PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Seismic requirements for design, testing, and installation of equipment.

1.02 DESCRIPTION

A. Equipment indicated as necessary to remain operable during and after a seismic event, or specified with a Component Importance Factor 1.5, shall meet the seismic requirements specified in this Contract Specifications Section, including equipment supports (which include raceways, hangers, anchorages, mountings and attachments), except equipment supports that have been fully designed and detailed on the Contract Drawings.

B. The requirements specified herein are in addition to seismic requirements specified elsewhere in these Contract Specifications. Where other Contract Specifications Sections require design or installation conforming to regulatory standards or codes such as California Building Code (CBC), or Sheet Metal and Air Conditioning Contractors National Association (SMACNA) publications, it shall be done using not less than the site-specific seismic parameters specified in Article 1.07A, herein.

1.03 RELATED SECTIONS

A. Section 20 30 13, Vibration Isolation and Seismic Control for Facility Services

B. Section 20 70 26, Common Materials and Methods for Electrical Systems

C. Section 20 72 25, Factory and Field Testing

D. Section 20 80 00, System Integration Testing

E. Section 23 13 23, Above Ground Fuel Storage Tanks

F. Section 26 05 17, Dry-Type Transformers

G. Section 26 05 70, Electrical Cabinets and Enclosures

H. Section 26 12 16, Medium Voltage Transformers

I. Section 26 18 42, Medium Voltage (4.16KV) Metal Clad Switchgear

J. Section 26 18 43, Emergency Generator Switchgear House (SGH)

K. Section 26 24 13, Switchboards

L. Section 26 24 22, Motor Starters and Contactors
M. Section 26 24 24, Circuit Breakers and Panel Boards
N. Section 26 28 15, Low Voltage Disconnect and Transfer Switch
O. Section 26 32 13, Engine Generators
P. Section 26 33 01, DC Battery System
Q. Section 26 34 37, Uninterruptible Power Supply (UPS)
R. Section 27 13 01, Communication Cables and Related Equipment
S. Section 27 60 00, Monitoring and Control System

1.04 MEASUREMENT AND PAYMENT
A. Separate measurement or payment will not be made for work required under this Contract Specifications Section. All costs in connection with the work specified herein will be considered to be included with the related items of work in the Bid Schedule of the Bid Form, or incidental to the Work.

1.05 REFERENCES
A. California Code of Regulations (CCR):
   1. CCR – Title 24, Part 2, California Building Code (CBC)
B. American Society of Civil Engineers (ASCE):
C. American Concrete Institute (ACI):
   1. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
   2. ACI 530 – Building Code Requirements for Masonry Structures.
   1. AC156 – Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components.
E. International Organization for Standardization (ISO):
   1. ISO 17025 – General requirements for the competence of testing and calibration laboratories.
F. Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA):
1.06 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00, Submittal Procedures.

B. Shop Drawings: Submit complete Shop Drawings including anchorage and base plate settings.

C. Test certification from manufacturer that demonstrates component is seismically qualified by shake table testing meeting Section 1.07 specified herein.

D. Special seismic certification test plan(s) for new or additional tests. Test plans for new or additional tests shall be submitted and approved prior to performing the tests. Test plan(s) shall include pre and post seismic-testing functional compliance verification procedures.

E. Test reports of new or additional tests showing conformance with the requirements specified herein, prepared and stamped by a professional Civil or Structural Engineer in the State of California.

F. Supporting data showing equipment is inherently rugged, where allowed herein.

G. Certificates of Compliance for Seismic Certification with the requirements specified herein, sealed by a professional Civil or Structural Engineer registered in the State of California.

H. Structural Calculations: Submit structural design calculations of the equipment support components and their anchorage to demonstrate adequacy of the system under the design loads specified in the CBC and Article 1.07 herein. Calculations shall be prepared and sealed by a professional civil or structural engineer registered in the State of California. The special inspection and test requirement of the equipment support including its anchorage shall be specified in the structural design calculations.

I. Special Inspection Report: Submit special inspections report performed by independent testing agency for equipment seismic qualification inspection and support anchorage installations.

1.07 SEISMIC PERFORMANCE REQUIREMENTS

A. Meet the requirements of ASCE 7 with the following site-specific seismic parameters:

1. Seismic Design Category D, E or F

2. Component Importance Factor, I_p = 1.5

3. Design earthquake spectral response acceleration parameter at short period, S_DS, determined in accordance with ASCE 7.

4. Height Factor Ratio, z/h, determined in accordance with ASCE 7. Where the location of the installed equipment is at or below grade, z/h = 0 may be used. Where the location of the installed equipment is undefined, z/h = 1 shall be used.
B. Meet the Special Certification Requirements for Designated Seismic Systems in ASCE 7, with the following additional requirements:

1. Active or energized equipment shall be certified exclusively on the basis of shake table testing in accordance with AC156, performed by an independent laboratory having accreditation to ISO 17025. Use of experience data is not an acceptable alternative to shake table testing. The following components may be exempted from shake table testing, provided their supports and attachments are shown by calculations to be in accordance with ASCE 7 and CBC using the seismic design parameters specified above:
   
a. Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components).
   
b. Pipes, ducts, conduits, cables, cable trays, and raceways, excluding in-line equipment and components.
   
c. Where it can be shown that the component is inherently rugged by comparison with similar seismically qualified components. Submit shake table test reports of similar equipment or experience data per ASCE 7 Section 13.2.6 to show the equipment is inherently rugged. Support and attachment calculation are still required for rigid component.

2. As required by AC156, the configuration of mounting to the shake-table shall simulate the actual service mounting conditions for the product. The flexibility of the supporting structure in the component to point of anchorage shall be replicated in the test setup; alternatively, the input motions for the test setup may be modified to account for this flexibility using a rational analytical method. See Section 4.5.2 of AC156. If anchorage used for shake table testing differs to field installed anchorage, verify that the shear and tensile capacities of test anchors are less than or equal to actual fasteners to be used for final field installation of component.

3. In accordance with AC156, shake-table tests of representative specimens of a product line may be used in lieu of testing the specific model of equipment to be used in service. A minimum of two representative equipment/components shall be tested for a product line with similar structural configuration, provided the mounting configurations simulate the actual service mounting conditions for the product. If the smallest/lightest and largest/heaviest representative equipment/components are selected for testing, it shall be shown that these provide the least seismic capacity when compared to other options that are available within the product line being qualified. See Section 4.5 of AC156 for further requirements for qualifying equipment product lines.

4. Functionality testing: The equipment shall be functionally tested pre- and post-seismic testing, to demonstrate that the essential operational and control features of the equipment needed for post-earthquake functionality are maintained. The essential operational and control features of the equipment shall be identified in advance of the shake-table testing, including the functionality testing methods and functionality acceptance criteria.
5. The shake table test input shall be based on the following parameters as defined in AC 156:
   a. $A_{FLX-H} = S_{DS}$
   b. $A_{RIG-H} = 0.4 \ S_{DS}$
   c. $A_{FLX-V} = 0.67 \ S_{DS}$
   d. $A_{RIG-V} = 0.27 \ S_{DS}$

C. Notify Engineer at least 4 weeks advance-notice of shake table test date for the observation of test setup and testing.

PART 2 – PRODUCTS

2.01 CONCRETE ANCHORS

A. Concrete anchors for equipment supports that are designed or specified by the Contractor or its Suppliers shall have a current and valid evaluation report from the International Code Council Evaluation Service (ICC-ES) and be suitable for seismic conditions and cracked concrete. Anchors susceptible to vibration environment shall not be used for anchorage of equipment that generates vibration, such as fans and generators.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

A. The following special inspections related to the seismic qualification of equipment, and installation thereof, shall be performed by the Contractor’s independent testing agency:

1. Verify the test instrument calibration data and date.

2. Verify that the label and anchorage or mounting conforms to the certificate of compliance.

3. Perform inspection and testing of the anchorage of mechanical and electrical equipment, in accordance with the applicable ICC-ES or Evaluation Report or certification of compliance and requirement specified on the Contract for each type of anchor.

4. Verify that the seismically certified equipment is mounted and attached in the same manner and configuration that is was used to test and certify in lab.
5. Label seismically certified equipment. Label shall list certifying agency, performance criteria of equipment (i.e., the seismic capacity of equipment), report number or certificate of compliance used by agency to certify equipment, manufacturers name, and equipment model.

END OF SECTION 20 30 14