Contractor's Designers .
 5. Commissioning Authority (CxA).
 6. Building Envelope/Enclosure Commissioning Authority (BECxA)
 7. Specialty Subcontractors.
 8. Design Criteria Consultant (DCC)

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Provide Coordination Drawings (see 1.7 Building Enclosure Coordination Drawings) showing the complete coordination and integration of all work of commissioned envelope systems to the Commissioning Authority. The Contractor shall be responsible for coordinating all aspects of intersecting building envelope trades/systems and develop the coordination drawings and review the coordination drawings with the Contractor's Designers and the DCC as required. The OAR shall also review the proposed coordination drawings with the BECxA.
- B. Provide cut sheets and Shop Drawings Submittals of commissioned systems to the Commissioning Authority. The Contractor shall be responsible for reviewing the Shop Drawings for accuracy and to identify conflicts requiring resolution prior to submitting to the Architect. This shall include coordinating all aspects of intersecting building envelope trades/systems and providing graphic documentation of mockup details as required to ensure accurate revisions of shop drawings are implemented.
- C. Conduct Preconstruction, Design, and Construction Phase building enclosure coordination meetings. Coordinate preconstruction meetings as required to ensure attendees include the installing subcontractor, installing subcontractors whose work interfaces with the systems being discussed, applicable manufacturers, BECxA, the Contractor's Designers and the OAR unless other specified.
- D. Provide Test Data, Letters of Compatibility, and Certificates to the Commissioning Agent.
- E. Coordinate trades in accordance with the requirements in the General Conditions and General Requirements of the Construction Contract.
- F. Permit and provide access to locations of installed systems, subsystems, and components for testing and inspection.
- G. Review test procedures to ensure feasibility, safety and equipment protection and provide necessary written limits to be used during tests.
- H. Provide schedule and accommodate field quality control tests and inspections required by the Contract Documents and product manufacturers to the Commissioning Authority.
 - 1. Upgrade schedule biweekly throughout the construction period.
- I. Completing verification checklists and responding to issues identified by the BECxA. Note: For this project, the BECxA will be utilizing a cloud-based Cx web application for managing the commissioning documentation associated with the project. Refer to Section 01 91 13.
- J. Provide field quality control testing and conduct systematic field quality control inspections on all exterior enclosure construction and submit reports to the BECxA and project's Commissioning Authority through the cloud-based Cx web site. Provide weekly updates of checklists provided by the BECxA for applicable building envelope systems and related components.

- K. Participate in testing/inspection procedures meetings.
- L. Direct appropriate subcontractors to correct deficiencies as interpreted by the Commissioning Agent, the Contractor's Designers, DCC, OAR and Owner. Field verify deficiencies have been corrected and provide written documentation and corresponding photographs of same through the cloud-based Cx web site.
- M. During construction, maintain as-built redline drawings for all drawings.
- N. Coordinate with manufacturers to determine specific requirements to maintain the validity of the warranty. This should include coordinating all required manufacturer's participation including any required preconstruction/progress meetings, site visits/inspections (including all required 3rd party inspections) and field testing. Additionally, this should include confirming the manufacturer's approval of all installing contractors (subcontractors) prior to bidding.
- O. Provide input and required documentation for LEED v4 certification of envelope Cx activities, including, but not limited to, Current Facility Requirements, O&M Plan, Ongoing Commissioning Plan, and Final Commissioning Report to the BECxA and the project's Commissioning Authority.
- P. Submit operation, maintenance and warranty data for systems, subsystems, and components to the Commissioning Authority.
- Q. Participate in maintenance orientation, training, and inspection.

1.5 CONTRACTOR'S DESIGNERS'S RESPONSIBILITIES

- A. Provide paper and electronic copies of Project Drawings and Specifications to the BECxA.
- B. Provide paper and electronic copies of submittals and shop drawings approved for construction to the BECxA.
- C. Provide written responses to design review comments from the BECxA, the Commissioning Authority or other parties as requested.
- D. Attend Design, Preconstruction, and Construction Phase coordination meetings.
- E. Design mock-up wall, incorporating required components and details as required for integrating project specific conditions for visual evaluation and testing; after discussions with the BECxA and the CxA.
- F. Participate in testing/inspection procedures meetings.
- G. Provide resolution for items for which the BECxA, the Commissioning Authority and Contractor may be in disagreement.

1.6 BUILDING ENCLOSURE COMMISSIONING AUTHORITY RESPONSIBILITIES

- A. The BECxA will begin work in the Pre-Design or Design Phases and continue until all building enclosure systems have been accepted by both the Designer and the Owner. The specific tasks/responsibilities of the BECxA include the following:
1. Incorporate commissioning requirements into the Construction Documents via a commissioning specification.
 2. Initial review of preliminary Construction Documents against OPR and BOD.
 3. Perform back check review of Construction Documents against OPR and BOD.
 4. Develop functional Test Plan for exterior enclosure.
 5. Develop inspection checklists for applicable building envelope systems and related components which shall be provided to the Construction Manager for distribution to subcontractors.
 6. Review of Project Drawings and Specifications at 60%, and 95% completion for constructability, durability, and performance of exterior enclosure conformance.
 7. Review of pertinent building enclosure Shop Drawings/Submittals and Coordination Drawings for compliance with Contract Documents.
 8. Review spray racks, testing equipment and test protocols for specified field testing outlined in Section 01 45 16.
 9. Observe the construction of mockups and observe testing of same.
 10. Document construction of commissioned components at the completion of mockup testing. This documentation will consist of photographs documentation provided by the BECxA and graphic representation of mockup details developed by the GC for use in revising shop drawings as needed.
 11. Attend pertinent Progress Meetings (as needed).
 12. Perform field observations of exterior enclosure installations.
 13. Maintain a log of deficient conditions.
 14. Direct contractor(s) and witness functional or manual field performance (in-situ) testing.
 15. Evaluate substitution requests for compliance with Contract Documents and for compatibility with work of other subcontractors.
 16. Compile test data, inspection reports, and certificates through the cloud-based Cx web application and include them in the final LEED documentation and Commissioning Record.
 17. Work in conjunction with the Contractor, the subcontractors and the Contractor's Designers to resolve conflicts in the installation of materials and assemblies specific to the building enclosure trades.
 18. Finalize Commissioning Record with warranties and closeout documentation.
 19. Verify applicable training procedures of building maintenance personnel.

1.7 BUILDING ENCLOSURE COORDINATION DOCUMENTS

- A. The Contractor shall be fully responsible for coordinating all trades, assuring proper construction sequences and schedules, and coordinating the actual installed location and interface of all work that impacts the building enclosure. Before materials are fabricated or the work begun, the Contractor shall supervise and direct the creation of one complete set of Coordination Drawings showing the complete

coordination and integration of all work of this Project relating to the thermal, drainage, air barrier, vapor barrier, expansion joints and structural systems of enclosure. Coordination Drawings are intended to assist the Contractor during construction, and may be produced using Architect's drawings, shop drawings, or other drawings as needed to communicate coordination requirements to all concerned subcontractors.

- B. Specifically, Coordination Drawings shall include, but are not limited to the following detail conditions and system connections:
1. Masonry and/or concrete panel tie-in to adjacent cladding and backup membranes.
 2. Thru-wall flashing tie-ins to adjacent waterproofing/air barrier membranes.
 3. Cladding type transitions (same plane and corners)
 4. Cladding transition flashing and closure metal as required at wall fenestrations and intersections between different building envelope systems.
 5. Canopy tie-in flashing at adjacent walls or cladding above.
 6. Below grade waterproofing systems along finished grade (landscape or hardscape) terminations, below grade vapor barrier transitions and adjacent wall cladding systems.
 7. All other major transition points between trades.
- C. Mockup Shop Drawings: Provide shop drawings for construction of windows, curtain-walls, wall claddings and related transition flashing, closure metal, expansion joints, sealant joints, etc., for mockups. Field revisions to mockups due to testing failure or other causes shall be documented in revised shop drawings to be identified as "Post Mockup Revision". The Contractor shall record changes to mockup details and review same with the BECxA, the Contractor's Designers, the DCC and the OAR for accuracy and concurrence
- D. In regard to coordination of building envelope systems and components, coordination of work and multiple trades shall include the following:
1. Building Enclosure Subcontractors: The GC shall circulate the Coordination Drawings to other subcontractors and trades whose work might conflict with other work and require these subcontractors to accurately and neatly show the actual size and location of all their work. These subcontractors shall note any apparent conflicts, suggest alternate solutions, and return the Coordination Drawings to the Contractor.
 2. After each trade completes its drawings, a meeting will be held to resolve conflicts between the trades and establish sequencing.
 - a. Trades Coordination Drawings shall be submitted to the Contractor for the Contractor's Designers's review prior to starting any installations.
 - b. Coordination issues or requests for variance shall be called to the Construction Manager's attention for the Architect's resolution.
 - c. The Coordination Drawings, including all Designers's resolutions, shall be reviewed with the BECxA before work in the field is begun.

- d. Contractor Review and Submission: The Contractor shall carefully review, modify, and approve Coordination Drawings in cooperation with the subcontractors to assure that conflicts, if any, are resolved before work in the field is begun.

1.8 FUNCTIONAL AND MANUAL PERFORMANCE TESTING (IN-SITU)

- A. Objectives and Scope: The objective of functional performance testing is to demonstrate that each building enclosure/assembly system is operating according to the documented design intent of the Contract Documents and in accordance with the OPR. Functional testing facilitates bringing the material assembly from a state of substantial completion to full operation. Additionally, during the testing process, areas of non-compliant performance are identified and corrected, improving the operation and functioning of the building enclosure/assemblies.
- B. Development of Test Procedures: Before test procedures are written, the BECxA shall obtain all requested documentation and a current list of change orders affecting building enclosure/assemblies. The BECxA shall develop specific test procedures for each building enclosure/assembly. Prior to execution, the BECxA shall provide a copy of the test procedures to the subcontractor(s) who will review the tests for feasibility, building enclosure/assemblies warranty protection.
 1. The BECxA shall direct and witness Owner-contracted performance testing.
 2. The Contractor shall construct or arrange for construction of test chambers, and shall provide staging and access equipment as needed to position spray racks at the exterior. The Contractor shall be responsible for locating and providing all water and electrical sources to perform testing.
 3. All testing shall be conducted by a qualified independent test agency with at least 5 years of documented experience in performing the specified testing.
 4. The purpose of any given specific test is to verify and document compliance with the stated criteria of the Construction Documents.
- C. Test Methods
 1. Functional and manual performance testing and verification will typically follow ASTM industry standards. The BECxA will determine which method is most appropriate for tests and modify test methods when an existing industry method is not available or applicable.
 2. Simulated Conditions: Simulating conditions may be allowed at the direction of the BECxA, though testing actual conditions is encouraged wherever practical.
- D. Coordination and Scheduling: The Contractor and their subcontractors shall provide sufficient notice to the Commissioning Authority regarding their completion schedule for the functional checklists and construction of the assemblies or building enclosure systems. The BECxA will schedule functional tests through the GC and affected subcontractors. All functional testing of all building enclosure assemblies or building enclosure systems shall be performed by the Contractor under the direction of the BECxA.

- E. In general, functional testing is conducted after mockup testing has been satisfactorily completed.
- F. Problem Solving: The BECxA may recommend solutions to problems found, however, the burden of responsibility to solve, correct, and retest problems is with the contractor responsible for the installation of the tested assembly.
- G. Failed tests will result in additional testing of the failed specimen in addition to conducting at least 1 additional test on a different test specimen at the location selected and mutually agreed upon between the Architect and the BECxA. In the event another failure occurs during the additional testing, 2 more test specimens will be selected for additional testing and the process will be repeated until passing results are achieved. In addition, the installing contractor and Construction Manager shall be responsible for field verifying that similar anomalies, to those that resulted in failure, do not exist elsewhere throughout all similar project wide units. The cost of re-staging and constructing test chamber shall be responsibility of the deficient Contractor. The cost for the BECxA to conduct or observe one (1) retest of the failed specimen will be borne by the Owner. Costs for subsequent retests due to failure shall be the responsibility of the deficient contractor. Test will be concluded only when satisfactory results are achieved.
- H. Testing reports shall be provided by the independent test agency within five (5) working days of each test. All test reports shall be distributed to the Contractor, Contractor's Designers, OAR, DCC, CxA, BECxA and applicable subcontractors. All test reports shall be uploaded through the cloud-based Cx web site.
- I. Non-Conformance:
 - 1. The independent test agency and the BECxA will record the results of the functional tests in a written report. All deficiencies or non-conformance issues shall be noted and reported.
 - 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the BECxA. In such cases, the deficiency and resolution will be documented in the written report.
 - 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
 - 4. As tests progress and a deficiency is identified, the BECxA discusses the issue with the OAR and Contractor.
 - a. When there is no dispute on the deficiency and the subcontractor accepts responsibility to correct it:
 - 1) The BECxA documents the deficiency and the subcontractor's response and intentions and work proceeds.
 - 2) The Contractor and BECxA will coordinate the rescheduled test with the affected Contractor, and the test is repeated.
 - b. If there is a dispute about a deficiency regarding whether it is a deficiency or who is responsible:
 - 1) The deficiency shall be documented on the Non-Compliance Form with the subcontractor's response and copy given to the

- Contractor and to the subcontractor's representative assumed to be responsible.
- 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Interpretive authority is with the A/E. Final acceptance authority is with the Owner's PM.
 - 3) The BECxX documents the resolution process.
 - 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the Statement of Correction on the Non-Compliance form, and provides it to the Contractor and the BECxX. The Contractor and the BECxX will reschedule the test with the affected Contractors on a mutually agreed upon date, and the test(s) are repeated until satisfactory performance is achieved.
 - 5) Any required retesting that is a result of deficient installation shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 COMMISSIONED SYSTEMS

- A. The BECxX shall develop and coordinate a systematic process to verify the building envelope/enclosure systems have been constructed according to the requirements of the OPR and BOD.
- B. Building envelope/enclosure commissioning shall be accomplished via the responsibilities outlined previously and may include a combination of submittal reviews, mockup inspection/testing, field observations, material sampling/testing, verification checklists completed by the installing contractor, functional performance testing, closeout documentation review, etc. Extent of Building Envelope/Enclosure Commissioning shall be determined during a Commissioning scoping meeting prior to construction.
- C. Building envelope/enclosure systems and associated components to be commissioned may include, but are not limited to:
 1. Section 03 30 00 - Cast In Place Concrete
 - a. Inspections or test observations may include:
 - 1) Inspect associated waterstops and vapor barriers.
 - 2) Monitor concrete placement and inspect finishes/surfaces scheduled to receive roofing, waterproofing, expansion joints, membranes, air barriers, sealants, sealers, paints, coatings, etc.
 - 3) Inspect penetration detailing, laps, membrane repairs, etc. at vapor barrier installations.

- 4) ASTM F 1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- 5) .
2. Section 06 10 00 – Rough Carpentry
3. Section 06 16 00 – Sheathing
 - a. Inspections or test observations may include:
 - 1) Inspect fastening requirements, sheathing joint treatment and all surfaces scheduled to receive roofing, membranes, air barriers, etc.
4. Section 07 13 26 – Self Adhering Sheet Waterproofing
 - a. Inspections or test observations may include:
 - 1) Inspect substrates to receive waterproofing membrane and associated insulation, protection board, drainage panels counter flashing, etc.
 - 2) Flood testing or modified AAMA 501.2 hose testing.
 - 3) Monitor concrete placement, U.V. exposure limitations, back filling techniques, repairs, etc.
5. Section 07 18 00/01 – Traffic Coatings
 - a. Inspections or test observations may include:
 - 1) Substrates to receive traffic coatings.
 - 2) Wet/dry film mil thickness sampling.
 - 3) Evaluation/sampling of related sealants.
6. Section 07 19 00 – Water Repellents
 - a. Inspections or test observations may include:
 - 1) Substrates to receive water repellents.
 - 2) Verify with manufacturer application/coverage rates including required mockup assemblies prior to widespread installation,
 - 3) Evaluation/sampling of water repellents mockups/installation.
7. Section 07 21 00 – Thermal Insulation
 - a. Inspections or test observations may include:
 - 1) Visual observations.
 - 2) Infrared survey of roofing assemblies.
 - 3) ASTM C1060 – Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings.
8. Section 07 21 19 – Foamed-In-Place Insulation
 - a. Inspections or test observations may include:
 - 1) Visual observations.
 - 2) ASTM C1060 – Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings.
9. Section 07 27 29 – Air-Barrier Coatings
 - a. Inspections or test observations may include:
 - 1) Substrates to receive air-barrier coatings.
 - 2) Wet/dry film mil thickness sampling.
 - 3) Inspect penetration detailing, laps, membrane repairs, etc.
 - 4) Evaluation/sampling of related sealants.
10. Section 07 41 10 - Metal Canopy Cladding System"

- a. Inspections or test observations may include:
 - 1) Inspect associated weather barrier membrane, insulation, flashing, sealants, etc.
 - 2) AAMA 501.2 (modified) – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
 - 3) Flood testing roof gutters to the highest water level possible (at overflow capacity) for a minimum 2 hours duration.
- 11. Section 07 42 13.23 – Metal Composite Material Wall Panels
 - a. Inspections or test observations may include:
 - 1) Inspect associated weather barrier membrane, insulation, flashing, sealants, etc.
 - 2) AAMA 501.2 (modified) – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
- 12. Section 07 92 00/01 – Joint Sealants
 - a. Inspections or test observations may include:
 - 1) ASTM C 1521 – Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
- 13. Section 07 95 01 – Expansion Control
 - a. Inspections or test observations may include:
 - 1) AAMA 501.2 (modified) – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
- 14. Section 07 95 13.16 – Exterior Expansion Joint Cover Assemblies
 - a. Inspections or test observations may include:
 - 1) AAMA 501.2 (modified) – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
- 15. Section 08 11 13 – Hollow Metal Doors and Frames
 - a. Inspections or test observations may include:
 - 1) Inspection of weatherproof gaskets, door sweeps, etc., intended to provide weather tightness.
- 16. Section 08 80 00 – Glazing
- 17. Section 08 91 19 – Fixed Louvers
 - a. Inspections or test observations may include:
 - 1) AAMA 501.2 (modified) – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
- 18. Section 09 24 00 – Portland Cement Plastering
 - a. Inspections or test observations may include:
 - 1) AAMA 501.2 (modified) – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
- 19. Section 09 91 13 – Exterior Painting
 - a. Inspections or test observations may include:
 - 1) Wet/dry film mil thickness sampling.

- 2) ASTM D 3359 – Standard test Methods for Measuring Adhesion by Tape Test.
20. Section 09 96 00 – High Performance Coatings
 - a. Inspections or test observations may include:
 - 1) Wet/dry film mil thickness sampling.
 - 2) ASTM D 3359 – Standard Test Methods for Measuring Adhesion by Tape Test.

3.2 SAMPLE SCHEDULE OF TESTS

- A. Window Mockup: Two (2) air infiltration tests and two (2) water infiltration tests of each window mockup type and surrounding components and systems. Infiltration tests to be performed by constructing a wood framed chamber with 10-mil clear polyethylene at the interior side and introducing negative pressure (suction) in the chamber during spray rack water test at the exterior side. Test Criteria: Air infiltration – ASTM E783-02; Water Infiltration – ASTM E1105-00. GC shall construct or arrange construction of the test chamber and associated spray rack per the size and specifications as provided by the Architect and as reviewed by the BECxA. Contractor shall also provide or arrange staging and access equipment for positioning of spray rack and provide water and electrical sources. All testing shall be performed with pressures equal to laboratory test pressures without reduction
- B. Window In-Situ Tests (Functional Performance Testing): Air and water infiltration tests shall be performed on a minimum of 5% of all storefront windows and 5% of glazed curtain walls throughout the project, prior to adjacent interior finish installation including wall insulation. Test protocols to match those on window mockup. Contractor shall construct or arrange construction of the test chamber and associated spray rack per the size and specifications as provided by the Contractor's Designer and as reviewed by the BECxA. OAR and DCC, and shall also provide or arrange staging and access equipment for positioning of spray rack and provide water and electrical sources. All testing shall be performed with test pressures equal to laboratory test pressures without reduction.

END OF SECTION 01 91 15