TO: Prospective Bidders and Others Concerned
DATE: May 1, 2017
PROJECT: TCTC New Data Center
OWNER: Tri-County Technical College
        Pendleton, South Carolina
BID DATE: Thursday, May 18, 2017
PROJECT NO.: 1643
SUBJECT: Changes to the Contract Documents

The Contract Documents for this Project are amended as set forth below. Bidders must acknowledge receipt of this Addendum on the Bid Form when bids are submitted.

PERTAINING TO THE TECHNICAL SPECIFICATIONS

ITEM 1  SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS. Owner would like to add the attached Specification Section into the Contract Documents for General Contractor commissioning for Owner supplied items.

ITEM 2  SECTION 26 32 13 - PACKAGED ENGINE GENERATOR SYSTEMS - DIESEL. Owner would like to add the attached Specification Section into the Contract Documents for General Contractor coordination with the Owner supplied packaged engine generators.

ITEM 3  SECTION 26 32 23 - AUTOMATIC TRANSFER SWITCHES. Owner would like to add the attached Specification Section into the Contract Documents for General Contractor coordination with the Owner supplied transfer switches.

ITEM 4  A Pre-Bid Meeting was held on Thursday, April 27. The minutes of that meeting with answers to questions and further explanations of certain items are a part of this addendum.

End of Addendum No. 1
PART 1 - GENERAL

1.1 SCOPE

A. This section provides for commissioning of the project equipment and systems as specified herein. The commissioning process includes specific tasks to be conducted during each phase in order to verify that design, construction, operation and occupancy meet the Owner's project requirements as defined in the project contract documents. The commissioning process and related work shall conform to the requirements of all applicable specification sections and drawings issued as a part of the overall project construction contract.

B. The generator sets and automatic transfer switches (ATS) that are included in the commissioning process under this specification section will be purchased directly by the Owner from a manufacturer’s authorized distributor for installation by the construction contractor (“Contractor”) under this contract.

C. The Uninterruptible Power Supply (UPS) units and data center in-row air conditioning units that are included in the commissioning process under this specification section will be purchased directly by the Owner from a manufacturer’s authorized distributor (“Supplier”) for installation by the Supplier under a separate contract. The Owner furnished Supplier installed equipment will be installed during the project construction phase. The Owner will schedule the Supplier’s equipment installation so as not to interfere with the Contractor’s operation. However, the Contractor shall coordinate project work and commissioning activities with the Owner furnished Supplier installed equipment.

D. The Contractor shall have primary responsibility for conducting the commissioning process. However, the equipment supplier and construction contractor shall coordinate with each other in completion of the work specified herein to provide a complete and operable system.

E. The commissioning process specified herein does not modify the responsibilities of the equipment suppliers of the equipment purchased directly by the Owner as described above to provide a complete and operable system. The equipment suppliers of the equipment purchased directly by the Owner shall maintain full participation in the commissioning process, and shall be responsible for all documentation requirements, testing personnel services and related test equipment/tools, resolution of testing issues, test reports, and compliance with all commissioning requirements specified herein, including achieving fully operational status of equipment supplied for this project in compliance with the project contract requirements. All documentation and test reports required by this specification shall be submitted by the equipment suppliers to the Contractor for collection and coordination with other documentation for the required project submittals.

1.2 COMMISSIONED SYSTEMS AND EQUIPMENT SUMMARY

Abbreviations:
OFCI: Owner furnished Contractor installed.
OFOI: Owner furnished Owner installed.
OFSI: Owner furnished Supplier installed.
CFCI: Contractor furnished Contractor installed.

A. Mechanical/HVAC:
1. In-row cooling unit IRC-1 & condenser unit IRCU-1 (OFSI)
2. In-row cooling unit IRC-2 & condenser unit IRCU-2 (OFSI)
3. In-row cooling unit IRC-3 & condenser unit IRCU-3 (OFSI)
4. In-row cooling unit IRC-4 & condenser unit IRCU-4 (OFSI)
5. UPS AC unit AC-1 & condenser unit CU-1 (CFCI)
6. UPS AC unit AC-2 & condenser unit CU-2 (CFCI)
7. Equipment room AC unit FC-1 & condenser unit CU-1 (CFCI)
8. HVAC system controls for all HVAC equipment

B. Electrical:
1. Generator “A” (OFOr)
2. Generator “B” (OFOr)
3. ATS “A” (OFOr)
4. ATS “B” (OFOr)
5. Uninterruptible Power Supply UPS-A (OFSI)
6. Uninterruptible Power Supply UPS-B (OFSI)
7. Panelboards: MDP, HC, HA, HB, HC, LA, LB, and all related accessories and metering (CFCI)
8. Transformers: TX-A, TX-B and all related accessories (CFCI)
9. Power monitoring systems (CFCI)

C. Summary of Commissioning Level Phases: Below is a summary of the commissioning activities related to the equipment listed above; these requirements are not all inclusive and additional requirements are specified herein:

Level 1: Factory Witness Testing (FWT) Summary:
Factory witness testing (FWT) consists of Owner/CA/AE-witnessed testing of equipment at the factory, by factory personnel. FWT is not required for this project; however, factory testing and related test reports for factory testing required by the specifications shall be included in the commissioning process.

Level 2: Component Quality Assurance (CQA) Summary:
Component quality assurance (CQA) includes inspection and verification of individual system components and equipment at the site upon delivery for compliance to the design specifications, drawings, and approved project submittals; it includes inspection of system components and equipment for shipping damage and missing items.

Level 3: Startup Verification (SUV) Summary:
Startup verification testing (SUV) includes review and conducting startup procedures and testing in accordance with the commissioning plan and manufacturer procedures.
Level 4: Functional Performance Testing (FPT) Summary:
Functional performance testing (FPT) includes demonstration that each system is operating according to the contract document requirements, manufacturer operational control sequences, and the commissioning plan; it includes bringing the systems from a state of individual substantial installation completion to full dynamic operational completion as individual systems.

Level 5: Integrated Systems Testing (IST) Summary
Integrated systems testing (IST) includes demonstration that each system is operating seamlessly in an integrated manner coordinated with all other related systems in the project, so that the facility as a whole meets the Owner requirements for reliability and availability; it includes bringing the systems from a state of individual operational completion to full-scale operation of systems as a cohesive integrated system.

D. Owner/Supplier Furnished Supplier Installed Equipment (OFSI)

1. Data center equipment furnished by the Owner and installed by the equipment Supplier (OFSI) indicated in the listing above is in the scope of the commissioning process. Refer to specification paragraphs “Scope” and “Responsibilities” herein for additional requirements for coordination of work.

E. Data Center Monitoring Systems (OFOI)

1. Data center monitoring (DCM) systems provided by the Owner (OFOI) for overall data center monitoring will interface with the monitoring provisions specified for the data center equipment, and will be provided by the Owner. Commissioning of the Owner data center monitoring systems is not in the scope of this contract. However, the Owner will be installing monitoring equipment and related work during the project construction phase. The Owner will be testing the DCM system concurrently with the commissioning work specified herein, and will schedule the Owner’s data center monitoring work so as not to interfere with the Contractor’s operation. However, the Contractor shall coordinate project work and commissioning activities with Owner monitoring system installation and testing operations.

1.3 RELATED DOCUMENTS

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

C. Related Sections include, but are not limited to, the following:

1. Individual Division 21, 22, 23, and 26 Sections contain requirements related to the commissioning process.

1.4 SUMMARY
A. An independent Commissioning Agent (CA) has been retained to implement and coordinate the commissioning process for this project.

B. The commissioning process includes specific tasks to be conducted during each phase in order to verify that design, construction, operation and occupancy meet the Owner's project requirements as defined in the project contract documents. The objectives of the commissioning process, as they relate to this specification, are to:

1. Verify that the performance of the mechanical and electrical systems provided under this contract meet contract requirements and Owner criteria.
2. Verify that O&M documentation left on site is complete.
3. Verify that the Owner’s operating personnel are adequately trained.

C. This section defines the members of the commissioning team (CxT) and outlines the responsibilities of each member of the CxT. All CxT members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

D. The commissioning process does not modify or reduce the responsibilities of the project Architect/Engineer (A/E) or Contractor of contractual obligations related to this project.

E. Participating CxT entities shall each include the cost to complete their work of the commissioning process in their proposal.

1.5 DEFINITIONS

A. Acceptance: A formal action, taken by a person with appropriate authority (which may or may not be contractually defined) to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

B. Basis of Design (BoD): A document 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.

C. Checklists: Verification checklists that are developed and used during all phases of the commissioning process to verify that the Owner’s Project requirements are being achieved. This includes checklists for general verification, plus testing, training, and other specific requirements.

D. Commissioning (Cx): A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s project requirements.
E. Commissioning Agent (CA): The entity identified by the Owner who plans, schedules, and coordinates the commissioning team to implement the commissioning process.

F. Commissioning Levels 1-5 activities are defined as:
   - Level 1: Factory Witness Testing (FWT)
   - Level 2: Component Quality Assurance (CQA)
   - Level 3: Startup Verification (SUV)
   - Level 4: Functional Performance Testing (FPT)
   - Level 5: Integrated Systems Testing (IST)

G. Commissioning Plan: A document that provides the organization, schedule, and coordination planning for the commissioning process.

H. Commissioning Process Activities: Components of the commissioning process.

I. Commissioning Process Progress Report: A written document that details activities completed as part of the commissioning process and significant findings from those activities, which is continuously updated during the course of a project.

J. Commissioning Request for Information (RFI): Form used by the CA to request information from the design and construction team.

K. Commissioning Team (CxT): The individuals who through coordinated actions are responsible for implementing the commissioning process.

L. Coordination Drawings: Drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers’ recommended maintenance clearances.

M. Deferred Performance Tests (DPTs): Performance tests that are performed, at the discretion of the CA, after Substantial Completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that do not allow the test to be performed.

N. 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.

O. Document Request Log: A log maintained by the CA to list and track documents requested from the design and construction team.

P. Factory Testing: Testing of equipment on-site or at the factory, by factory personnel, with or without an Owner’s Representative present.
Q. Functional Performance Test: A written protocol that defines methods, personnel, and expectations, for tests conducted on components, equipment assemblies, systems, and interfaces among systems.

R. Integrated System Testing: A written protocol that defines methods, personnel and expectations for tests conducted to verify proper interface and interaction between HVAC, building automation, electrical, and fire systems. In addition to testing the response of these systems to a building power outage and restoration, HVAC equipment is tested to verify that modules of capacity are brought on automatically in response to added heat load.

S. Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the commissioning team during the course of the commissioning process.

T. Non-Compliance: See Deficiency.

U. Non-Conformance: See Deficiency.

V. Owner’s Project Requirements (OPR): A written protocol that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, and supporting information.

W. Phased Commissioning: Commissioning that is completed in phases as required by the phasing plan as approved for the Project and other scheduling issues.

X. Pre-Functional/Start-Up Checklist: A form used by the Contractor to verify that appropriate components are on-site, ready for installation, correctly installed, and functional.

Y. Seasonal Performance Tests: Performance tests that are deferred until the system(s) will experience conditions closer to their design conditions based on weather conditions.

Z. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

AA. Systems Manual: A system-focused document that refers to reference materials and their physical location and bound information that includes the operation manual, maintenance manual, and additional information of use to the Owner during the occupancy and operation phase.

BB. Training Plan: A written document that details the expectations, schedule, budget, and deliverables of commissioning process activities related to training of project operating and maintenance personnel, users, and occupants.
CC. Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner’s Project requirements.

1.6 SUBMITTALS

A. General: The Contractor shall submit electronically to the CA for concurrent review along with the A/E and the Owner submittals for all electrical and mechanical equipment required in the respective specification sections for the equipment. In addition, the Contractor shall submit electronically to the CA for concurrent review along with the A/E and the Owner all submittals specified herein.

B. The CA will review submittals for conformance to the contract documents as it relates to the commissioning process, to the performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of performance test procedures and only secondly to verify compliance with equipment specifications. Review of submittals by the CA does not relieve the contractor of compliance with all contract requirements, whether identified by the CA or not. CA will submit submittal review comments to the Owner, A/E, and Contractor. The Owner will determine if CA review comments require resubmission of submittals.

C. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

D. Submittals to be submitted for CA review:

1. Submittals shall include all mechanical systems, electrical systems, and related work and control systems. Include a complete bill of material of equipment used indicating quantity, manufacturer and model number and other relevant technical data.

2. Manufacturer’s description and technical data, such as performance curves, performance test procedures, product specification sheets, schedules, settings and installation, narrative description of control sequences of operation, as-built wiring schematics, sub-system interfaces, interlocks, operation and maintenance instructions, and detailed startup/testing procedures.

3. Equipment outline dimensions, layout details, operating and maintenance clearances and sufficient engineering data to indicate compliance with the specifications.

4. Layout and coordination drawings for all equipment, drawn accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work.

5. Each piece of equipment shall be identified by the number shown in the schedules and specification article number pertaining to the item. Shop drawings shall be prepared by the Contractor for the project and not reproduced from the A/E’s Drawings.

6. When manufacturer’s cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project will be highlighted or
clearly indicated by other means. General catalogs will not be accepted as cut sheets to fulfill submittal requirements.

7. O&M manual documentation. Submittals to the CA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CA will review them.

1.7 COMMISSIONING TEAM

A. Members appointed by Contractor: Individuals, each having expertise and authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CA.

B. Members Appointed by Owner:

1. CA: An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner has engaged the CA under a separate contract.

2. Owner representatives of the facility user and maintenance organizations.

C. Members of the Commissioning Team, at minimum, shall include:

1. Owner’s Representative
2. Architect/Engineer (A/E)
3. Electrical, HVAC, plumbing, and fire protection equipment suppliers, including suppliers of Owner-Furnished equipment that is procured directly by the Owner. Refer to paragraph “Scope” above for delineation of contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

4. General Contractor
5. Fire Protection Sub-contractor
6. Plumbing Sub-contractor
7. Mechanical Sub-contractor
8. Electrical Sub-contractor
9. BMS Sub-contractor
10. All control system Sub-contractors
12. Test and Balance Subcontractor
13. Electrical Test Subcontractor

14. Commissioning Agent

D. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.
1.8 RESPONSIBILITIES

A. All Cx team Members:

1. Follow the commissioning plan.
2. Attend preconstruction commissioning meeting and additional commissioning meetings as necessary.
3. Cooperate with all other Cx team members to carry out commissioning process.
4. Include the price of commissioning responsibilities/tasks in each Cx team member’s proposal.

B. Commissioning Agent (CA):

1. Develops a commissioning plan outlining the organization, schedule, and documentation requirements of the commissioning process. CA oversees implementation of commissioning plan.
2. Plans the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, updated timelines and schedules, and technical expertise.
3. The CA will develop specific commissioning documentation. This commissioning documentation will be kept in electronic format and three ring binders. The CA-developed commissioning documentation shall include the following documentation subject to Owner approval:
   a. Commissioning plan.
   b. Commissioning schedule.
   c. Commissioning RFDs.
   d. Commissioning issues log.
   e. Commissioning checklists.
   f. Commissioning test procedures.
   g. Commissioning progress reports.
   h. Commissioning team meeting minutes.
   i. Final commissioning report.
4. CA documentation will be developed for review by the Cx team after submission and review of proposed project equipment submittals.

C. Owner:

1. Defines the Owner’s Project requirements (OPR), provides interpretations and clarifications to the OPR, and provides OPR document to CA and Contractor for information and use.
2. Manages the contract of the A/E (A/E) and Contractor.
3. Provides the approved basis of design documents (BoD) to the CA and Contractor.
4. Facilitates the coordination of the commissioning work by the CA, and, with the Contractor and CA, within the overall construction schedule.
5. Assigns operations and maintenance personnel and arranges for them to participate in the Cx meetings and testing.
6. Reviews, comments and approves the documentation prepared by the CA.

D. Architect/Engineer (A/E):

1. Provides design and construction phase support services as contracted to the Owner.
2. Prepares construction contract documents.
3. Specifies and verifies adequate maintenance access for each piece of equipment in design, Shop Drawings, and actual installation.
4. Provides system design parameters to Owner and obtains approval.
5. Provides any design narrative documentation requested by the CA. This includes 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.
6. Notifies the CA of substantive changes to the contract documents.
7. Reviews and comments on documentation prepared by the CA.

E. Contractor:

1. Supports all commissioning activities and coordinates all commissioning activities of his sub-contractors and equipment suppliers, as required.
2. Facilitates the coordination of commissioning work by the CA and integrates activates of the Contractor, his sub-contractors, and all other CxT member commissioning tasks/activities into the construction schedule.
3. Submits electronically all construction documents, addenda, change orders, requests for information, submittals related to commissioned equipment/systems to CA.
4. Includes requirements for submittal data, O&M data, commissioning tasks and training in each purchase order or subcontract written.
5. Performs review of submittals for completeness and accuracy prior to forwarding submittals on the the Cx team for review.
6. Provides qualified personnel for performing all test procedures, including testing identified by CA.
7. Coordinates training of Owner personnel. Develops training agenda, training materials, conducts training sessions. Schedules sub-contractors, equipment suppliers, etc. to participate in training the Owner’s personnel. Coordinates with Owner schedule for training Owner operating personnel. Provides training agenda, materials and schedules to CA for review and comment.
8. Attends CxT meetings.
9. Provides functional and seasonal testing plan in accordance with procedures supplied by the CA.
10. Responds to and addresses items documented in the issues log.
11. Notifies the CA four weeks in advance of all equipment startup, Contractor directed testing, and testing required by contract documents.
12. Certify that equipment/systems have been installed per manufacturer’s instructions.
13. Notifies the CA when systems and assemblies are ready for CA witnessed testing.
14. Remedies any deficiencies identified in the Cx testing and notifies CA when deficiencies have been addressed.
15. Coordinates and facilitates the resolution of non-compliance, deficiencies and discrepancies identified in all phases of commissioning.
16. Prepares O&M manuals, according to the contract documents, including clarifying and updating the original sequences of operation to as-built conditions. Submits O&M manuals to CA for review prior to Owner operating personnel training. O&M manuals are to be used in training sessions.
17. Submits complete set of record drawings to CA for review.

F. Equipment Suppliers:
1. Provides all submittal data required in the contract documents, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assists in equipment testing per agreements with Contractor.
3. Includes all special tools and instruments required for testing equipment according to these contract documents.
4. Reviews specified products and requests clarifications as needed from the A/E.
5. Provides information requested by CA regarding equipment sequence of operation and testing procedures.
6. Reviews and coordinates test procedures for equipment installed by factory representatives.
7. Provides personnel, services, documents, tools, etc. for all project requirements and testing that are applicable to equipment suppliers.

G. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

1.9 COORDINATION

A. The CA shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and Shop Drawings related to commissioned system/equipment directly from the Contractor.

B. The CA shall disseminate written information and documents to all responsible parties relative to the nature and extent of the communication.

C. The CA is primarily responsible to the Owner and, as such, shall regularly apprise the Contractor and the Owner of progress, pending problems and/or disputes, and shall provide regular status reports on progress with each system. Any potential change in the contractual and/or financial obligations of the Owner (credits, change orders,
schedule changes, etc.) shall be identified by the Contractor and submitted to the Owner for review in a timely fashion to support the overall project schedule.

D. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

1.10 SCHEDULE

A. The Contractor shall coordinate the schedule of commissioning activities with the construction schedule. It is possible that some procedures will be completed before the entire system is completed. Contractor schedules and scheduling is the responsibility of the Contractor. The CA shall provide commissioning scheduling information to the Contractor for review and planning activities. CA developed commissioning activities shall be integrated into the construction schedule by the Contractor.

B. The schedule shall incorporate sufficient time for the commissioning process steps specified herein.

C. The Contractor shall integrate all commissioning activities into the overall construction schedule. All parties shall address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

D. Problems observed shall be addressed immediately, responsible parties notified, and actions taken to correct deficiencies coordinated in a timely manner.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All test equipment, special tools, ladder/lifts, two way radios and equipment required for performing the specified tests shall be provided by the Contractor for Contractor-furnished equipment, and shall be provided by the Supplier for Owner-furnished Supplier installed equipment, as approved by the CA. The Owner shall furnish necessary utilities for the commissioning process.

B. All portable or hand-held setup/calibration devices required to initialize the control system shall be provided by the control system sub-contractor and equipment supplier for testing.

C. The instrumentation used in the commissioning process shall meet the following standards:

1. Be sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
2. Be calibrated at the manufacturer’s recommended intervals with calibration tags permanently affixed to the instrument.
3. Be maintained in good repair and operating condition throughout the duration of use on this project.
4. Be immediately recalibrated, repaired, or replaced if dropped and/or damaged in any way during use on this project.

D. Proprietary test equipment and software required by any equipment manufacturer for programming and/or startup, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

d. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

2.2 LOAD BANKS

A. All load banks required for commissioning will be furnished by the Owner for Contractor use in testing in accordance with the Cx plan, and shall be returned in fully operable original condition to the Owner upon completion of load bank testing. Contractor shall be responsible for connection and operation of load banks.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN

A. The CA will develop a commissioning plan with the information specified below for the project:

1. Contact directory of key commissioning team personnel
2. Communications protocol for project
3. Listing of equipment/systems to be commissioned
4. Sampling strategy to be used for equipment and systems for applicable commissioning process.
5. Responsibilities for each party involved with the commissioning process
6. Commissioning milestones and schedule
7. Listing of key deliverables associated with the commissioning process
8. Note that the commissioning plan will be incorporated into the commissioning report so that one document will be used throughout the commissioning process and when the process is completed this document will be called the final commissioning report.
9. Listing of exhibits to the commissioning plan/report.
3.2 MEETINGS

A. The CA will schedule, plan and conduct an initial commissioning meeting with the Contractor. The Contractor and its responsible parties are required to attend.

B. Other meetings will be planned and conducted by the CA as construction progresses. The meetings will cover coordination, deficiency resolution, and planning issues. These meetings will be held at least monthly, until the final three months of construction, when they may be held as frequently as one per week.

C. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

3.3 CONSTRUCTION OBSERVATION

A. CA construction observation is an additional and separate activity from that provided by the design team. Construction observation is required as part of the commissioning and coordination process to be provided by the CA.

3.4 TEST AND BALANCE (TAB)

A. Air and water test and balance shall be accomplished by a test and balance firm as specified by the A/E.

3.5 COMMISSIONING PHASE LEVELS

A. Refer to the commissioning systems and equipment summary specified herein for guidance on general requirements for each phase of the commissioning process. More detailed information will be included in the commissioning plan that will be developed by the CA.

B. Commissioning phase levels are defined as:
   Level 1: Factory Witness Testing (FWT)
   Level 2: Component Quality Assurance (CQA)
   Level 3: Startup Verification (SUV)
   Level 4: Functional Performance Testing (FPT)
   Level 5: Integrated Systems Testing (IST)
C. Summary of Commissioning Level Phases: Below is a summary of the commissioning activities related to the equipment listed above; these requirements are not all inclusive and additional requirements are specified herein:

3.6 LEVEL 1 - FACTORY WITNESS TESTING (FWT)

A. Factory Witness Testing (FWT) consists of testing of equipment at the factory, by factory personnel, and includes demonstration of features, attributes and capacity of the equipment at the factory to verify the manufactured equipment is operating in accordance with the manufacturer’s published specifications.

B. FWT normally includes witnessing of factory testing by representatives from the Owner, CA, and A/E. However, FWT is not required for this project. However, factory testing and related test reports for factory testing required by the specifications shall be included in the Cx process.

C. Contractor shall submit factory test reports in accordance with contract documents and the Cx plan for review and approval.

3.7 LEVEL 2: COMPONENT QUALITY ASSURANCE (CQA)

A. CQA consists of inspection and verification of individual system components and equipment at the site upon delivery for compliance to the design specifications, drawings, and approved project submittals. CQA shall also include inspection of system components and equipment for shipping damage and missing items. CQA shall be conducted by the Contractor and associated subcontractors that will be installing the equipment in accordance with contract documents and the Cx plan, prior to unloading and storage of equipment and system components, and will be observed by the Owner.

B. Contractor shall submit CQA reports in accordance with contract documents and the Cx plan for review and approval.

C. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

3.8 LEVEL 3: STARTUP VERIFICATION TESTING (SUV)

A. SUV consists of review of the equipment startup and testing plans and procedures developed by the contractor and associated equipment manufacturers, followed by conducting startup procedures and testing in accordance with the Cx plan and manufacturer procedures. SUV includes an evaluation of interconnection between components, physical arrangement, support and anchoring, access provisions, clearance, and verification of the overall construction completion of the equipment and systems for compliance with the contract documents and manufacturer instructions.

B. SUV shall be conducted after preparation of startup and testing plans and procedures, and after completion of installation by the Contractor with verification of equipment installation completion.
As a part of SUV, prefunctional/startup checklists shall be completed in accordance with the Cx plan as specified below.

C. SUV shall be conducted by the Contractor and the equipment manufacturer factory-certified technicians and observed by the CA and Owner.

D. Upon CA approval of the SUV test reports, the equipment/system shall be considered ready for Functional performance testing (FPT), as specified below.

E. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

3.9 PRE-FUNCTIONAL/STARTUP CHECKLISTS

A. The following procedures apply to all equipment/systems to be commissioned.

B. Pre-functional/startup checklists shall be used to verify that the equipment and systems are installed, fully connected and ready to operate in accordance with contract documents, so that performance testing may proceed without unnecessary delays. The pre-functional/startup checklist for a given system must be successfully completed and approved prior to formal performance testing of equipment or subsystems of the given system.

C. The CA will coordinate with Contractor and his sub-contractors for the commissioned equipment/system to create a pre-functional/Start-up checklist that is specific to the particular equipment/system. The intent of the pre-function/startup checklist is to incorporate the manufacturer’s startup routines and CA’s initial checkout and startup requirements.

D. The Owner will approve the final content and documentation format for all pre-functional/startup checklists used for commissioned equipment/systems on this project.

E. The Contractor shall determine which trade is responsible for executing and documenting each of the line item tasks and transmit the checklist to the responsible sub-contractors. Each checklist form may have more than one trade responsible for its execution. The Contractor and his sub-contractors shall provide the services of personnel to implement the pre-functional/startup checklists. The Contractor shall provide for all equipment the manufacturer’s startup and testing procedures, shop drawings, equipment cut sheets, control system schematics, narrative description of control sequences of operation, as-built wiring schematics, sub-system interfaces, and interlocks.

F. The equipment manufacturer shall provide all tools and test equipment required to complete the manufacturer’s startup and testing procedures.

G. Execution of Pre-functional/Startup Checklists:
1. Four weeks prior to the scheduled startup, the Contractor shall coordinate startup and checkout with the Owner, A/E and CA. The execution of the pre-functional and startup checklists, startup, and checkout shall be directed and performed on 100% of the equipment/systems by the personnel of the Contractor, sub-contractors and/or equipment suppliers. Signatures are required of personnel performing pre-functional/startup checklist tasks for verification of completion of their work.

2. The Owner will observe the execution of pre-functional/startup checklists. The A/E will observe the execution of pre-functional/startup checklists, if requested by the Owner.

3. The CA will observe execution of pre-functional/startup checklists in accordance with the commissioning plan.

4. The Contractor, sub-contractors, and equipment suppliers shall execute startup and Contractor shall provide the CA, with a signed and dated copy of the completed pre-functional/startup checklists.

5. Only personnel of the Contractor (technicians, engineers, tradesmen, equipment suppliers, etc.) who have direct knowledge and witnessed that a line item task on the pre-functional/startup checklist was actually performed shall check off that item. It is not acceptable for witnessing supervisors to fill out these forms.

6. CA will review and approve pre-functional/startup checklists submitted by Contractor.

H. Pre-functional/startup checklists filled out by the appropriate personnel, signed and approved by the CA will be included in the commissioning report.

I. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

3.10 LEVEL 4: FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Functional performance testing (FPT) shall be conducted by the Contractor as specified by the CA in the Cx plan to demonstrate that each system is operating according to the contract documents, manufacturer operational control sequences, and the Cx plan. Functional performance testing shall achieve bringing the systems from a state of individual substantial installation completion to full dynamic operational completion as individual systems.

B. Functional performance test forms (FPTFs) will be developed by the CA. The basis of the FPTFs shall be the control sequence of operation for the equipment/system.

C. Control sequences of operation specified by the A/E or as proposed by the equipment supplier shall be provided by the Contractor or Supplier as appropriate, and shall include all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.

D. Before test procedures are finalized, the Contractor shall provide to the A/E and the CA all requested documentation and a current list of changes affecting equipment or systems,
including an updated points list, program code, control sequences, and testing parameters. Using the testing parameters and requirements in the technical specifications, the CA shall update/develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Contractor, sub-contractors, and equipment suppliers, as appropriate, shall provide assistance to the CA in developing the final procedures. Prior to finalization, the Owner and A/E will review the test procedure.

E. Execution of Functional Performance Testing (FPT)

1. FPT consists of the following tests that will be conducted by the Contractor as specified by the CA in the commissioning plan. FPT shall be conducted after pre-functional/startup checklist process is completed and checklists have been approved by the CA.

2. Air and water system balance shall be completed before performance testing of air or water-related equipment or systems.

3. Contractor shall coordinate with Owner, A/E and CA the start of FPT on the commissioning equipment/systems. FPT shall be scheduled for no sooner than 48 hours from approval from CA of FPT checklists.

4. The CA, Owner, and A/E will observe the execution of FPT.

5. The Contractor shall conduct the FPT in accordance with the approved Cx plan developed by the CA.

6. The contracting team carrying out FPT will include trades necessary to functionally test the equipment/system and its interaction with other equipment/systems. This generally includes mechanical, electrical, temperature control personnel and may also include equipment suppliers and test and balance personnel.

7. The Contractor shall coordinate so that all personnel required to carry out FPT are present and are working together to complete the specified tasks.

8. FPT shall include but not be limited to the following, at a minimum:

   a. Set the system equipment into the operating mode to be tested (e.g. normal shut-down, normal auto position, normal manual position, unoccupied cycle, emergency power and alarm conditions, etc.)

   b. Repeat test for each operating cycle that applies to the system being tested.

   c. Perform operating checks of all safety cutouts, alarms, and interlocks with smoke control and life safety systems during all modes of operation of the mechanical/electrical systems.

   d. Operate each system through all modes of operation where there is a specified system response. Modes of operation include seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, emergency conditions, normal operation, bypass conditions, etc. Proper responses to extreme conditions such as power failure, freezing, low oil pressure, no flow, equipment failure, etc. shall also be tested. Each individual sequence of operation shall be monitored and verified. Functionality shall be verified through manual testing where required, in which the test technician
simulates an equipment condition or induces an operational or alarm condition, after which the equipment is monitored and evaluated for the required response.

9. The Contractor shall inspect, verify, and demonstrate the position of each device and interlock identified in the test procedures. Each item shall be signed off as acceptable (yes) or failed (no).

10. FPT shall be completed on 100% of the equipment/systems included in the commissioning process.

11. During FPT, the contracting team completing the testing procedures shall attempt to resolve all problems or equipment/system failures when they appear in the testing process if possible, and shall complete and sign the FPT procedure forms.

12. Failures of the testing shall require retesting on the affected equipment. If extensive work is required to correct deficiencies that cannot be accomplished during the scheduled testing, completion of the testing will be rescheduled for another date and conducted at Contractor’s expense for expenses related to Owner/CA/AE expenses for travel and hourly rates. Retesting on the same date will not incur any charges to the contractor for Owner/CA/AE retesting expenses.

12. Once FPT is complete, all deficiencies resolved, and forms filled out and signed by the appropriate personnel, Contractor shall submit the forms to CA for review and approval.

13. Only individuals of the Contractor (technicians, engineers, tradesmen, equipment suppliers, etc.) who have direct knowledge and witnessed that a line item task on the functional test procedure was actually performed shall check off that line item. It is not acceptable for witnessing supervisors to fill out these forms.

14. Upon CA approval of the FPT reports, the equipment/system shall be considered ready for integrated systems testing (IST), as specified below.

F. Contractor FPT forms filled out by the appropriate personnel, signed and approved by the CA will be included in the final commissioning report.

G. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

3.11 LEVEL 5: INTEGRATED SYSTEMS TESTING (IST)

A. Integrated systems testing (IST) shall be conducted by the Contractor as specified by the CA in the Cx plan to demonstrate that each system is operating seamlessly in an integrated manner coordinated with all other related systems in the project, so that the facility as a whole meets the Owner requirements for reliability and availability. Integrated systems testing shall achieve bringing the systems from a state of individual operational completion to full-scale operation of systems as a cohesive integrated system.
B. Integrated systems testing test forms (ISTFs) will be developed by the CA. The basis of the ISTFs shall be the control sequence of operation for the equipment/system.

C. Control sequences of operation specified by the A/E or as proposed by the equipment supplier shall be provided by the Contractor shall include all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.

D. Before test procedures are finalized, the Contractor shall provide to the A/E and the CA all requested documentation and a current list of changes affecting equipment or systems, including an updated points list, program code, control sequences, and testing parameters. Using the testing parameters and requirements in the technical specifications, the CA shall update/develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Contractor, sub-contractors, and equipment suppliers, as appropriate, shall provide assistance to the CA in developing the final procedures. Prior to finalization, the Owner and A/E will review the test procedure.

E. Execution of Integrated Systems Testing (IST)

1. IST consists of the following tests that will be conducted by the Contractor as specified by the CA in the commissioning plan. IST shall be conducted after the IST checklist process is completed and checklists have been approved by the CA.

2. Air and water system balance shall be completed before performance testing of air or water-related equipment or systems.

3. Contractor shall coordinate with Owner, A/E and CA the start of IST on the commissioning equipment/systems. IST shall be scheduled for no sooner than 48 hours from approval from CA of IST checklists.

4. The CA, Owner, and A/E will observe the execution of the IST.

5. The Contractor shall conduct the IST in accordance with the approved Cx plan developed by the CA.

6. The contracting team carrying out IST shall include trades necessary to functionally test the equipment/system and its interaction with other equipment/systems. This generally includes mechanical, electrical, temperature control personnel and may also include equipment suppliers and test and balance personnel.

7. The Contractor shall coordinate so that all personnel required to carry out IST are present and are working together to complete the task.

8. IST shall include the following, at minimum:

   a. Verify that the mechanical, electrical, control and safety systems work as designed during normal operations, as well as during multiple systems failures.

   b. Verify that all of the systems correctly operate in conjunction with one another, and that the project control systems and equipment respond as specified in the event of a loss of equipment, an equipment or system alarm, or loss of utility power.
c. Verify that electrical, mechanical and control systems return to normal operation after an electrical power system interruption. Testing will also involve the interruption of power to control systems to verify correct default “failsafe” operation of HVAC equipment.

9. Systems shall be tested in all operating modes (e.g. normal shut-down, normal auto position, normal manual position, unoccupied cycle, backup power, alarm conditions, etc.)

10. IST shall be completed on 100% of the equipment/systems included in the commissioning process.

11. During IST, the contracting team completing the testing procedures shall attempt to resolve all problems or equipment/system failures when they appear in the testing process if possible, and shall complete and sign the IST procedure forms.

12. Any failures of the testing shall require retesting on the affected equipment. If extensive work is required to correct deficiencies that cannot be accomplished during the scheduled testing, completion of the testing will be rescheduled for another date and conducted at Contractor’s expense for expenses related to Owner/CA/AE expenses for travel and hourly rates. Retesting on the same date will not incur any charges to the contractor for Owner/CA/AE retesting expenses.

12. Once IST is complete, all deficiencies resolved, and forms filled out and signed by the appropriate personnel, submit the forms to CA for review and approval.

13. Only individuals of the Contractor (technicians, engineers, tradesmen, equipment suppliers, etc.) who have direct knowledge and witnessed that a line item task on the integrated systems test procedure was actually performed shall check off that line item. It is not acceptable for witnessing supervisors to fill out these forms.

14. Upon CA approval of the IST reports, the equipment/system is ready for final acceptance review by the Owner.

F. Contractor IST forms filled out by the appropriate personnel, signed and approved by the CA will be included in the final commissioning report.

G. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

3.12 NON-CONFORMANCE AND TESTING FAILURE RESOLUTION PROCEDURES

A. Non-Conformance

1. As tests progress and a deficiency is identified, the CA will review the issue with the Owner, A/E, Contractor, and affected equipment supplier(s).

2. When there is no dispute on the deficiency and the Contractor or Supplier accepts responsibility to correct the issue:
a. The CA will document the deficiency and the Contractor’s response and intentions. The CA will submit the noncompliance reports to the Owner. The Contractor 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 CA.

b. The Contractor shall reschedule the test; and the test shall be repeated.

3. If there is a dispute about a deficiency, regarding whether or not it is a deficiency:

a. The dispute shall be documented on the non-compliance form with the Contractor or Supplier response.

b. Resolutions will be sought at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner.

c. The CA documents the resolution process.

d. Once the interpretation and resolution have been decided, the Contractor/Supplier corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The Contractor shall reschedule the test and the test is repeated until satisfactory performance is achieved.

4. Cost of retesting a performance test shall be paid by the Contractor for Contractor-provided equipment and paid by the Supplier for Owner-furnished equipment.

5. The Contractor shall submit in writing to the Owner and CA at least as often as commissioning meetings are being scheduled, the status of each outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreement and proposals for their resolutions.

a. The CA will retain the original non-conformance forms until the end of the project.

b. Retesting shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

B. Failure Due to Manufacturing Defect: If 10% (or three, whichever is greater) of identical pieces of equipment fail to perform to the contract documents (mechanically or substantively) due to a manufacturing defect, not allowing it to meet its submitted performance specification, all identical units may be determined to be unacceptable by the Owner, based on the CA and A/E recommendations. In such case, the Contractor or Supplier as appropriate shall provide the Owner with the following:

1. Within one week of notification from the Owner, the Contractor/Supplier with the assistance of the equipment manufacturer’s representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Owner within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor and Supplier shall provide a signed and dated, written explanation of the problem, cause of failures, etc., and all proposed solutions.

3. The Owner will determine whether a replacement of all identical units or a repair is acceptable, based on recommendations from the A/E and CA.

5. Upon acceptance, the Contractor and/or Supplier as applicable shall replace or repair all identical items, at their expense. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

C. Refer to paragraph “Scope” above for delineation of Contractor and Owner-furnished equipment supplier responsibilities in the commissioning process.

3.13 OPERATING AND MAINTENANCE DATA

A. Refer to Section “Closeout Procedures” for additional requirements.

B. Operations and maintenance data shall cover all systems, equipment, devices, materials and finishes described within these specifications and provided by Contractor or Supplier under this Project.

C. The CA and A/E will review the draft form of the O&M manuals provided by the Division 21, 22, 23, and, 26 subcontractors. The review process shall verify that O&M instructions meet specifications and are included for all commissioned equipment/systems provided by the Contractor, and that the information, instructions, and wiring diagrams are specific (edited where necessary) to the actual equipment provided for this Project.

D. The O&M manual review and coordination efforts shall be completed prior to Owner training sessions, as these documents are to be utilized in the training sessions.

E. The CA’s review does not replace the A/E’s review of O&M manuals according to the A/E’s contract.

F. O&M Data Format:

1. O&M data shall be provided in neatly indexed, heavy duty, vinyl, 3-ring binders of manageable size. Binders shall be indexed by specification Section, with additional dividers provided under each specification section if multiple types of equipment and/or systems are defined within a single specification Section. Dividers shall be heavy paper with plastic covered tabs.

2. Fold all oversized sheets to neatly fit within binder. For sheets greater than 11” x 17” provide inserts for storage in binder.

3. Provide a table of contents in each binder. If more than one binder is used, clearly identify in the table of contents which information is contained in each binder.

4. Clearly label each manual with the title “OPERATION AND MAINTENANCE MANUAL – VOLUME _ OF _” and the Project name.
G. O&M Data Content:

1. For the BAS, EPMS, and EPCS (as appropriate to the system), include the following in the O&M manuals:

   a. General/Hardware:

      1) Description of the system including definitions, size, architecture and functionality of each component of the system.
      2) As-built drawings for the system; control diagrams, wiring diagrams, system schematics, etc.
      3) Hardware component manufacturer’s specifications, installation instructions, operating and servicing instructions.
      4) Design data for sensors and control components external to digital controllers. Include manufacturer’s specifications, installation, maintenance and calibration procedures.
      5) Output hardware data. Include manufacturer’s installation, maintenance and operations procedures.
      6) Step-by-step instructions to set controllers from installation to a point they can accept control programs from a computer. Include shop drawings showing cable connections, equipment settings for the operation of each controller.
      7) Interconnection wiring diagrams with system components and device identification.
      8) Step-by-step procedure for diagnosing and installing controller.
      9) Drawings: Project as-built drawings will be included in O&M manuals. Reduce to 11x17 format, provide with reinforced punch binder tab. Bind with text; fold drawings to size of text pages. (Larger drawing will be allowed if 11x17 is unreadable.
      10) Include all submittals, product data and shop drawings updated to as-built conditions.
      11) Spare parts lists for each type of control device.
      12) Inspection period, cleaning methods, recommended cleaning materials and calibration tolerances.

   b. Software

      1) Include step-by-step procedures for uploading and downloading of software programs from and to each controller and the operator station computer.
2) Include documentation for software setup of every physical and virtual point. Include point name, location, type, and any other characteristic to define point.

3) Include step-by-step procedure for making set point and equipment scheduling changes.

4) Include documentation describing running and analyzing controller diagnostics.

5) List alarms and messages programmed into each controller.

6) Provide PID Loop turning procedures for the control system.

7) Include step-by-step procedure for loading operator station software and accessing the control system.

8) Documentation for creating, editing and using graphics.

9) Sequences of operation in English narrative and graphic chart format. Sequences to include normal, emergency and failsafe modes of operation.

10) Include all software documentation updated to as-built conditions.

c. Provide two (2) copies of all job software in electronic format which can be directly loaded by the Owner.

3.14 TRAINING OF OWNER’S OPERATING PERSONNEL

A. The Contractor for CFCI equipment and the Supplier for OFCI/OFSI equipment shall provide training coordination, scheduling of sub-contractors, and ensure that training is completed. All training shall be coordinated through the Owner and with review by the A/E and the CA. Refer to Section “Closeout Procedures” for additional requirements. If approved by the Owner, training may be conducted in coordination with FPT and IST.

B. The Contractor shall ensure that each sub-contractor and equipment supplier (mechanical, plumbing, fire, electrical, specialty, etc) shall have the following responsibilities:

1. Provide to the CA a training plan sixty days before the planned training covering the following elements:

   a. Equipment
   b. Intended audience
   c. Location of training
   d. Objectives
   e. Subjects covered (description, duration of discussion, special methods, etc)
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up the system.

3. Training shall normally start with classroom sessions followed by hands-on demonstration/training on each piece of equipment.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time, if necessary.

5. The appropriate trade or manufacturer’s representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. Monitoring and controls sub-contractors shall attend sessions other than their specific requirements for training, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. The training sessions shall follow the outline in the table of contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.

8. Training shall include:

   a. Use of the printed installation, operation and maintenance instruction material included in the O&M manual.
   b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
   c. Discussion of relevant health and safety issues and concerns.
   d. Discussion of warranties and guarantees.
   e. Common troubleshooting problems and solutions.
   f. Explanatory information included in the O&M manuals.
   g. Discussion of any peculiarities of equipment installation or operation.
   h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
   i. Hands-on training shall include startup, operation in all modes possible, including manual, shut-down, alarms, power failure and any emergency procedures, and preventative maintenance for all pieces of equipment.
9. The Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the main control systems.

C. At the discretion of the CA, training may occur before performance testing is complete if required by the facility operators to assist the CA in the performance testing.

D. Videotaping of the training sessions will be provided by the Contractor and added to the O&M manuals. In addition, factory training videos identifying key troubleshooting, repair, service and/or replacement techniques shall be provided and reviewed with the Owner.

3.12 RECORD DOCUMENTS

A. Refer to Section “Closeout Procedures” for additional requirements.

B. The Contractor for CFCI equipment and the Supplier for OFCI/OFSI equipment shall maintain at the site one record copy of all drawings, specifications, addenda, approved Shop Drawings, change orders, and other modifications, in good order and marked to record all changes applicable to the work made during construction. All changes from design made during construction shall be recorded by the Contractor. Contractor/Ssupplier shall be responsible for sufficient detail and accuracy of all changes made.

C. Contractor record documents will be periodically reviewed and verified during construction by the CA. Discrepancies in the record documents will be documented in site visit reports and the Contractor shall be responsible to verify and correct the record documents against the installed system for specified and all similar problems noted.

D. Contractor shall supply draft copy of complete record documents to the A/E and Owner prior to initial training session.

3.13 WARRANTIES

A. Refer to Section “Closeout Procedures” for additional requirements and individual warranty sections in commissioned systems specifications.

B. Contractor for CFCI equipment and the Supplier for OFCI/OFSI equipment shall supply a complete copy of all warranties applicable to the Project, the terms of maintenance for each warranty, and the inception and expiration dates for each warranty. This information will become part of the O&M data.

END OF SECTION 01 91 13
PART 1 GENERAL

1.1 S/C - SCOPE

This section provides two packaged diesel engine generator systems that include but are not limited to engine generator set, cooling system, combustion air intake and engine exhaust systems, starting system, enclosure, and the additional features specified herein.

The generator sets provided under this specification section will be purchased directly by the Owner from a generator manufacturer’s authorized distributor (“Supplier”) for installation by the construction contractor (“Contractor”) under a separate construction contract providing renovations to an existing facility to construct a new data center facility.

Assignment of specification compliance responsibilities is defined in this specification section by the inclusion of the terms “S” (Supplier) and “C” (Contractor) at the beginning of the specification paragraphs. However, the equipment supplier and construction contractor shall coordinate with each other in completion of the work specified herein to provide a complete and operable system. The term “S/C” indicates contract provisions that apply to both the Supplier and the Contractor.

The generator set installation and related work shall conform to the requirements of all applicable specification sections and drawings issued as a part of the overall project construction contract.

1.2 S/C - REFERENCE CODES AND STANDARDS

A. The generator set shall conform to the requirements of the following codes and standards for the editions currently in effect:

1. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
2. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
3. IEC8528 part 4, Control Systems for Generator Sets.
4. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
5. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
6. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
8. NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
1.3 S/C - DEFINITIONS

A. Emergency or Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage, with capability for 100% rated load for the duration of the power outage.

B. Operational Bandwidth: The total variation from the lowest to the highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

C. Power Output Rating: Gross electrical power output of generator set minus total power requirements of electric motor-driven accessories normally constituting part of the engine assembly.

D. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hz or cycles per second.

1.4 S/C - SYSTEM DESCRIPTION

A. System Includes: Standby-rated, automatically started diesel engine mechanically coupled to an a.c. generator unit. Engine and generator shall be factory-mounted and aligned on a structural steel skid. Subsystems and auxiliary components and equipment shall be as indicated or specified. Provide all labor, materials, and equipment to furnish, install, and place in operation the power generation system in accordance with the contract documents and manufacturer's drawings and installation instructions. These specifications also describe requirements for the design, fabrication, and testing of the power system.

The installation of the power generation system shall include the following:

1. Engine-driven generator set
2. Control system
3. Cooling system
4. Fuel supply and storage system
5. Generator set accessories
6. Mounting system
7. System controls, including control and monitoring panel.

B. Functional Description: When the mode selector switch on the control and monitoring panel is in the "automatic" position, remote control contacts in one or more separate automatic transfer switches initiate the starting and stopping of the generator set. When the mode selector switch is placed in the "on" position, the generator set shall start manually. The "off" position of the same switch shall initiate shutdown of the generator set. When the unit is running, specified system or equipment failures or derangements shall automatically shut the unit down and initiate alarms. Operation of a remote emergency stop switch shall also shut down the unit. Automatic transfer switches are specified in Section 16495.
C. The engine-generator and related work shall be provided as a complete and operable system, in full compliance with all requirements on the drawings and all specifications requirements. The drawings are diagrammatic and the specifications are performance-based, and the contractor shall provide all work required to comply with the drawings and specifications, even if not explicitly indicated or specified. The contractor shall be responsible for coordinating installation of the engine-generator system with all field conditions and the work of other trades. Minimum clearances and work required for compliance with NFPA 70 "National Electrical Code" and the manufacturer’s instructions shall be provided.

D. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line. The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year. System manufacturer shall maintain a service center capable of providing training, parts, and emergency maintenance and repairs at the Project site with 2 hours maximum response time.

1.5 S/C - SUBMITTALS

A. S - General: Unless specified otherwise, the Supplier shall submit the following documentation with the RFP response to the Owner’s Representative. RFP responses without the specified documentation or missing documentation may be rejected by the Owner’s Representative, at the Owner’s Representative discretion. Submit and obtain approval of all product data, shop drawings, wiring diagrams, protective device studies, coordination drawings, certifications, and compliance certifications prior to release of equipment for fabrication.

B. S - Product data for products specified in this Section. Include data on features, performance, components, and ratings, including KW, KVA, starting KVA, voltage dip, transient reactance, sub transient reactance, and zero-sequence reactance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components. Submit certified total harmonic current distortion ratings for voltage regulators.

C. S - Submit as a part of project closeout documentation O&M operation and maintenance data for system and components for inclusion in Operating and Maintenance Manual specified in Division 1 of the construction contract. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay setting and calibration instructions. Include detailed operating instructions. Cover operation under both normal and abnormal conditions.

D. S - Shop Drawings: Detail fabrication, piping, wiring, and installation of the field-installed portions of the system. Include general arrangement drawings showing locations of auxiliary components in relation to the engine generator set and duct, piping, and wiring connections between the generator set and the auxiliary equipment. Show connections, mounting, and support provisions and access and working space requirements.
E. S - Wiring Diagrams for System: Show power and control connections and distinguish between factory-installed and field-installed wiring.

F. S - Computer calculations by generator manufacturer to verify proposed generator and engine ratings for compliance with specified/indicated ratings and applied loads indicated in the generator load schedule.

G. S - Qualification Data for Manufacturer: Include capabilities and experience data required to demonstrate qualifications specified in Quality Assurance Article. Include list of five completed projects with equipment similar to the system specified herein, with project names and addresses and names of Engineers and Owners, plus other information specified.

H. C - Field-Testing Organization Certificates: Signed by Contractor, certifying that the organization complies with the requirements specified in Quality Assurance below.

I. S - Certified Summary of Prototype Unit Test Report: Submit certified copies of actual prototype unit test report if subsequently requested.

J. S - Exhaust Emissions Test Report, where required by federal, state or local regulations.

K. S - Certification of Torsional Vibration Compatibility: Conform to NFPA 110.

L. S - Factory Test Reports: For units to be shipped for this Project showing evidence of compliance with specified requirements.

M. S/C - After completion of field testing, submit field test report as a record of tests specified in Part 3.

N. S/C – Coordination and installation/coordination layout drawings shall be submitted within 30 days of proposal acceptance

1. The purpose of the submittals specified herein is not only to show compliance with the requirements, but is also for future identification, replacement, duplication, and servicing.

2. The work described in all submittals shall be carefully checked by the contractor and proposed equipment manufacturer for all clearances, including those required for maintenance and servicing, field conditions, maintenance of architectural conditions, and proper coordination. Each submittal shall include a certification by the contractor and proposed equipment manufacturer that all related conditions have been checked and that no conflict exists. No submittal will be reviewed without such certification.

3. Based on equipment drawings and diagrams provided by the Supplier as a part of project submittals, the Contractor shall prepare complete coordination layout drawings and field wiring diagrams for the generator set equipment, automatic transfer switches, and related equipment. Layout drawings will verify equipment locations, conduit and wiring provisions, and space allocated for maintenance and service. Layout drawings will indicate code-required clearances and manufacturer-recommended clearances around all equipment.

O. S/C - Submittal Submission Schedule:
All drawings, etc., shall be submitted sufficiently in advance of field requirements to allow ample time for checking, and no claim for extension of contract time will be granted to Supplier or Contractor, by reason of his failure in this respect. All submittals shall be complete and shall contain all required and detailed information. Submittals with multiple parts shall be submitted as a complete package.

P. S - Compliance Certification:

Submit a complete copy of this specification section and all other related sections with each paragraph and subparagraph marked with either "compliance," "deviation," or "alternate." Submit copy of drawing equipment schedules and related drawing notes, marked in the same manner as specified above for specification paragraphs. All deviations and alternates to the specifications and drawings shall be fully described in attached documentation as to what the contractor and manufacturer propose to provide. Approval of deviations and will remain within the sole discretion of the Owner's Representative. If proposed deviations or alternates are disapproved, the contractor shall provide equipment and materials in full compliance with the specifications, at no additional cost and without schedule extension.

Q. S - Certifications:

1. Seismic Design and Testing Certificate: Document compliance with all specification and applicable building code requirements for equipment seismic design and testing.
2. EPA: Document compliance with all specification and applicable building code requirements for equipment emissions.

1.6 S/C - QUALITY ASSURANCE

A. Manufacturer Qualifications: Refer to requirements specified above in paragraph “System Description”.

B. Field-Testing Organization Qualifications: To qualify for acceptance, a testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct the indicated testing satisfactorily.

C. Comply with NFPA 70, "National Electrical Code."


E. Listing and labeling: Electrical equipment shall be listed and labeled by Underwriter’s Laboratories (UL), or another nationally recognized testing laboratory (NRTL). All equipment, materials, and devices required to comply with referenced UL standards shall bear labeling from the NRTL to verify compliance. Engine-generator sets shall be listed and labeled to UL 2200.

The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

F. Engine Exhaust Emissions: Comply with applicable Federal, State, and local government requirements.

G. Single-Source Responsibility: Obtain engine generator system components from a single manufacturer with responsibility for entire system. Unit shall be a representative product built
from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

1.7 S/C - DELIVERY, STORAGE, AND HANDLING

Supplier shall deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards. Supplier is responsible for transportation of equipment to the project site unloading area designated by the Owner’s Representative. Contractor is responsible for unloading of all equipment and provisions for safe and protected storage at the project site until equipment is installed by the Contractor.

PART 2 - PRODUCTS

2.1 S - MANUFACTURERS

A. Subject to compliance with this specification, automatic transfer switches shall be from the same manufacturer of a manufacturer listed below:

1. Kohler – Basis of Design
   Alternate manufacturers from which the owner will accept proposals for consideration:
2. Caterpillar
3. Cummins
4. Generac

Note: Listing of a manufacturer above does not commit the Owner to accepting any proposals from a manufacturer listed. All proposals must include the submittal data listed in paragraph “Submittals” specified hereinbefore. Substitutions and additional alternate manufacturers shall not be permitted unless authorized by the Owner’s Representative in writing.

2.2 S - SYSTEM SERVICE CONDITIONS

A. Service Conditions: Engine generator system shall operate within the following service conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 20 degrees F to plus 100 degrees F.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: 750 feet above sea level.
4. Fuel Type: Diesel.
5. Installation Location: Exterior location within a weatherproof enclosure.

2.3 S - ENGINE GENERATOR SYSTEM

A. General: System shall be a coordinated assembly of compatible components.
B. Ratings: Voltage, frequency, and power output ratings of the system shall be as indicated on the Engine-Generator Set Load Schedule.

C. Output Connections: As indicated.


E. Nameplates: Each major system component shall be equipped with a conspicuous nameplate of the component manufacturer. Nameplate shall identify manufacturer of origin and address, and the model and serial number of the item.

G. Manufacturer: The engine-generator set along with all major items of auxiliary equipment shall be manufactured by a manufacturer currently engaged in the production of such equipment. The unit shall be factory-assembled and factory-tested before being shipped to the job site.

H. Local Service and Maintenance: The engine-generator and automatic transfer switch manufacturer shall maintain a local service shop with an adequate stock of spare parts and trained mechanics within 100 miles of the site.

I. Responsibility: The engine-generator set and its associated equipment shall be assembled, tested, and shipped by one manufacturer who shall accept full responsibility for the quality and performance of all components.

2.4 S - SYSTEM PERFORMANCE

A. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.

B. Steady-State Frequency Modulation: Less than 1 Hz.

C. Transient Voltage Performance: Not more than 20 percent variation for 100 percent step-load increase or decrease. Voltage shall recover to +/-0.5% of rated voltage within 1 second.

D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

E. Steady-State Frequency Stability: When the system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no regular or cyclical hunting or surging of speed.

F. Transient Frequency Performance: No more than 3 Hz variations for a 50 percent step-load increase or decrease. Frequency shall recover to remain within the steady-state operating band within 3 seconds.

G. Output Waveform: At no load, the harmonic content measured line-to-line or line-to-neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor determined according to NEMA MG1, "Motors and Generators," shall not exceed 50.

H. Sustained Short-Circuit and Overload Current: For a 3-phase bolted short circuit at the system output terminals, the generator shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any
generator system component. The generator shall sustain 150% of continuous load current for 2 minutes with field set for rated load excitation.

I. Temperature Rise of Generator: Within acceptable limits for insulation systems used according to NEMA MG1 when operating continuously at standby rating conditions.

J. Nonlinear Load Performance: System performance shall not be degraded from that specified in this Article by operation with the non-linear loads specified hereinafter.

K. Starting Time: Maximum total time period for a cold start, with ambient temperature at the low end of the specified range, shall be 8 seconds. Time period includes output voltage and frequency settlement within specified steady-state bands, and load acceptance.

L. Generator Circuit Breakers: Ratings and features shall be as specified below in the generator load schedule, unless recommended otherwise by the generator manufacturer as a part of submittals and approved in writing by the Owner’s Representative. All circuit breakers indicated to be provided with the generator set shall be enclosed within the generator housing, either group mounted or provided in a panelboard assembly. Mounting method shall isolate the control panel from generator set vibration.

1. For each generator set provide a factory installed, 100% rated circuit breakers rated at 400 amperes that are UL489 listed. Circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC. Circuit breakers shall be provided for:
   a. Generator output line breaker (to ATS)
   b. Generator output load bank breaker (for connection of a portable load bank)
   c. Provide on all breakers key interlocks with keys as correct to prevent both line and load bank breakers to be closed at the same time

2. The circuit breaker(s) shall incorporate an electronic trip device with the following characteristics:
   a. Adjustable long time delay
   b. Adjustable short time delay
   c. Instantaneous

6. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections.

7. The shunt trip device shall be connected to trip the generator breaker when the generator-set is shut down by other protective devices.

8. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the generator-set alarms.

9. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

M. Load Schedule: As specified in paragraph "Submittals" in this section, submit computer calculations by the generator set manufacturer to verify compliance with the following ratings:

1. Basis of Design: Kohler model 250REOZJE with a 4UA13 alternator

2. KW, KVA, starting KVA, and voltage dip performance specified for the load schedule specified below.
3. Engine-Generator ratings and generator reactance values shall be adequate to ensure satisfactory operation for the loads specified in the load schedule below, including motor loads and non-linear variable speed drive loads indicated in the load schedule below.

4. Starting of motor loads shall be based on the following conditions:
   a. Motor windings to be at room temperature.
   b. Generator to be driven by a synchronous driver.
   c. Generator is to be hot, equivalent to the stabilized temperature band between the generator’s 75% and 100% continuous load rating.

5. Minimum ratings – Refer to generator set load schedule below.
   b. 130°C alternator temperature rise rating while operating in the ambient conditions specified hereinbefore for standby duty
   c. Engine brake horsepower shall be sufficient to deliver full rated generator set kW/kVA when operated at rated rpm and equipped with all engine-mounted parasitic and external loads such as radiator fans and power generators.
   d. Alternator pitch: 2/3 pitch, unless recommended otherwise by generator manufacturer and documented in equipment submittals.
   e. The engine shall be EPA certified from the factory
   f. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 980 locked rotor KVA minimum for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.
   g. The generator set must accept rated load in one-step with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115.
   h. Refer to the load schedule below as a basis for the computer calculations by generator manufacturer to verify proposed generator and engine ratings for compliance with specified/indicated ratings and applied loads indicated in the generator load schedule.
### Generator Set Load Schedule - Typical for Generator "A" & Generator "B"

<table>
<thead>
<tr>
<th>STEP</th>
<th>DELAY</th>
<th>LOAD TYPE</th>
<th>LOAD DESCRIPTION</th>
<th>QTY</th>
<th>KW</th>
<th>KVA</th>
<th>PF</th>
<th>KW</th>
<th>KVA</th>
<th>PF</th>
<th>DIP %</th>
<th>DIP %</th>
<th>DIST %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>0 SEC</td>
<td>UPS - 3 PH; IGBT; 1/2 LOAD 70KW/KVA UPS - 18% BATT CHG</td>
<td>2</td>
<td>86.09</td>
<td>101.29</td>
<td>0.85</td>
<td>86.09</td>
<td>101.29</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>0 SEC</td>
<td>LED LIGHTING EVENLY DISTRIBUTED; FILTERED BALLAST</td>
<td>1</td>
<td>0.93</td>
<td>0.98</td>
<td>0.95</td>
<td>0.93</td>
<td>0.98</td>
<td>0.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>0 SEC</td>
<td>LED LIGHTING EVENLY DISTRIBUTED; FILTERED BALLAST</td>
<td>1</td>
<td>0.50</td>
<td>0.63</td>
<td>0.80</td>
<td>0.50</td>
<td>0.63</td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>0 SEC</td>
<td>OFFICE EQPT 3 PH NON-LINEAR LOAD</td>
<td>1</td>
<td>4.50</td>
<td>5.27</td>
<td>0.85</td>
<td>4.50</td>
<td>5.27</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>0 SEC</td>
<td>AIR COND 1 PH A-C CU-S UPS RM A/C COND; X-LINE; PH A-C</td>
<td>2</td>
<td>3.90</td>
<td>5.49</td>
<td>0.71</td>
<td>20.30</td>
<td>33.28</td>
<td>0.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>0 SEC</td>
<td>NON-LINEAR LOAD EVENLY DISTRIBUTED; FILTERED BALLAST</td>
<td>1</td>
<td>2.00</td>
<td>2.22</td>
<td>0.90</td>
<td>2.00</td>
<td>2.22</td>
<td>0.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>0 SEC</td>
<td>MISC. LINEAR LOAD 3 PH</td>
<td>1</td>
<td>3.00</td>
<td>3.00</td>
<td>1.00</td>
<td>3.00</td>
<td>3.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>STEP TOTAL</td>
<td></td>
<td></td>
<td>100.92</td>
<td>118.24</td>
<td>0.85</td>
<td>117.32</td>
<td>144.36</td>
<td>0.81</td>
<td>8.46</td>
<td>7.21</td>
<td>3.51</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>CUM.TOTAL</td>
<td></td>
<td></td>
<td>100.92</td>
<td>118.24</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>30 SEC</td>
<td>AIR CONDITIONING AIR COOLED CONDENSER; X-LINE; 3 PH</td>
<td>3</td>
<td>19.11</td>
<td>24.69</td>
<td>0.77</td>
<td>76.32</td>
<td>149.64</td>
<td>0.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>30 SEC</td>
<td>AIR CONDITIONING IN-ROW A/C COMPRESSOR; VFD; 3 PH</td>
<td>3</td>
<td>35.88</td>
<td>46.00</td>
<td>0.78</td>
<td>41.40</td>
<td>46.00</td>
<td>0.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>STEP TOTAL</td>
<td></td>
<td></td>
<td>54.99</td>
<td>70.69</td>
<td>0.78</td>
<td>117.72</td>
<td>189.71</td>
<td>0.62</td>
<td>10.70</td>
<td>7.24</td>
<td>7.38</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>CUM.TOTAL</td>
<td></td>
<td></td>
<td>155.91</td>
<td>188.55</td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>60 SEC</td>
<td>MISC. LINEAR LOAD IN-ROW ELECTRIC HEAT; 3 PH</td>
<td>3</td>
<td>24.75</td>
<td>24.75</td>
<td>1.00</td>
<td>24.75</td>
<td>24.75</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>STEP TOTAL</td>
<td></td>
<td></td>
<td>24.75</td>
<td>24.75</td>
<td>1.00</td>
<td>24.75</td>
<td>24.75</td>
<td>1.00</td>
<td>1.28</td>
<td>0.59</td>
<td>7.38</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>CUM.TOTAL</td>
<td></td>
<td></td>
<td>180.66</td>
<td>209.48</td>
<td>0.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td></td>
<td>GRAND TOTAL</td>
<td></td>
<td></td>
<td>180.66</td>
<td>209.48</td>
<td>0.86</td>
<td>10.70</td>
<td>7.24</td>
<td>7.38</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Generator Performance Summary

- **Altitude**: 750 feet
- **Maximum Allowable Voltage Dip**: 10.70%
- **Minimum Alt. Starting KVA at 35% V Dip**: 980
- **Minimum Required KW/KVA Rating**: 255/318
- **Minimum Site Rated KW**: 252.45
- **Minimum Required % Loaded**: 71.56%
- **Generator Voltage**: 480/277

### General Requirements:

1. The schedule above indicates the configuration and timing of step loading used to determine the required generator ratings for the project.
2. Provide programming of equipment and controls to achieve the time delays indicated below for restarting equipment after loss of power.
3. Coordinate programming of restart time delays among the equipment and related control systems that pertain to the equipment listed.
4. Time delays indicated are from T=0 when all generators are connected via ATS to EQPT.
5. Verify equipment ratings and loads during submittals review and adjust steps/time delays where needed to accommodate proposed equipment ratings.
6. Time delays indicated for non-controlled loads are assumed time sequences for purposes of generator sizing calculations for load profile.

---

**Packaged Engine Generator Systems – Diesel**

12 April 2017
2.5 S - ENGINE GENERATOR SET

A. Power Output Rating: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.

B. Mounting Base: The engine-generator manufacturer shall assemble the engine and generator to a common base. The generator set base shall be designed and built by the engine-generator manufacturer to resist deflection, maintain alignment, and minimize resonant linear vibration. Mounting base shall have adequate strength and rigidity to maintain alignment of mounted components without dependence on a concrete foundation. The base shall be constructed of formed steel "C" channel members with a minimum thickness of 0.25 inches. The base arrangement shall incorporate a common interior width for furnishing dedicated stub up areas for mechanical and electrical connections. Steel cross members shall support genset and add rigidity to base with vibration isolators installed between generator set and supports. The base shall have provisions at each corner for overhead lifting. End caps shall be added to the base for the overhead lifting.

C. Rigging Diagram: Inscribed on a metal plate permanently attached to the skid. Diagram indicates location and lifting capacity of each lifting attachment and location of the center of gravity.

2.6 S - ENGINE

A. Comply with NFPA 37, "Stationary Combustion Engines and Gas Turbines."


C. Engine: 1800 rpm, 4 cycle.

D. Lubrication System: Includes but not limited to the following:

1. Oil Pump: The lubrication oil pump shall be a positive displacement type that is integral with the engine and driven from the engine crankshaft. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.

2. Bypass Valve: The bypass valve shall be integral with the engine filter base or receptacle. Systems where bypass valves are located in the replaceable oil filter are not acceptable. Pistons shall be oil cooled by continuous jet spray to the underside or inside of the crown and piston pin.

5. Filter and Strainer: Rated to remove 90 percent of particles 5 microns and smaller while passing full flow.

6. Oil Cooler: Maintains lubricating oil at the manufacturer's recommended optimum temperature.

5. Thermostatic Control Valve: Controls flow in the system to maintain optimum oil temperature. Unit shall be capable of full flow and shall be designed to be fail-safe.

6. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without the use of pumps or siphons or special tools or appliances.
E. Engine Fuel System: Comply with NFPA 30, "Flammable and Combustible Liquids." System includes:

1. Integral Injection Pumps: Driven by the engine camshaft. Pumps shall be adjustable for timing and cylinder pressure balancing.


3. Fuel Oil Filter: Ahead of the injection pumps.

4. Relief/Bypass Valve: Automatically regulates pressure in the fuel line and returns excess fuel to the source.

F. Jacket Coolant Heater: Electric immersion type, factory-installed in the jacket coolant system, and rated for the voltage provided in the circuit indicated. Unit shall be rated and thermostatically controlled to maintain an engine temperature of 78 degrees F at the low end of the ambient temperature range specified under "Environmental Conditions" above. Provide manual shutoff valves to isolate the heater during servicing.

G. Speed Governor: Adjustable isochronous electronic type, with speed sensing, providing 0.25% maximum steady-state frequency regulation.

2.7 S - ENGINE COOLING SYSTEM

A. Description: Closed-loop, liquid-cooled, with radiator factory-mounted on engine generator set skid and integral engine-driven coolant pumping.

B. Radiator: Factory-piped and -rated for specified coolant.

1. Radiator Core Tubes: Nonferrous metal construction other than aluminum.

2. Size of Radiator: Adequate to contain expansion of total system coolant.

3. Fan: Driven by multiple belts from engine shaft.

C. Coolant: Solution of 50 percent ethylene glycol and 50 percent water.

D. Temperature Control: Self-contained thermostatic control valve shall modulate coolant flow automatically to maintain optimum constant coolant temperature as recommended by the engine manufacturer. Features shall include:

1. Thermostatic Elements: Interchangeable and nonadjustable.

2. Actuator Design: Normally-open valves to return to open position when actuator fails.

E. Coolant Hose: Flexible assembly with nonporous rubber inside surface and aging, ultraviolet, and abrasion-resistant fabric outer covering.

1. Rating: 50 psi maximum working pressure with 180 deg F coolant, and noncollapsible under vacuum.
2.  End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.8  S - FUEL SUPPLY SYSTEM


B.  Sub-Base Tank: Factory-fabricated assembly of UL-listed double wall containment sub-base fuel tank located between or beneath the generator set skids inside the generator set housing, with fuel pump and the features described below.

1.  Tank capacity shall supply fuel to the engine for an uninterrupted period of 72 hours operation at 100 percent of rated power output of the engine generator system without being refilled, with a minimum capacity of 1270 gallons of diesel fuel.

2.  The sub-base fuel system shall be listed under UL 142, subsection entitled Special Purpose Tanks EFVT category, and will bear their mark of UL Approval according to their particular classification.

3.  Provide a fuel filtration system with connections to both generator tanks. Fuel filtration system shall be "FUELTEC" model CF4.0-PLC or an approved equal. This system shall meet or exceed ISO cleanliness levels of 18/16/13 with a water content of less than 0.05%. Diesel fuel shall meet this ISO level after one pass through the fuel filtration system. System shall be complete with a one micron primary filter, micro-glass filter/coalescer, and Teflon coated stainless steel hydrophobic water separator. Provide with 36" X 42" X 14" aluminum enclosure, pumps, filters, etc. and mounting post with base.

4.  The above ground steel secondary containment rectangular tank for use as a sub base for diesel generators is manufactured and intended to be installed in accordance with the Flammable and Combustible Liquids Code-NFPA 30, the Standard for Installation and Use of Stationary Combustible Engine and Gas Turbines-NFPA 37, and Emergency and Standby Power Systems-NFPA 110.

5.  The primary tank shall be rectangular in shape and constructed in clam shell fashion to ensure maximum structural integrity and allow the use of a full throat fillet weld.

6.  Steel Channel Support System. Reinforced steel box channel for generator support, with a load rating of 5,000 lbs. per generator mounting hole location. Full height gussets at either end of channel and at generator mounting holes shall be utilized.

7.  Exterior Finish. The sub-base tank exterior finish shall be a polyurea-textured rubberized coating.

8.  Normal venting shall be sized in accordance with the American Petroleum Institute Standard No 2000, Venting Atmospheric and Low Pressure Storage Tanks not less than 1-1/4" (3 cm.) nominal inside diameter and at a height of no less than 11 feet above grade.

9.  The emergency vent opening shall be sized to accommodate the total capacity of both normal and emergency venting and shall be not less than that derived from NFPA 30, table 2-8, and based on the wetted surface area of the tank. The wetted area of the tank shall be calculated on the basis of 100 percent of the primary tank. The vent is to be spring-pressure operated: opening pressure is 0.5/psig and full opening pressure is 2.5 psig. The emergency relief vent is to be sized to accommodate the total venting capacity of both normal and emergency vents.

10.  A direct reading, UL listed, magnetic fuel level gauge with a hermetically sealed, vacuum tested dial, to eliminate fogging, with Fuel level read out at generator controller shall be provided.
11. A float switch for remote or local annunciation of a (50% standard) low fuel level condition shall be supplied.
12. High fuel level switch - A fuel level switch will be installed in the tank and the contacts will close when the fuel level reaches 90%.
13. Fuel fill option - The fuel fill is equipped with an OSHPD and IBC approved 5 gallon above ground fill/spill container with auto shut off feature that contains fuel overfill spills that may occur during fill-ups.

2.9 S - ENGINE EXHAUST SYSTEM

A. Muffler: Horizontal aluminized critical-type, sized as recommended by the engine manufacturer.

B. Connections from Engine to Exhaust System: Flexible section of corrugated stainless steel pipe.

C. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liners.

D. Supports for Muffler and Exhaust Piping: Vibration isolating-type.

E. Discharge: Provide elbow and vertical riser, with hinged rain cap. Supports and bracing as recommended by the manufacturer.

2.10 S - COMBUSTION AIR-INTAKE SYSTEM

A. Air-Intake Silencer: Filter-type providing filtration as recommended by the engine manufacturer.

B. Supports for Air-Intake Piping and Filter-Silencer: Vibration isolation-type as recommended by manufacturer.

2.11 S - STARTING SYSTEM

A. Description: 24 V electric starting system with negative ground, and including the following items:

1. Components: Rated so they will not be damaged during a full engine-cranking cycle with the ambient temperature at the maximum specified in paragraph "Environmental Conditions."

2. Cranking Motor: Heavy-duty 24-volt positive-engagement solenoid shift-starting motor that automatically engages and releases from the engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery shall comply with SAE J537, "Storage Batteries," and shall have adequate capacity within the ambient temperature range specified in paragraph "Environmental Conditions" to provide the specified cranking cycle series at least three times without recharging. Provide BCI group 31 batteries for all each generator which must meet the
engine manufactures' specifications for the ambient conditions specified in “Project Conditions” and shall comply with the NFPA requirements for engine cranking cycles. Each battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 950 amps and a minimum reserve capacity of 185 Minutes at 80 degrees F. The battery plates shall be constructed of a calcium-lead alloy to provide long waterless operation and extended battery life. The battery elements must be anchor-locked with full-frame grids and tight-packed commercial plates to resist the effects of vibration. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Removable cell covers shall be provided to allow for checking of electrolyte specific gravity

5. Battery Cable: Size as recommended by the generator set manufacturer for the required cable length. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory-fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall maintain battery above 50 degrees F within range specified under "Environmental Conditions;" and shall shut off automatically when battery temperature reaches 70 degrees F. Include accessories required to support and fasten batteries in place.


8. Battery Charger: Current limiting, automatic equalizing and float charging-type designed for operation from a 120 V 60 Hz supply source. Unit shall comply with UL 508, "Electrical Industrial Control Equipment," UL 1012, and shall include the following features:

a. Operation: Equalizing charging rate of 10 amperes shall be initiated automatically after the battery has lost charge until an adjustable equalizing voltage is achieved at the battery terminals. The unit shall then automatically implement an automatic 3-stage float to equalization charge mode to switch to a lower float-charging mode, and shall continue operating in that mode until the battery is discharged again.

b. Automatic Temperature Compensation: Adjusts the float and equalizes voltages for variations in the ambient temperature from minus 40 degrees F to 140 degrees F to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Voltage regulation of 1% from no to full load over 10% AC input line voltage variations.


e. Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing "low battery voltage" indication on control and monitoring panel. Also provide sensing of high battery voltage and loss of a.c. input or d.c. output of battery charger. Either of these conditions shall close contacts that provide "battery charger malfunction" indication at system control and monitoring panel. Provide alarm circuit board with alarm contacts for low battery voltage, high battery voltage, and battery charger malfunction.

f. Enclosure and Mounting: NEMA Class 1, mounted within generator set enclosures.

2.12 S - CONTROL AND MONITORING
A. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped on a common control and monitoring panel mounted on the generator set.

B. Controller

1. Refer to paragraph “MANUFACTURERS’ for controller basis of design specification.
   a. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software.
   b. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.

2. Codes and Standards
   a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
   b. The controller shall meet NFPA 99 and NEC requirements.
   c. The controller shall be UL 508 listed.

3. Applicability
   a. The controller shall be a standard offering in the manufacturer's controller product line.
   b. The controller shall support 12-volt and 24 volt starting systems.
   c. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
   d. The controller shall mount on the generator

4. Hardware Requirements
   a. Control Panel shall include:
      1. The control shall have a run-off/reset-auto three-position selector switch
      2. Emergency Stop Switch. The controller mounted, latch type remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
      3. Five indicating lights (LED):
         a. System Ready - green
         b. Not in Auto - yellow
         c. Programming Mode - yellow
         d. System Warning – yellow
         e. System Shutdown – red
      4. Digital Display. The digital display shall be a vacuum fluorescent display with two lines of alphanumeric, with 2 lines of data and 20 characters. The display shall be viewable in all light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. The 16-button keypad gives the user information access and local programming capability.
      6. For ease of use, an operating guide shall be printed on the
controller faceplate.

7. Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.

8. Lamp Test Button. When this button is depressed, it shall test all controller lamps.

9. Alarm Off. This button will silence the alarm horn when the unit is AUTO.

10. Panel lights shall be supplied as standard.

5. Control Functional Requirements

a. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:

1. Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.

2. Field-programmable time delay engine cool down. Adjustment range 0-10 minutes in 1 second increments.

3. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.

4. The idle function including engine cooldown at idle speed.

5. Real-time clock and calendar for time stamping of events.

6. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds

7. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.

8. Programmable cyclic cranking that provides up to 30 seconds of programmable cyclic cranking and up to 60 seconds rest with up to 6 cycles.

9. The capability to reduce controller current battery draw, for applications where no continuous battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.

10. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.

11. Control logic with RMS digital voltage regulation. The system shall have integral microprocessor based voltage regulator system that provides +/- 0.25% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems. The system shall be prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 20% adjustable of nominal voltage.

12. The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.

13. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
14. Control function shall include output voltage adjustment.
15. Battle switch function selection to override normal fault shutdowns, except emergency stop and over speed shutdowns.
16. The control shall detect the following conditions and display on control panel:
   a. Customer programmed digital auxiliary input ON (any of the 21 inputs available)
   b. Customer programmed analog auxiliary input out of bounds for any of 7 inputs for ECM equipped engines:
   c. Emergency stop
   d. High coolant temperature
   e. High oil temperature
   f. Controller internal fault
   g. Locked rotor - fail to rotate
   h. Low coolant level
   i. Low oil pressure
   j. Master switch error
   k. NFPA common alarm
   l. Overcrank
   m. Overspeed with user-adjustable level, range 60-70 Hz.
   n. Overvoltage with user adjustable level, range 105% to 135%
   o. Overfrequency with user adjustable level, range 102% to 140%
   p. Underfrequency with user adjustable level, range 80% to 90%
   q. Undervoltage with user adjustable level, range 70% to 95%
   r. Coolant temperature signal loss
   s. Oil pressure gauge signal loss
17. Conditions resulting in generator warning (generator will continue to operate):
   a. Battery charger failure
   b. Customer programmed digital auxiliary input on (any of the 21 inputs available)
   c. Customer programmed analog auxiliary input on any of the 7 inputs available on ECM engines
   d. Power system supplying load
   e. Ground fault detected - detection by others
   f. High battery voltage - Level shall be user adjustable. (Range 29-33 volts for 24-volt systems.)
   g. High coolant temperature
   h. Load shed
   i. Loss of AC sensing
   j. Underfrequency
   k. Low battery voltage - level shall be user adjustable (Range 20-25 volts for 24-volt systems.)
   l. Low coolant temperature
   m. Low fuel level or pressure
   n. Low oil pressure
   o. NFPA common alarms
p. Overcurrent
q. Speed sensor fault
r. Weak battery
s. Alternator protection activated

6. Control Monitoring Requirements
   a. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
      1. All monitored functions must be viewable on the control panel display.
      2. The following generator set functions shall be monitored:
         a. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
         b. All single phase and three phase currents, 0.25% accuracy
         c. Output frequency, 0.25% accuracy
         d. Power factor by phase with leading/lagging indication
         e. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
         f. kVARs total and per phase, 0.5% accuracy
         g. kVA total and per phase, 0.5% accuracy
         h. kW hours
         i. A display of percent generator set duty level (actual kW loading divided by the kW rating)
      3. Engine parameters listed below shall be monitored, as available with ECM equipped engines
         a. Coolant temperature both in English and metric units
         b. Oil pressure in English and metric units
         c. Battery voltage
         d. RPM
         e. Lube oil temperature
         f. Lube oil level
         g. Crankcase pressure
         h. Coolant level
         i. Coolant pressure
         j. Fuel pressure
         k. Fuel temperature
         l. Fuel rate
         m. Fuel used during the last run
         n. Ambient temperature
      4. Operational records shall be stored in the control beginning at system startup.
         a. Run time hours
         b. Run time loaded hours
         c. Run time unloaded hours
         d. Number of starts
         e. Factory test date
f. Last run data including date, duration, and whether loaded or unloaded
g. Run time kilowatt hours

5. The following operational records shall be a resettable for maintenance purposes:
   a. Run time hours
   b. Run time loaded hours
   c. Run time unloaded hours
   d. Run time kilowatt hours
   e. Days of operation
   f. Number of starts
   g. Start date after reset

6. The controller shall store the last one hundred generator set system events with date and time of the event.

7. For maintenance and service purposes, the controller shall store and display on demand the following information:
   a. Manufacturer's model and serial number
   b. Battery voltage
   c. Generator set kilowatt rating
   d. Rated current
   e. System voltage
   f. System frequency
   g. Number of phases

7. Inputs and Outputs
   a. Inputs
      1. There shall be 21 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
      2. There shall be 7 user-programmable analog inputs for ECM-equipped engines for monitoring and control.
      3. Each analog input can accept 0-5 volt analog signals
      4. Resolution shall be 1:10,000
      5. Each input shall include range settings for 2 warnings and 2 shutdowns.
      6. All values shall be on the control panel display.
      7. Shall be user-assigned.
   b. Outputs
      1. All NFPA 110 Level 1 outputs shall be available.
      2. Thirty outputs shall be available for interfacing to other equipment
         a. All outputs shall be user-configurable from a list of 25 functions and faults
            b. These outputs shall drive optional dry contacts.
      3. A programmable user-defined common fault output with over 40
selections shall be available.

8. Communications (Modbus protocol)
   a. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
   b. Industry standard Modbus communication shall be provided.
   c. A Modbus master shall monitor and alter parameters, and start or stop a generator.
   d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows 7 or later.
   e. Communications shall be available for serial, CAN, and Ethernet bus networks.
   f. A variety of connections shall be available based on requirements:
      1. A single control connection to a PC.
      2. Multiple controls on an intranet network connected to a PC.
      3. A single control connection to a PC via phone line.
      4. Multiple controls to a PC via phone line.
   g. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
   h. The capability to connect up to 128 controls (any combination of generator sets and transfer switches) on a single network shall be supported.
   i. Cabling shall not be limited to the controller location.
   j. Network shall be self-powered.

9. Communications accessories
   a. Supply a Modbus to Ethernet Converter that provides one RJ45 jack for standard Ethernet 10/100 connection, and a terminal block for RS-485 connection, and is powered by 12 VDC. The Baud rate on the Modbus RTU side shall be selectable 9600 or 19200. The converter shall support Simple Network Management Protocol (SNMP) users to poll or issue trap commands.

10. Remote annunciator panel - The remote annunciator shall meet NFPA 110, Level 1 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Remote annunciator shall also indicate ATS source availability, contactor position, and loaded or unloaded test for up to four transfer switches. The panel shall have the capability to be either flush-mounted or surface-mounted. The annunciator shall meet UL508 requirements.

C. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.

G. Wiring: Provide types and number of conductors required in conduit to provide the functions specified.
A. Comply with NEMA MG 1, "Motors and Generators," and specified performance requirements.

B. Drive: Generator shaft shall be directly connected to the engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: NEMA Class H. Temperature rise of rotor and stator shall be limited to the temperature rise indicated on the generator set schedule.

D. Stator Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at rated capacity.

F. Excitation system shall be brushless, permanent magnet type, and shall derive excitation current from a pilot exciter mounted on the rotor shaft. Exciter shall enable the generator to provide the short circuit current specified hereinafter in paragraph "System Performance."

G. Pitch: Generator pitch shall be as indicated on the engine-generator set schedule.

H. Enclosure: Dripproof.

I. Instrument Transformers: Mounted within generator enclosure.

J. Voltage Regulator: Three phase sensing, digital solid-state-type, environmentally sealed, separate from exciter, providing performance as specified. Provide the following performance, features and accessories:
   1. Adjusting rheostat on control and monitoring panel provides plus or minus 10 percent adjustment of output voltage operating band.
   2. Voltage regulator shall be suitable for use with non-linear and silicon-controlled rectifier (SCR) loads, and shall be designed to maintain voltage control with at least 20% total harmonic current distortion. Provide additional circuitry and filtering as required for the application and to comply with all specifications.

K. Surge Protection: Conform to UL 1449, "Transient Voltage Surge Suppressors." Mount suppressors in generator enclosure and connect to load terminals.

L. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above the dew point.

M. Alternator:
   1. The alternator shall be salient-pole, brushless, pitch as indicated on the generator load schedule, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless
construction controlled by a digital, three phase sensing, solid-state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.

2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.

2.14 S/C - SEISMIC REQUIREMENTS

A. Internal and external supports for components, supports, and fastenings for equipment, piping, and wiring shall be designed to withstand static or anticipated seismic forces, or both, in all directions. The generator set shall be IBC Certified as meeting the required maximum seismic design acceleration level per the International Building Code in effect at the time of issuance of this specification for the specific location of the generator installation site. The generator shall be analyzed or shake tested by a third party, accompanied by a Certificate of Compliance, and include a seismic label on the generator set (per Section 1702 of the IBC Code). Seismic certified generators shall be installed per the specific seismic instructions provided by the manufacturer.

2.15 S - OUTDOOR GENERATOR SET ENCLOSURE

A. Enclosure: Level 1 Sound Attenuated Enclosure.

1. The generator set shall be supplied with a Sound Attenuated Enclosure, providing a sound pressure of 75 dB(A) while the generator is operating at 100% load at 7 meters (23 feet) - free field - using acoustic insulation and acoustic-lined inlet hoods, constructed from high strength, low alloy 14 gauge galvanized steel. The acoustic insulation used shall meet UL 94 HF1 flammability classification. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement. The enclosure shall use external vertical air inlet and outlet hoods with 90 degree angles to discharge air up and reduce noise. The enclosure shall have an integral rodent guard and skid end caps and shall have bracing to meet 241 kph (150 mph) wind loading.

2. The enclosure components and skid shall be cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts. Components shall then be subjected to a zirconium-based conversion coating process to prepare the metal for electrocoat adhesion. All enclosure parts shall receive an 100% epoxy primer electrocoat with high-edge protection. Following the electrocoat process, the parts shall be finish coated with powder baked paint for corrosion-resistance.

3. The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.

4. Enclosures will be finished in the manufacturer's standard color.

5. The enclosures shall allow the generator set to operate at full load in an ambient temperature of 50°C with no additional derating of the electrical output of the generator set.

6. Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set,
an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.

7. Doors shall be fitted with hinges, hardware, and the doors shall be removable.
8. Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.
9. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
10. The complete exhaust system shall be internal to the enclosure.
11. The critical silencer shall be fitted with a tailpipe and rain cap.

B. Space Heater: Provide a space heater where determined necessary by the manufacturer in order to comply with specification requirements for cranking capacity and environmental conditions. If required, provide complete with all required accessories and wiring, including field wiring.

2.16 S - FINISHES

A. Indoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

B. Outdoor Enclosures: Refer to enclosure specifications above.

2.17 S - SOURCE QUALITY CONTROL

A. Factory Tests: Include prototype testing and Project-specific equipment tests (equipment manufactured specifically for this Project).

B. Prototype Testing: Performed on a separate engine generator set using the same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Conform to those required for Level 1 energy converters in paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2 of NFPA 110. In addition, provide the following testing:
   a. Maximum power (kw).
   b. Maximum kilovolt amperes (kva).
   c. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-32.6
   d. Governor speed regulation under steady-state and transient conditions.
   e. Voltage regulation and generator transient response.
   f. Fuel consumption at 1/4, 1/2, 3/4, and full load.
   g. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
   h. Three-phase line-to-line short circuit test.
   i. Alternator cooling air flow.
   j. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
   k. Maximum motor starting (kVA) at 35% instantaneous voltage dip
   l. Endurance testing

2. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype have been acceptably tested to demonstrate compatibility and reliability.
C. Project-Specific Equipment Tests: Test engine generator set and other system components and accessories prior to shipment. Test items individually and assembled and connected as a complete system at the factory in a manner equivalent to that required at the Project site. Record and report test data. Conform to SAE 8528, "Engine Power Test Code-Spark Ignition and Diesel," and the following:

1. Test Equipment: Use instruments calibrated within the previous 12 months and with accuracy directly traceable to the National Institute of Standards and Technology (NIST).

2. Hydrostatic Test: Perform on radiator, heat exchanger, and engine water jacket.


4. Complete System Continuous Operation Test: Includes nonstop operation for a minimum of 4 hours, including at least 1 hour each at 1/4, 1/2, 3/4, and full load. If unit stops during the 4-hour test, repeat the complete test. Record the following minimum data at the start and end of each load run, at 15-minute intervals between those times, and at 15-minute intervals during the balance of the test:
   a. Fuel consumption.
   b. Exhaust temperature.
   c. Jacket water temperature.
   d. Lubricating oil temperature and pressure.
   e. Generator load current and voltage, each phase.
   f. Generator system gross and net output kW.

5. Complete System Performance Tests: Include the following to demonstrate conformance to specified performance requirements:
   b. Transient and steady-state governing.
   c. Transient and steady-state voltage performance.
   d. Safety shutdown devices
   e. Rated Power @ 0.8 PF
   f. Maximum power

6. Observation of Test: Provide 2-week advance notice of tests and opportunity for observation of test by Owner's representatives.

7. Report test results within 10 days of completion of test and issue a certified test record to Owner’s Representative prior to shipment.

2.18 S - WARRANTY

1. Warranty and Service: The generator set shall include a standard warranty covering one (1) year or 2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the
generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

PART 3 - EXECUTION

3.1 C - INSTALLATION

A. Anchor generator set and other system components on concrete bases conforming to specified requirements and as indicated. Provide anchorage according to manufacturer's recommendations.

B. Exhaust Piping Installation: In accordance with manufacturer's recommendations.

C. Maintain minimum working space around components according to manufacturer's recommendations and NEC.

D. Manufacturer's Field Services: Arrange and pay for the services of a factory-authorized service representative to supervise the installing, connecting, testing, and adjusting of the unit.

E. Grounding: Provide grounding of the engine-generator set as indicated or specified. Additional grounding requirements are specified in Section 16310.

3.2 S/C - IDENTIFICATION

A. Identify system components with labeling in accordance with manufacturer recommendations.

3.3 S/C - FIELD QUALITY CONTROL

A. Supervised Adjusting and Pretesting: Under supervision of factory-authorized service representative, Contractor shall pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to Specifications.

B. Tests: Under supervision of factory-authorized service representative, Contractor shall perform the tests listed below according to manufacturer's recommendations upon completion of installation of system. Use instruments bearing records of calibration within the last 12 months, traceable to NIST standards, and adequate for making positive observation of test results. Include the following tests:

1. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.

2. Battery Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

3. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
4. Simulation of malfunctions to verify proper operation of local and remote protective, alarm, and monitoring devices.

5. Load Test: Provide a temporary variable resistive load bank capable of simulating kW of load for which unit is rated. Run unit at 25, 50, and 75 percent of rated capacity for 30 minutes each, and at 100 percent for 3 hours. Record voltage, frequency, load current, battery-charging current, power output, oil pressure, and coolant temperature periodically during the test.


8. Operational Tests: The manufacturer's factory-trained distributor service representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. Set all generator and transfer switch controls in compliance with drawings and specifications. Perform two (2) complete operational tests by simulating loss of commercial power. Verify engine-generator start-up, load transfer, operation, for one-hour minimum, sequencing of loads, and voltage drop. Reapply commercial power, and verify load re-transfer and engine-generator cool down and shut down. The tests shall include but not be limited to:

   a. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
   b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
   c. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
   d. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

C. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

D. Commissioning: The Owner will be retaining the services of an independent commissioning agent to participate in additional commissioning documentation and testing. The Supplier shall provide the services of the manufacturer's factory-trained distributor service representative for two 8 hour days for commissioning testing. The Contractor shall provide the services of licensed electrician for two 8 hour days for commissioning testing. Commissioning testing procedures will be provided to the Supplier and Contractor after review and approval of project submittals.

E. Coordinate testing and training with testing/training of automatic transfer switches and run them concurrently.

3.4 C - CLEANING

PACKAGED ENGINE GENERATOR SYSTEMS – DIESEL

12 April 2017
A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 S/C - DEMONSTRATION

A. Training: Supplier shall provide the services of a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of the system and to train Owner's personnel for a minimum of 8 hours total.

D. Schedule training at Owner’s convenience with at least 14-day advance written notice.

END OF SECTION
PART 1 GENERAL

PART 1 - GENERAL

1.1 S/C - SCOPE

This section provides two automatic transfer switches that include but are not limited to enclosures, switch mechanisms, controls, operator interfaces, and the additional features specified herein.

The automatic transfer switches provided under this specification section will be purchased directly by the Owner from a generator manufacturer’s authorized distributor (“Supplier”) for installation by the construction contractor (“Contractor”) under a separate construction contract providing renovations to an existing facility to construct a new data center facility.

Assignment of specification compliance responsibilities is defined in this specification section by the inclusion of the terms “S” (Supplier) and “C” (Contractor) at the beginning of the specification paragraphs. However, the equipment supplier and construction contractor shall coordinate with each other in completion of the work specified herein to provide a complete and operable system. The term “S/C” indicates contract provisions that apply to both the Supplier and the Contractor.

The automatic transfer switch installation and related work shall conform to the requirements of all applicable specification sections and drawings issued as a part of the overall project construction contract

1.2 S/C - REFERENCE CODES AND STANDARDS

A. The automatic transfer switches shall conform to the requirements of the following codes and standards for the editions currently in effect:

1. UL 1008 - Standard for Transfer Switch Equipment
2. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
3. NFPA 70 - National Electrical Code
4. NFPA 99 - Essential Electrical Systems for Health Care Facilities
5. NFPA 110 - Emergency and Standby Power Systems
8. EN61000-4-4 Fast Transient Immunity Severity Level 4
9. EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
10. IEEE 472 (ANSI C37.90A) Ring Wave Test
11. IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)
12. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

1.3 S/C - SYSTEM DESCRIPTION

A. System includes: Automatic transfer switches. Subsystems and auxiliary components and equipment shall be as indicated or specified. Provide all labor, materials, and equipment to furnish, install, and place in operation the power switching system in accordance with the contract documents and manufacturer's drawings and installation instructions. These specifications also describe requirements for the design, fabrication, and testing of the power switching system.

B. The automatic transfer switches and related work shall be provided as a complete and operable system, in full compliance with all requirements on the drawings and all specifications requirements. The drawings are diagrammatic and the specifications are performance-based, and the contractor shall provide all work required to comply with the drawings and specifications, even if not explicitly indicated or specified. The contractor shall be responsible for coordinating installation of the engine-generator system with all field conditions and the work of other trades. Minimum clearances and work required for compliance with NFPA 70 "National Electrical Code" and the manufacturer’s instructions shall be provided.

C. All equipment shall be new and of current production by an international, power system manufacturer of, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians. The power switching system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line. The power switching system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year. System manufacturer shall maintain a service center capable of providing training, parts, and emergency maintenance and repairs at the Project site with 2 hours maximum response time.

1.4 S/C - SUBMITTALS

A. S - General: Unless specified otherwise, the Supplier shall submit the following documentation with the RFP response to the Owner’s Representative. RFP responses without the specified documentation or missing documentation may be rejected by the Owner’s Representative, at the Owner’s Representative discretion. Submit and obtain approval of all product data, shop drawings, wiring diagrams, protective device studies, coordination drawings, certifications, and compliance certifications prior to release of equipment for fabrication.
B. S - Product data for products specified in this Section. Include data on features, performance, components, and ratings, including KW, KVA, starting KVA, voltage dip, transient reactance, sub transient reactance, and zero-sequence reactance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components. Submit certified total harmonic current distortion ratings for voltage regulators.

C. S - Submit as a part of project closeout documentation O&M operation and maintenance data for system and components for inclusion in Operating and Maintenance Manual specified in Division 1 of the construction contract. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay setting and calibration instructions. Include detailed operating instructions. Cover operation under both normal and abnormal conditions.

D. S - Shop Drawings: Shop drawings or published product data for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances; conductor entry provisions; gutter space; installed features and devices; and materials lists.

E. S - Wiring Diagrams for System: Show power and control connections and distinguish between factory-installed and field-installed wiring.

F. Manufacturer's certificate of compliance to the referenced standards and tested short-circuit closing and withstand ratings applicable to the protective devices and current ratings used in this Project, as indicated and as specified in paragraph "Tested Fault Current Ratings."

G. S - Qualification Data for Manufacturer: Include capabilities and experience data required to demonstrate qualifications specified in Quality Assurance Article. Include list of five completed projects with equipment similar to the system specified herein, with project names and addresses and names of Engineers and Owners, plus other information specified.

H. C Field-Testing Organization Certificates: Signed by Contractor, certifying that the organization complies with the requirements specified in Quality Assurance below.

I. S - After completion of factory testing, submit factory test reports for units to be shipped for this Project showing evidence of compliance with specified requirements.

J. S/C - After completion of field testing, submit field test report as a record of tests specified in Part 3.

K. S/C – Coordination and installation/coordination layout drawings shall be submitted within 30 days of proposal acceptance.

1. The purpose of the submittals specified herein is not only to show compliance with the requirements, but is also for future identification, replacement, duplication, and servicing.

2. The work described in all submittals shall be carefully checked by the contractor and proposed equipment manufacturer for all clearances, including those required for maintenance and servicing, field conditions, maintenance of architectural conditions, and proper coordination. Each submittal shall include a certification by the contractor and
proposed equipment manufacturer that all related conditions have been checked and that no conflict exists. No submittal will be reviewed without such certification.

3. Based on equipment drawings and diagrams provided by the Supplier as a part of project submittals, the Contractor shall prepare complete coordination layout drawings and field wiring diagrams for the generator set equipment, automatic transfer switches, and related equipment. Layout drawings will verify equipment locations, conduit and wiring provisions, and space allocated for maintenance and service. Layout drawings will indicate code-required clearances and manufacturer-recommended clearances around all equipment.

L. S/C - Submittal Submission Schedule:

All drawings, etc., shall be submitted sufficiently in advance of field requirements to allow ample time for checking, and no claim for extension of contract time will be granted to Supplier or Contractor, by reason of his failure in this respect. All submittals shall be complete and shall contain all required and detailed information. Submittals with multiple parts shall be submitted as a complete package.

M. S - Compliance Certification:

Submit a complete copy of this specification section and all other related sections with each paragraph and subparagraph marked with either "compliance," "deviation," or "alternate." Submit copy of drawing equipment schedules and related drawing notes, marked in the same manner as specified above for specification paragraphs. All deviations and alternates to the specifications and drawings shall be fully described in attached documentation as to what the contractor and manufacturer propose to provide. Approval of deviations and will remain within the sole discretion of the Owner's Representative. If proposed deviations or alternates are disapproved, the contractor shall provide equipment and materials in full compliance with the specifications, at no additional cost and without schedule extension.

N. S - Certifications:

Seismic Design and Testing Certificate:: Document compliance with all specification and applicable building code requirements for equipment seismic design and testing.

O. S – Proposed Settings:

As a part of submittals, indicate proposed ATS voltage/frequency/time delay settings in accordance with manufacturer recommendations and indicate where direction is needed from Owner's Representative on selected settings.

1.5 S/C - QUALITY ASSURANCE

A. Manufacturer Qualifications: Refer to requirements specified above in paragraph “System Description”.

B. Field-Testing Organization Qualifications: To qualify for acceptance, a testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct the indicated testing satisfactorily.

C. Comply with NFPA 70, "National Electrical Code."


E. Listing and labeling: Electrical equipment shall be listed and labeled by Underwriter’s Laboratories (UL), or another nationally recognized testing laboratory (NRTL). All equipment, materials, and devices required to comply with referenced UL standards shall bear labeling from the NRTL to verify compliance. Comply with UL Standard 1008, "Automatic Transfer Switches".

The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.


G. Single-Source Responsibility: Obtain engine generator system components from a single manufacturer with responsibility for entire system. Unit shall be a representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

1.6 S/C - DELIVERY, STORAGE, AND HANDLING

Supplier shall deliver automatic transfer switches to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards. Supplier is responsible for transportation of equipment to the project site unloading area designated by the Owner’s Representative. Contractor is responsible for unloading of all equipment and provisions for safe and protected storage at the project site until equipment is installed by the Contractor.

PART 2 PRODUCTS

2.1 S - MANUFACTURERS

A. Subject to compliance with this specification, automatic transfer switches shall be from the same manufacturer of a manufacturer listed below:

1. Kohler – Basis of Design
Alternate manufacturers from which the owner will accept proposals for consideration:
2. Caterpillar
3. Cummins
4. Generac
5. Asco
6. Russelectric

Note: Listing of a manufacturer above does not commit the Owner to accepting any proposals from a manufacturer listed. All proposals must include the submittal data listed in paragraph “Submittals” specified hereinbefore. Substitutions and additional alternate manufacturers shall not be permitted unless authorized by the Owner’s Representative in writing.

2.2 S - SYSTEM SERVICE CONDITIONS

A. Service Conditions: Engine generator system shall operate within the following service conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 4 degrees F to plus 158 degrees F.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: 750 feet above sea level.
4. Installation Location: Refer to automatic transfer switch schedule.

2.2 S - AUTOMATIC TRANSFER SWITCHES (ATS's)

A. General: Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer. Provide two (2) Isolation bypass automatic transfer switches, of which one shall be a standard open transition mechanism, the other shall be a Gen to Gen control configuration and open transition mechanism configuration, as indicated on the automatic transfer switch schedule.

1. Comply with Level 1 equipment according to NFPA 110, "Standard for Emergency and Standby Power Systems."

2. Number of Poles and Current and Voltage Ratings: As indicated on the automatic transfer switch schedule included below in this specification section.

3. Units rated for 400 amps or less shall not have different current ratings for different classes or mixtures of loads, including 100 percent tungsten filament lamp or 100 percent inductive load.

4. Units rated for 600 amperes and larger have current ratings that apply to mixtures of loads including 30-percent-maximum tungsten filament lamp load.

B. Tested Fault-Current Ratings: Closing and withstand ratings shall be as indicated on the automatic transfer switch schedule, and shall be based on testing according to UL Standard 1008, conducted at full-rated system voltage and 20 percent power factor. Rate each product
for withstand duration time as follows when tested for rated short-circuit current correlated with
the actual type of circuit protective device indicated for transfer switches for this Project:

1. Molded-Case Circuit Breakers, 150 Amperes or Smaller: 1.5 closing and withstand
duration cycles.
2. Molded-Case Circuit Breakers, Larger than 150 Amperes: 3 closing and withstand
duration cycles.
4. Current-Limiting Fuses: 0.5 (nominal) closing and withstand duration cycles.

C. Switch Mechanism Construction
1. The transfer switch shall be electrically operated and mechanically held with double throw
construction, and operated by a momentarily energized solenoid-driven mechanism.
2. All transfer switch sizes shall use only one type of main operator for ease of maintenance
and commonality of parts.
3. The switch shall be positively locked and unaffected by momentarily outages, so that
contact pressure is maintained at a constant value and contact temperature rise is
minimized for maximum reliability and operating life.
4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall
have segmented, blow-on construction for high withstand and close-on capability and be
protected by separate arcing contacts.
5. Inspection of all contacts shall be possible from the front of the switch without
disassembly of operating linkages and without disconnection of power conductors.
Switches rated 800 amperes and higher shall have front removable and replaceable
contacts. All stationary and moveable contacts shall be replaceable without removing
power conductors and/or bus bars.
6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof,
which are not intended for continuous duty, repetitive switching or transfer between two
active power sources, shall not be permitted. Overcurrent devices shall not be part of
switch products. Transfer switches constructed with either automatic or non-automatic
circuit breakers shall not be permitted. Transfer switches equipped with protective devices
to interrupt fault currents shall not be permitted.
7. For two and three pole switches, where neutral conductors are to be solidly connected as
shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors
shall be provided.
8. For four pole switches with a switching neutral, where neutral conductors must be
switched as shown on the plans, the contactor shall be provided with fully rated switched
neutral transfer contacts.
9. Overlapping neutral contacts shall be provided where indicated or specified. The
overlapping neutral transfer contacts shall not overlap for time duration greater than 100
milliseconds. A non-overlapping neutral transfer pole shall not be permitted where an
overlapping neutral pole is indicated.

D. Enclosure
1. The ATS shall have a NEMA 1 or NEMA 3R enclosure, as indicated on the automatic
transfer switch schedule.
2. All standard door mounted switches and indicating LEDs shall be integrated into a flush-
mounted, interface membrane or equivalent in the enclosure door for easy viewing &
replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage surge withstand capability requirements when tested according to ANSI C37.90.1, IEEE Guide for Surge Withstand Capability (SWC) Tests. Components shall meet or exceed voltage impulse withstand test of NEMA ICS 1. Provide a Surge Protection Device ( SPD) for protection of the normal source supply. The SPD shall be provided with replaceable cartridges to allow replacement of components without disconnecting the normal source supply. A 90dB audible alarm shall be provided as standard. A terminal block for remote contacts shall be provided. The SPD shall provide L-L, L-N, L-G, and N-G lines protection. LED status indicators shall be available on the face of the device to indicate operational state. The SPD device shall be listed to UL 1449, Edition 3.

H. Factory Wiring: Train and bundle factory wiring and identify consistently with shop drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated terminals accommodate field wiring.

2. Power Terminals Arrangement and Field Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Terminals: Pressure-type, suitable for copper or aluminum conductors of sizes indicated.

4. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

I. Standard I/O Module. The standard I/O Module shall have two programmable inputs and six programmable outputs.

1. Inputs available: 2
   a. Contact Closure
   b. Current 5mA Max.
   c. Connection Type Terminal Strip
   d. Wire Size #14-24 AWG
   e. Max Distance 700 feet

2. Outputs available: 6
   a. Contact Type Form C (SPDT)
   b. Contact Rating 2A @ 30VDC, 500mA @ 125VAC
   c. Connection Type Terminal Strip
   d. Wire Size #14-24

J. External Battery Supply Module. The external battery shall energize the ATS controls using an external battery when no source power is available, allow extended engine start time delays, the use of any combination of accessory modules, connect to one or two batteries, 12 VDC
or 24 VDC, current draw, 140 mA @ 12 VDC, 86 mA @ 24 VDC, shall provide low external battery voltage indication to the transfer switch controller, and reverse-polarity protected.

2.3 S - AUTOMATIC TRANSFER SWITCH FEATURES

E. Test Switch: Simulates normal source failure.

F. Switch-Position Pilot Lights: Indicate source to which the load is connected.

G. Source-Available Indicating Lights: Supervise sources via the transfer switch normal and emergency source-sensing circuits.
   1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

H. Transfer Override Switch: Overrides automatic retransfer control so the ATS will remain connected to the emergency power source regardless of the condition of the normal source. A pilot light indicates the override status.

I. Engine Starting Contacts: One isolated normally closed and 1 isolated normally open. Contacts shall be gold flashed or gold plated and rated 10 amperes at 32 V d.c. minimum.

J. Engine Shutdown Contacts: Time delay adjustable from 0 to 60 minutes; factory set at 5 minutes.

K. Time Delay Bypass Switch: Bypasses time delay functions.

L. Manual Return-To-Normal Switch.

M. Operator: A manual operator, conforming to the applicable provisions of UL 1008, shall be provided to permit manual operation of the ATS under either loaded or no-load conditions.

2.4 S - AUTOMATIC TRANSFER SWITCH CONTROLS

A. Controls
   1. Provide a four line, 20 character LCD display and keypad as an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
      a. Nominal line voltage and frequency
      b. Single or three phase sensing
      c. Operating parameter protection
d. Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

**B Voltage and Frequency**

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities shown as % of nominal unless otherwise specified:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dropout/Trip</th>
<th>Pickup/Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under voltage</td>
<td>75 to 98%</td>
<td>85 to 100%</td>
</tr>
<tr>
<td>Over voltage</td>
<td>106 to 135%</td>
<td>95 to 100% of trip</td>
</tr>
<tr>
<td>Under frequency</td>
<td>95 to 99%</td>
<td>80 to 95%</td>
</tr>
<tr>
<td>Over frequency</td>
<td>01 to 115%</td>
<td>105 to 120%</td>
</tr>
<tr>
<td>Voltage unbalance</td>
<td>5 to 20%</td>
<td>3 to 18%</td>
</tr>
</tbody>
</table>

2. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 70°C.

3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.

4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB. As a part of submittals, indicate proposed settings in accordance with manufacturer recommendations and indicate where direction is needed from Owner’s Representative on selected settings.

5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, only where approved in writing by the Owner’s Representative.

6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.

7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

**C Time Delays**

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.

2. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

3. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect and reconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.

6. All time delays shall be adjustable in 1 second increments.

7. All time delays shall be adjustable by using the display and keypad, with a remote device connected to the communications interface port or USB. As a part of submittals, indicate proposed settings in accordance with manufacturer recommendations and indicate where direction is needed from Owner’s Representative on selected settings.

8. Each time delay shall be identified and a dynamic countdown shall be shown on the display. Active time delays can be viewed with a remote device connected to the communications interface port or USB.

D Generator to Generator Transfer Switch Automatic Transfer Control: Provide where indicated on the automatic transfer switch schedule.

1. Along with standard controls for automatic transfer switch operation; the automatic transfer switch shall be designed for field programming to serve as a dual source generator to generator transfer switch. Programming shall include all necessary control functions to control and monitor the two generator sets as needed for automatic standby mode. Typical operation programming will designate one generator as the primary “lead” unit to respond to an outage signal from the “Utility-Generator” automatic transfer switch. Should the primary generator fail the secondary generator will be started and connected to the switch output terminals. Selection of either generator to be the primary “lead” generator shall be a programmable option. This switch shall include an external battery power supply connection for control power during utility power outages, which shall be extended to each generator’s battery DC system for connection.

2.5 S - AUTOMATIC TRANSFER SWITCH SPECIAL REQUIREMENTS

Refer to Automatic Transfer Switch Schedule on the drawings. Where specified or indicated, provide the features specified below:

A. Bypass-Isolation Switch Mechanism.

B. Open Transition Transfer Switch.

C. Programmed Transition Transfer Switch.

D. Open Transition Transfer Switch.

D. Engine-Generator Exerciser: Solid-state programmable time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiate exercise cycle at preset intervals adjustable from
7 to 30 days. Running periods shall be adjustable from 10 to 120 minutes. Factory-set periods are for 7 days and 20 minutes, respectively. Exerciser features include:

1. Exerciser transfer selector switch, which permits selection between exercise with and without load transfer.
2. Push button programming controls with digital display of settings.
3. Integral battery operation of time switch when normal control power is not available.

E. Auxiliary Automatic Transfer Switch Position Contacts: Quantity as indicated.

E. Auxiliary Bypass - Isolation Switch Position Contacts: Quantity as indicated.

G. Load-Shedding Control Contacts: Quantity as indicated.

H. Fully Rated Solid Neutral.

J. Overlapping Neutral Transfer Contacts.

I. Selective Load Disconnect Control Contacts: Quantity and timing as indicated.

J. Digital Communications Interface.

K. In-Phase Monitor Control: Factory-installed and factory-wired internal in-phase monitor relay. The relay shall control transfer so it occurs when the 2 sources are synchronized in phase. The relay shall compare phase relationship and frequency difference between the normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if the transfer can be completed within 60 electrical degrees. In-phase transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage. In-phase monitor shall limit motor inrush currents to no more than normal starting currents.

L. Timed Transfer Midpoint Position Switch: Operator shall have a programmed neutral position arranged to provide a midpoint between the 2 working switch positions with an intentional, controlled, timed pause during transfer at the midpoint. The midpoint pause is adjustable from 0.5 to 30 seconds minimum, and factory set at 10 seconds, except as indicated otherwise. Time delay shall occur for both transfer directions.

2.6 S - MANUAL TRANSFER SWITCHES (MTS’s)

A. Manual transfer switches shall have same construction and features specified for automatic transfer switches, but without controls and switch operator for automatic operation. MTS’s shall have a manual operation handle.

2.7 S - FINISHES

A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.
2.8 S - SOURCE QUALITY CONTROL

A. Factory test components, assembled switches, and associated equipment to ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for conformance with specified requirements. Perform dielectric strength test conforming to NEMA ICS 1.

2.14 S/C - SEISMIC REQUIREMENTS

A. Internal and external supports for components, supports, and fastenings for equipment, piping, and wiring shall be designed to withstand static or anticipated seismic forces, or both, in all directions. The generator set shall be IBC Certified as meeting the required maximum seismic design acceleration level per the International Building Code in effect at the time of issuance of this specification for the specific location of the generator installation site. The generator shall be analyzed or shake tested by a third party, accompanied by a Certificate of Compliance, and include a seismic label on the generator set (per Section 1702 of the IBC Code). Seismic certified generators shall be installed per the specific seismic instructions provided by the manufacturer.
2.15 S/C – AUTOMATIC TRANSFER SWITCH SCHEDULE

A. Automatic Transfer Switch Schedule: Comply with the ratings and other requirements indicated below.


<table>
<thead>
<tr>
<th>AUTOMATIC TRANSFER SWITCH SCHEDULE</th>
<th>FAULT CURRENT RATING (A)</th>
<th>REMARKS/ACCESSORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESIGN</strong></td>
<td><strong>RATING</strong></td>
<td><strong>NEUTRAL</strong></td>
</tr>
<tr>
<td>ATS &quot;A&quot;</td>
<td>480V, 3PH 4P, 400A</td>
<td>SWITCHED</td>
</tr>
<tr>
<td>ATS &quot;B&quot;</td>
<td>480V, 3PH 4P, 400A</td>
<td>SWITCHED</td>
</tr>
</tbody>
</table>
2.16  S - WARRANTY

1. Warranty and Service: The automatic transfer switches shall include a standard warranty covering one (1) year to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup. The automatic transfer switch manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

PART 3  EXECUTION

3.1  C - INSTALLATION

A. Mounting of Transfer Switches: Level and anchor the unit to the floor or wall as indicated.

B. Annunciator Panel Mounting: Mount flush in wall except as indicated.

C. Identify components according to applicable codes and manufacturer recommendations.

3.2  C - CONNECTIONS

A. Tighten factory-made connections, including connectors, terminals, bus joints, mountings, and grounding. Tighten field-connected connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values. When manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.3  C - GROUNDING

A. Make equipment-grounding connections for transfer switch units as indicated and as required by the NEC.

3.4  S/C - FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise field tests.

B. Preliminary Tests: Perform electrical tests as recommended by the manufacturer and as follows:

1. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester, including external annunciator and control circuits. Use test voltages and procedure recommended by the manufacturer. Meet manufacturer's specified minimum resistance.
2. Check for electrical continuity of circuits and for short circuits.

C. Field Tests: Give 7-day advance notice of the tests and perform tests in presence of owner's representative.

D. Coordinate testing and training with testing/training of generator plant and run them concurrently.

E. Tests: Provide all testing recommended by the manufacturer, and additional testing as follows:
   1. Contact Resistance Test: Measure resistance of power contacts for ATSs. Resolve values in excess of 500 micro-ohms and differences between adjacent poles exceeding 50 percent.
   2. Operational Tests: Demonstrate interlock, sequence, and operational function for each switch at least 3 times.
      a. Simulate power failures of normal source to ATSs and of emergency source with normal source available.
      b. Simulate low phase-to-ground voltage for each phase of normal source of ATSs.
      c. Verify time-delay settings and pick-up and drop-out voltages.

F. Test Failures: Correct deficiencies identified by tests and prepare for retest. Verify that equipment meets the specified requirements.

G. Commissioning: The Owner will be retaining the services of an independent commissioning agent to participate in additional commissioning documentation and testing. The Supplier shall provide the services of the manufacturer's factory-trained distributor service representative for two 8 hour days for commissioning testing. The Contractor shall provide the services of licensed electrician for two 8 hour days for commissioning testing. Commissioning testing procedures will be provided to the Supplier and Contractor after review and approval of project submittals.

H. Reports: Maintain a written record of observations and tests. Report defective materials and workmanship and retest corrected items. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 S/C - DEMONSTRATION

A. Training: Supplier shall provide the services of a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of the system and to train Owner's personnel for a minimum of 8 hours total.

D. Schedule training at Owner’s convenience with at least 14-day advance written notice.

END OF SECTION
'27 Years of Responsive Service'

PRE-BID MEETING MINUTES

To: Attendees

From: Christopher Nordmeyer

Date: May 1, 2017

Project: Tri-County Technical College Pendleton Campus
TCTC New Data Center
OSE Project Number: H59-N944-PD

Project No.: 1643

Meeting Date: April 27, 2017

Location: Tri-County Technical College
Conference Room 101 Physical Plant
Pendleton, South Carolina

The following persons were present:

Richard MacBeth - Tri-County Technical College
Kristal Doherty - Tri-County Technical College
Lee Perkins - Tri-County Technical College
Mike Looper - 1st Class Construction, Inc.
Andy Joines - 1st Class Construction, Inc.
David Belk - The Belk Company, LLC
Chris Welborn - Capital Construction
Jake Fine - Clayton Construction Company, Inc.
Tripp Ross - J. Davis Construction, Inc.
Carl Oger - Mashburn Construction Company, Inc.
Jack Hayes - MSW Electrical Contractors of SC, Inc.
Brent Powell - MSW Electrical Contractors of SC, Inc.
Briggs Dorn - MSW Electrical Contractors of SC, Inc.
David Bullard - THG Construction, Inc.
Jordan Truesdale - Triangle Construction Company, Inc.
Greg Harding - Zorn Company, Inc.
Joe Powell - Williams Plastering, Inc.
Chris Nordmeyer - Design South Professionals, Inc.
**ITEMS OF DISCUSSION**

1. Mr. Macbeth conducted a brief overview of the renovations to take place at the New Data Center. Such renovations include converting a building adjacent to the Physical Plant building into the Pendleton Campus' TCTC New Data Center.

2. Mr. MacBeth noted for the next two weeks, no appointment is needed to walk the site during normal business hours.

3. Following are clarifications on the Drawings:
   a. Drawing C2.2 shows removal of existing gravel as Alternate #2. This is not an Alternate, General Contractor to remove existing gravel.
   b. Drawing C2.2 shows removal of existing propane tank. The propane tank will be removed by Owner before start of work.
   c. Drawing C2.2 shows removal of existing HVAC units. Only one HVAC unit will be removed, the none working one (southern unit).
   d. Drawing C2.3 shows new gravel as Alternate #2. This is not an Alternate, General Contractor shall provide new gravel.

4. Mr. MacBeth noted the final location of the New Generator Pads will be determined once the Generators are purchased by TCTC.

5. The following questions were asked:
   - What is GABC on detail C1/C3.1
     
     *GABC is Graded Aggregate Base Course, SCDOT standard.*
   - What is the time frame between the notice to proceed and the bid date?
     
     *Mr. MacBeth stated that there would be approximately 10 - 14 days between them.*
   - No Asphalt shown on drawing, but specification is included in the project manual.
     
     *Mr. MacBeth stated asphalt was removed from project, so Specification Section 32 12 16.01 Hot-Mix Asphalt Paving is removed from project manual.*
   - Panic hardware shown on the Aluminum Storefront, is it needed?
Panic hardware can be removed from the Aluminum Storefront hardware. Please provide standard storefront push/pull hardware.

- What’s the status of the long lead time equipment provided by Owner?

  Mr. MacBeth stated the request has been sent to the State Engineer with request that the equipment be delivered before July 31st.

- On the Mechanical drawings, the schedule titles do not match the units?

  The title for the Ductless Split System Unit System is incorrect. That schedule should read Existing Unit Schedule.

6. Mr. MacBeth noted that the overhead door is being removed, but the electric drive should be returned to TCTC.

7. Mr. MacBeth noted that the existing ceiling mounted space heater in the IT/Data Center space should be returned to TCTC.

8. Mr. MacBeth noted that the existing lights in the IT/Data Center space should be returned to TCTC.

9. Mr. MacBeth noted that the existing fence with no barbwire will be moved by TCTC.

10. Mr. MacBeth noted the two generators and the transfer switches will be provided by Owner and installed by General Contractor. Commissioning is also the responsibility of the General Contractor. The design specifications of these items will be included in an Addendum.

11. Dates to note:

   a. Construction End date is September 11, 2017. Liquidated damages will be $500.00 per day if not met.

**ADDITIONAL REMARKS**

1. Per SE 310, Invitation for Construction Services, only those bidding documents/plans obtained from Design South Professionals are official.

**CORRECTIONS/ADDITIONS**

If any of the above items are incorrect or fail to record discussions at the meeting, please contact the writer of these minutes as soon as possible.

CLN:psh
# Meeting Sign-In Sheet

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Company</th>
<th>Phone</th>
<th>E-Mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chris Welborn</td>
<td>PM</td>
<td>Capitol Construction</td>
<td>864-419</td>
<td><a href="mailto:cwelborn@capitolconstruction.us">cwelborn@capitolconstruction.us</a></td>
</tr>
<tr>
<td>Jack Hayes</td>
<td>Manager</td>
<td>MSW</td>
<td>864-940-5907</td>
<td><a href="mailto:jhayes@mswelectrical.com">jhayes@mswelectrical.com</a></td>
</tr>
<tr>
<td>Jake Fine</td>
<td>Estimator</td>
<td>Clayton Custom</td>
<td>864-576-1901</td>
<td><a href="mailto:jfine@claytoncustomconstruction.com">jfine@claytoncustomconstruction.com</a></td>
</tr>
<tr>
<td>Carl Green</td>
<td>Pecan Man</td>
<td>Mashburn</td>
<td>864-660-8528</td>
<td><a href="mailto:cgreen@mashburnconstruction.com">cgreen@mashburnconstruction.com</a></td>
</tr>
<tr>
<td>Trip Ross</td>
<td>Estimator</td>
<td>J. Davis</td>
<td>864-912-4929</td>
<td><a href="mailto:tripp@jcolausinc.com">tripp@jcolausinc.com</a></td>
</tr>
<tr>
<td>Jordan Innesdale</td>
<td>P.M.</td>
<td>Triangle Construction</td>
<td>864-533-9643</td>
<td><a href="mailto:jinnesdale@triangleconstruction.com">jinnesdale@triangleconstruction.com</a></td>
</tr>
<tr>
<td>Chris Noromayer</td>
<td>Architect</td>
<td>DSPI</td>
<td>864-229-5177</td>
<td><a href="mailto:chrisn@dsouth.com">chrisn@dsouth.com</a></td>
</tr>
<tr>
<td>Brent Powell</td>
<td>Project Manager</td>
<td>MSW</td>
<td>864-302-4029</td>
<td><a href="mailto:bpowell@mswelectrical.com">bpowell@mswelectrical.com</a></td>
</tr>
<tr>
<td>Greg Hendrix</td>
<td>Owner</td>
<td>Yes</td>
<td>864-533-0759</td>
<td><a href="mailto:rhendix@mswelectrical.com">rhendix@mswelectrical.com</a></td>
</tr>
<tr>
<td>Brage Den</td>
<td>APM</td>
<td>MSW</td>
<td>864-980-1046</td>
<td><a href="mailto:jbrager@mswelectrical.com">jbrager@mswelectrical.com</a></td>
</tr>
<tr>
<td>Joe Powell</td>
<td>Architect</td>
<td>WPI</td>
<td>864-933-5929</td>
<td><a href="mailto:jpowell@mswelectrical.com">jpowell@mswelectrical.com</a></td>
</tr>
<tr>
<td>David Bullard</td>
<td></td>
<td>Thy Construction Inc.</td>
<td>864-517-1100</td>
<td><a href="mailto:dave@thyconstruction.com">dave@thyconstruction.com</a></td>
</tr>
<tr>
<td>David Bell</td>
<td></td>
<td>Belk</td>
<td>933-738</td>
<td><a href="mailto:dbell@belkinc.com">dbell@belkinc.com</a></td>
</tr>
<tr>
<td>Mike Ulmer</td>
<td>PM</td>
<td>1st Class Curtom</td>
<td>224-9448</td>
<td><a href="mailto:MIKEULMER1STCLASS@GMAIL.COM">MIKEULMER1STCLASS@GMAIL.COM</a></td>
</tr>
<tr>
<td>Andy Jones</td>
<td>Estimator</td>
<td>1st Class Curtom</td>
<td>370-903-7</td>
<td><a href="mailto:andyj1stclass@gmail.com">andyj1stclass@gmail.com</a></td>
</tr>
<tr>
<td>Kristal Doleah</td>
<td>Fund Manager</td>
<td>TGC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>