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USACE / NAVFAC / AFCEC / NASA **UFGS-33 77 19.00 40 (August 2016)**

Preparing Activity: NASA **Superseding UFGS-33 77 19.00 40 (August 2013)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2021
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DIVISION 33 - UTILITIES

SECTION 33 77 19.00 40

MEDIUM-VOLTAGE SWITCH

08/16

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SECTION 33 77 19.00 40

MEDIUM-VOLTAGE SWITCH
08/16

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NOTE: This guide specification covers the requirements for the requirements for 5k through 38 kV, 600A load-break sulphur hexafluoride (SF6) gas and solid dielectricswitches. Refer to 26 13 01 PAD-MOUNTED DEAD-FRONT AIR INSULATED SWITCHGEAR if air-insulated switches are to be used. On drawings, indicate subsurface, vault, pad-mount, indoor, metal-enclosed, or pole mounted type; the number of switched ways; separable connections; and single-side, double-side, floor, wall, ceiling, or other type installation.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

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NOTE: If Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES, and Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES are not included in the project specification, insert applicable requirements therefrom and delete the following paragraph.
****

Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES, and Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES apply to work specified in this section.

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text are automatically deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System
ASTM D2472	(2000; R 2014) Standard Specification for Sulphur Hexafluoride

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE 592	(2018) Standard for Insulation Shields on Medium-Voltage (15 kV - 35 kV) Cable Joints and Separable Connectors
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

IEEE C37.74	(2014) Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 70B	(2019) Recommended Practice for Electrical Equipment Maintenance

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes

following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Assembly Drawings; G[, [____]]

SD-03 Product Data

Medium Voltage Switches; G[, [____]]

SD-06 Test Reports

Factory Test Report; G[, [____]]

Acceptance Test Report; G[, [____]]

SD-10 Operation and Maintenance Data

Medium Voltage Switches

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and

materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

Ensure products manufactured more than 3 years prior to date of delivery to site not be used, unless specified otherwise.

1.3.3 Delivery, Storage, and Handling

Handle and store medium voltage switches in accordance with manufacturer's recommendations. Ensure switches are shipped preassembled from the manufacturer.

1.3.4 Predictive Testing and Inspection Technology Requirements

****
NOTE: The Predictive Testing and Inspection (PT&I) tests prescribed in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS are MANDATORY for all NASA assets and systems identified as Critical, Configured, or Mission Essential. If the system is non-critical, non-configured, and not mission essential, use sound engineering discretion to assess the value of adding these additional test and acceptance requirements. See Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS for additional information regarding cost feasibility of PT&I.
****

This section contains systems and equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems have been installed properly and contain no identifiable defects that shorten the design life of a system and its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 EQUIPMENT

Provide [manually][automatically] operated, load-interrupting type medium voltage switches for use on a 3-phase, [3][4]-wire system and with ratings as follows:

****
NOTE: Ratings shown below are typical minimums manufacturer minimums. Refer to basis of design manufacturer's product data for the system being designed when selecting switch and ratings.
****

a. [15][ ] kV Maximum Design Voltage

b. [110][ ] kV Basic Impulse Level (BIL)

c. [600][ ] A Minimum Continuous Current

d. [600][ ] A Minimum Load Break Current

e. [12.5][ ] kA Symmetrical Fault Interrupter Rating

f. [20][ ] kA Asymmetrical Fault Interrupter Rating

Submit product data for medium voltage switches including manufacturer's assembly drawings detailing switch construction, configuration, and mounting and installation.

Provide switches with suitable attachments to permit closing and opening under full rated load current, without damage. Ensure switches are equipped with a visible break option that allows direct viewing or indication of the switch contacts in the open and closed positions.

****
NOTE: Coordinate cable termination requirements of medium voltage switches with 26 05 13.00 40 MEDIUM-VOLTAGE CABLES.
****

Provide cable and cable terminations in accordance with Section 26 05 13.00 40 MEDIUM-VOLTAGE CABLES. Equip switches with [600][200] ampere bushing wells and bushing well inserts to accept load break elbows, as indicated.

Provide fittings, lifting eyes, insulators, and other required accessories with the switch as necessary for transportation and installation of the equipment.

Provide all corrosion-resistant metal operating parts of switch assemblies.

2.1.1 Solid Dielectric Switches

Provide [indoor][outdoor] rated switch with switched and protected ways as indicated and rated for the required continuous load and interrupting current. Ensure switch is designed for [front[and]][rear] access to operators, bushings, and terminations. Provide switch enclosures constructed in accordance with [IEEE C57.12.28][IEEE C57.12.29] equipped with ground bus capable of carrying the rated fault current for one second for each way. Ensure enclosure is equipped with hinged access doors equipped with penta head locking bolts and provisions for padlocking.

Provide switch of dead-front design with stainless steel operating mechanism housing equipped with a viewing window for verification of vacuum interrupter contact position with indicator position labeling visible from viewing window. Ensure each switched way is equipped with a two position switch for "Open" position, "Closed" position, and has provisions for grounding.

Provide solid dielectric modules coated with a semi-conductive layer of epoxy tested to IEEE 592. Ensure modules are fully sealed and tested to to prevent ingress of moisture and designed to interrupt all load and

fault currents within the vacuum bottle. Provide fault interrupter assembly consisting of switch mechanism consisting of three individual vacuum bottle assemblies mechanically linked to a single spring-assisted operating mechanism. Ensure manual opening and closing of each way is via an operating handle.

Provide stainless steel three line diagram and nameplates installed on switch. Ensure nameplates indicate the manufacturer's name, catalog number, model number, date of manufacture, and serial number.

2.1.2 Sulfur Hexafluoride (SF6) Switches

Provide [indoor][outdoor] rated switch with switched and protected ways as indicated and rated for the required continuous load and interrupting current. Ensure switch is designed for [front[and]][rear] access to operators, bushings, and terminations. Provide switch enclosures constructed in accordance with [IEEE C57.12.28][IEEE C57.12.29] equipped with ground bus capable of carrying the rated fault current for one second for each way. Ensure enclosure is equipped with hinged access doors equipped with penta head locking bolts and provisions for padlocking.

Provide switch with contacts and cable entrance terminations contained in a single welded, [mild steel][304 stainless steel] tank. Ensure switch is factory filled with SF6 gas conforming to ASTM D2472 to a nominal 69 kpa 10 psig positive pressure at 24 degrees C 75 degrees F. Paint switch tank using a corrosion resistant-epoxy paint. Ensure switch is equipped with [temperature compensated] SF6 gas pressure gauge and fill valve.[Equip switch with low pressure warning device and dry contact for remote notification if SF6 pressure falls below manufacturer recommended levels.]

Provide switch of dead-front design with stainless steel operating mechanism housing equipped with a viewing window for verification of vacuum interrupter contact position with indicator position labeling visible from viewing window. Ensure each switched way is equipped with a two position switch for "Open" position, "Closed" position, and has provisions for grounding.

Provide solid dielectric modules coated with a semi-conductive layer of epoxy tested to IEEE 592. Ensure modules are fully sealed and tested to to prevent ingress of moisture and designed to interrupt all load and fault currents within the vacuum bottle. Provide fault interrupter assembly consisting of switch mechanism consisting of three individual vacuum bottle assemblies mechanically linked to a single spring-assisted operating mechanism. Ensure manual opening and closing of each way is via an operating handle.

Provide stainless steel three line diagram and nameplates installed on switch. Ensure nameplates indicate the manufacturer's name, catalog number, model number, date of manufacture, and serial number.

Provide provisions for padlocking each handle in any position.

2.2 COMPONENTS

Provide fuses located in a separate compartment on the outgoing feeders as indicated and per Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES and Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

****

NOTE: Space heaters are seldom required with SF6 and solid dielectric switches. Choose the following paragraphs only when metal enclosed switch/fuse modules are used and where moisture could condense on components in air-filled compartments.

Wattage supplied by heaters is 1/4 of the heater nameplate rating when 240-volt heaters are operated at 120 volts.

****

2.2.1 Factory Finish

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NOTE: For all outdoor applications and all indoor applications in a harsh environment refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS or IEEE C57.12.29. High performance coatings are specified for all outdoor applications because ultraviolet radiation breaks down most standard coatings, causing a phenomena known as chalking, which is the first stage of the corrosion process. For additional information contact The Coatings Industry Alliance, specific suppliers such as Keeler and Long and PPG, and NACE International (NACE).

****

Provide switches with the manufacturer's standard paint finish when used for most indoor installations.

For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to [Section 09 96 00 HIGH-PERFORMANCE COATINGS][09 90 00 PAINTS AND COATINGS].

Paint [switchgear tank and support frame][enclosure including base] ASTM D1535 Munsell 7GY3.29/1.5 green. Comply with [IEEE C57.12.28][IEEE C57.12.29] for the paint coating system regardless of equipment material.

2.2.2 Pad-Mounting Provisions

****

NOTE: Choose the following paragraphs when pad-mounted switches are used. Subsurface switches do not require frames since they mount directly to the floor, walls, or ceiling.

****

Provide mounting frames that are of angle-iron construction, for all [pad] [_____] -mounted switches and are hot-dipped galvanized after fabrication in accordance with [ASTM A123/A123M] [ASTM A153/A153M].

2.2.3 Cable Entrances

Provide cable entrances tested to IEEE 386 and be minimum [15][ ] kV, [110][ ] kV BIL, [600][200] A [dead][load] break apparatus bushings.

2.2.4 Space Heaters

Permanently mark connection diagrams for heater connections on detail drawings and shipping covers.

Equip ventilated cable termination compartment and the fuse compartment on outdoor switches with externally energized space heaters to provide approximately [40] [_____] watts/square meter [4] [_____] watts/square foot of outer surface area. Provide heaters that have a power density that does not exceed [4] [_____] watts per 645 square millimeter [4] [_____] watts per square inch of heater element surface. Provide heaters that are rated at [240] [_____] volts for connection at [120] [_____] volts. Locate heaters at the lowest portion of each space to be heated. Cover terminals. Use thermostats to regulate the temperature.

Provide installed and operable heaters at the time of shipment so that the heaters can be operated immediately on arrival at the site, during storage, or before installation. Mark connection locations prominently on drawings and shipping covers with temporary leads for storage operation easily accessible without removal of shipping protection.

[2.2.5 Interrupter Control

Provide an electronic control to monitor load and fault current on all three phases of the interrupter. Ensure the current transformers are encapsulated within the [solid dielectric modules][switch tank] to provide control power and current sensing. Ensure no external power source is required for overcurrent protection.

Ensure the controller provides multiple Time Current Characteristic (TCC) curves and all settings may be inputted via the controller's display or via a computer. Ensure the controller allows for multiple TCC curve modification options, including Instantaneous Trip, Inrush Restraint, Phase Time Delay and a Phase Imbalance (Ground Fault) setting.[Provide a controller that includes a Sequence of Events Recorder (SER) which records the last 16 causes of trip.]

Mount controller in a separate NEMA 4X, stainless steel junction box.[Provide 2, Form C (Single Pole, Double Throw) auxiliary contacts on all ways wired to separate terminal strips in controller junction box].

Provide manufacturer's programming kit for controller.

]2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Factory Test Report

Submit factory test report which include results of design and production tests performed according to IEEE C37.74 to ensure that design performance is maintained in production. Tests are to include but are not limited to:

a. Mechanical operation check.

b. AC hi-potential tested one minute phase-to-phase, phase-to-ground and across the open contacts.

c. Circuit resistance testing.

d. Leak test to insure the integrity of all seals and gaskets[

e. Primary current injection test to test CTs, trip mechanism, and electronic control.][

f. X-ray inspection and a partial discharge test of solid dielectric modules to ensure void-free construction.][

g. SF6 leak tests to ensure that the completed switch assembly has a leak rate less than 0.0000001 cubic centimeters per second by a helium mass spectrometer test.]

PART 3 EXECUTION

3.1 INSTALLATION

Install switches in accordance with the manufacturer's instructions. Include in the installation all necessary hardware, insulators, and connections to line wire or bus. Ensure installation is in accordance with IEEE C2 and NFPA 70.

3.1.1 Grounding

Solidly bond tanks, mounting frames, and operating mechanisms to the station ground counterpoise in accordance with IEEE C37.74 and Section 26 05 26.00 40GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

Identify incoming line position with a warning tag that states "CAUTION: INCOMING LINE, DO NOT GROUND."

3.2 FIELD QUALITY CONTROL

3.2.1 Acceptance Testing

****
NOTE: If the specified system is identified as critical, configured, or mission essential, use Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS to establish predictive and acceptance testing criteria, above and beyond that listed below.
****

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Perform acceptance testing in accordance with the manufacturer's recommendations, NFPA 70B, and NETA ATS. Submit acceptance test report documenting result

[3.2.2 Coordination

Program settings into medium voltage switch controllers in accordance with the final, Government approved coordination study.

]3.3 CLOSEOUT ACTIVITIES

Submit operation and maintenance manuals for medium voltage switches.

-- End of Section --