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USACE / NAVFAC / AFCEC / NASA **UFGS-26 13 00.00 20 (August 2011)**

Preparing Activity: NAVFAC **Superseding UFGS-26 13 00.00 20 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2014
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DIVISION 26 - ELECTRICAL

SECTION 26 13 00.00 20

SF6/HIGH-FIREPOINT FLUIDS INSULATED PAD-MOUNTED SWITCHGEAR

08/11

-- End of Section Table of Contents --

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SECTION 26 13 00.00 20

SF6/HIGH-FIREPOINT FLUIDS INSULATED PAD-MOUNTED SWITCHGEAR
08/11

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NOTE: This guide specification covers the requirements for SF6 or high-firepoint biodegradable fluid insulated, dead-front, enclosed and non-enclosed, pad-mounted switchgear with load and fault interrupting switched ways, with maximum ratings of 600 amperes and 38 kV, 60 Hz.

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 items(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).
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NOTE: This guide specification can be used for subsurface (vault) applications with appropriate modifications.

Use the following related guide specifications for power distribution equipment:

--Section 26 08 00 APPARATUS INSPECTION AND TESTING
--Section 26 11 16 SECONDARY UNIT SUBSTATIONS
--Section 26 11 13.00 20 PRIMARY UNIT SUBSTATION
--Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS
--Section 26 12 21 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS
--Section 33 71 01 OVERHEAD TRANSMISSION AND

DISTRIBUTION
--Section 33 71 02 UNDERGROUND ELECTRICAL
DISTRIBUTION

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NOTE: The following information shall be indicated on the project drawings:

1. Site Plan showing location, space available, and desired arrangement of switchgear.

2. Single-line diagram showing: nominal system voltage; number and configuration of switched ways; type, number, and size of conductors for each circuit; and method of power cable termination (600 ampere deadbreak connectors). Individually identify each switched way as load or fault interrupter and single-pole or three-pole tripping.

3. Grounding Detail with ground rods, ground loop and interconnecting cables when interconnecting with other grounding systems or if multiple switches are provided.

4. Special conditions, such as altitude, temperature and humidity, exposure to fumes, vapors, dust, and gases.
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PART 1 GENERAL

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 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 will automatically be 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 A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D1535	(2013) Specifying Color by the Munsell System
ASTM D2472	(2000; R 2006) Standard Specification for Sulphur Hexafluoride
ASTM D6871	(2003; R 2008) Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013) National Electrical Safety Code
IEEE C37.60	(2012) Standard Requirements for Overhead, Pad Mounted, Dry Vault and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems Up to 38 kV
IEEE C37.74	(2003; Int 1 2004) 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	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60265-1	(1998; Corrigendum 2000) High Voltage Switches - Part 1: Switches for Rated

Voltages Above 1 kV and Less Than 52 kV

IEC 61099	(2010; ED 2.0) Insulating Liquids - Specifications for Unused Synthetic Organic Esters for Electrical Purposes
IEC 62271-111	(2012; ED 2.0) High Voltage Switchgear And Controlgear - Part 111: Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems up to 38 kV

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code
NFPA 70B	(2013) Recommended Practice for Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

****

NOTE: Include Section 26 08 00 APPARATUS INSPECTION AND TESTING on all projects involving medium voltage and specialized power distribution equipment.

****

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS and Section 26 08 00 APPARATUS INSPECTION AND TESTING, apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Switched Way

A switched way is considered a three-phase circuit entrance to the bus through a switch. For single-phase switches, it is a single-phase entrance to the bus through a switch.

1.4 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings[; G][; G, [_____]]

SD-03 Product Data

****

NOTE: Include the following paragraph when the switchgear will have fault interrupting switched ways.

****

[Electronic Overcurrent Control Curves[; G][; G, [_____]]]

SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear[; G][; G, [_____]]

Insulated High-Voltage Connectors[; G][; G, [_____]]

Surge Arresters[; G][; G, [_____]]

Each submittal shall include data on switches and associated accessories. Each submittal shall include manufacturer's information for each component, device and accessory provided with the equipment.

SD-06 Test Reports

Acceptance Checks and Tests[; G][; G, [_____]]

SD-07 Certificates

Paint Coating System[; G][; G, [_____]]

SD-09 Manufacturer's Field Reports

Switchgear design and production tests[; G][; G, [_____]]

SD-10 Operation and Maintenance Data

SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear Operation and Maintenance, Data Package 5[; G][; G, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Switchgear Drawings

Furnish drawings that include, but are not limited to, the following:

a. Overall dimensions, weights, plan view, and front view

b. Ratings

c. Single-line diagram.

1.5.2 Paint Coating System

****
NOTE: Select IEEE C57.12.29 when specifying stainless steel enclosures.
****

Submit [IEEE C57.12.28][IEEE C57.12.29] paint coating system performance requirement tests.

1.5.3 [Electronic Overcurrent Control Curves

Provide time-current characteristic curves (in electronic format suitable for import into computer programs EasyPower and SKM PowerTools for Windows) and instruction manuals for the electronic overcurrent control.

]1.6 MAINTENANCE

1.6.1 SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 SF6/HIGH-FIREPOINT FLUID INSULATED PAD-MOUNTED SWITCHGEAR

****
NOTE: Add reference to IEC 60265-1 for projects located in Europe only after verifying that at least three manufacturers of this switchgear comply with this standard.

****

IEEE C37.74[, IEC 60265-1]

2.1.1 Ratings and Test Requirements

The voltage rating of the switchgear shall be [15.5 kV][27 kV][38 kV][as indicated]. The corresponding ratings associated with the required switchgear voltage rating shall be as follows:

****

NOTE: The following optional ratings are available for switchgear assemblies, however, specifying these will require proprietary justification.

1. Optional short-time and short-circuit interrupting current ratings of 16,000, 20,000 and 25,000 rms symmetrical amperes is available.

2. For Norfolk Naval Shipyard projects, select optional 25,000 rms symmetrical amperes short-time and short-circuit interrupting current ratings for switchgear assemblies that are to be installed on the 11.5 kV system.

****

Rated Maximum Voltage, kV	[15.5][27][38]
Rated Withstand Impulse Voltage, kV BIL	[95][125][150]
Continuous and Load Interrupting Current, A	[600][600][600]
Short-Time Current, kA rms Sym	[[12.5][16][20][25]] [[12.5][16][20][25]] [[12.5][16][20][25]]
[Short-Circuit interrupting Current,kA rms Sym	[[12.5][16][20][25]] [[12.5][16][20][25]] [[12.5][16][20][25]]]

2.1.2 Switchgear Construction

Switch contacts and cable entrance terminations shall be contained in a sealed, dielectric-filled stainless steel tank. Switchgear shall be shipped factory filled with appropriate levels of SF6 gas conforming to ASTM D2472 or less-flammable, high-firepoint biodegradable fluid conforming to ASTM D6871 and IEC 61099. Switchgear shall be configured with[load interrupting][and][fault interrupting] switched ways as indicated. Switchgear shall have front accessible terminations suitable for cables entering from below with the manual operating provisions either mounted on the rear or capable of hookstick operation. Switch contact positions for switched ways shall be visible through viewing windows in the switchgear tank located adjacent to the manual operating provisions. Provide internal gas pressure gage or fluid level gage in viewable location from switch operating handle. Each switched way shall have three position switch; Open, Closed, Ground and provisions for grounding.

2.1.2.1 Pad-mounting Provisions

****
NOTE: Choose stainless steel enclosure where environmental conditions are not suitable for mild steel or where a higher level of corrosion protection is desired. Select IEEE C57.12.29 when enclosure is required to be stainless steel.
****

Provide [non-]enclosed switchgear suitable for installation on a concrete pad. Switchgear[support frame][enclosure base][enclosure] shall be fabricated of ASTM A167 type 304 or 304L stainless steel.[Enclosure base shall include any part of the switchgear enclosure that is within 75 mm 3 inches of concrete pad.] Paint [switchgear tank and support frame][enclosure including base] ASTM D1535 Munsell 7GY3.29/1.5 green. Paint coating system shall comply with [IEEE C57.12.28][IEEE C57.12.29] regardless of equipment material.

[2.1.3 Load Interrupting Switched Ways

Load interrupter switched ways shall provide[single-pole][three-pole group operated] switching[as indicated].

][2.1.4 Fault Interrupting Switched Ways

IEEE C37.60, IEC 62271-111. Provide non-fused, non-reclosing, manual reset, vacuum interrupters consisting of vacuum interrupter and a spring assisted operating mechanism. Each fault interrupting switched way shall utilize internally mounted current transformers and an electronic overcurrent control to provide[single-pole][three-pole ganged] tripping[as indicated] for single-phase[and three-phase] faults. The electronic overcurrent control shall have provisions for a wide variety of field changeable time-current characteristic curves with ten field changeable trip levels through a current range of0-600 amperes.[The electronic overcurrent control shall have an EIA-RS-485 communications port that supports Modbus and DNP 3.0 Level 2 protocals.] [Fault interrupting switched ways shall have provisions for remote tripping via an external dry contact device[as indicated]. Remote trip control power shall be [120 Vac][48 Vdc].]

][2.1.5 Automatic Switch Controls

Provide an automatic switch control system to execute Manual, Automatic Source-Transfer, and SCADA operation of the load interrupting switch ways. The automatic switch control shall accept 120 Vac control power and shall be powered from an integral battery-charger DC supply system. Switch way operation shall be via motor operators and associated motor operator controllers. The motor operator controllers shall have "Close," "Open," and "Ground" pushbuttons for manual operation. The Source-Transfer controls shall effect opening of an incoming switch way where voltage is lost and close the other incoming switch way if voltage is present. The Source-Transfer controls shall include an overcurrent-lockout feature that prevents automatic closing of a switch way into a system fault. The automatic switch control system shall execute remote commands received from a SCADA master station and transmit switchgear operation information to a SCADA master station via DNP 3.0 communications. Execution of remote commands shall include enabling of the Source-Transfer controls and

transfer of switch ways to "Close," "Open," and "Ground" positions. Transmission of switchgear information shall include switch way positions, voltage and current readings, and DC supply system status. The control shall have communication port provisions for connection to a multi-mode serial fiber link.

][2.1.6 Low Voltage Test Pins

Load interrupting switch ways shall have internal load side voltage sensors and external test pins that allow for low voltage checks to confirm energized and in-phase conditions using a standard high-impedance voltmeter.

][2.1.7 Key Interlock

****
NOTE: Add requirements for key interlock if needed. Provide details of interlock system on the drawings.
****

Provide key interlock system as indicated on the drawings.

]2.1.8 Dead-Front High-Voltage Bushings

IEEE 386. [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Provide 600 ampere one-piece deadbreak apparatus bushingsfor each switched way.

****
NOTE: Include standoff bushings only when the Activity requires the additional items.
****

[a. Parking stands: Provide a parking stand near each dead-front bushing.[Provide insulated standoff bushings for parking of energized load-break connectors on each parking stands.]

]2.2 Insulated High-Voltage Connectors

IEEE 386. Provide corresponding connector for each switched way. Connectors shall have a grounding eye and test point.

****
NOTE: For NAVFAC projects, provide 200 ampere bushing interface on all 600 ampere connectors.
****

a. 600 Ampere deadbreak connector ratings: Voltage: [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Short time rating: 25,000 rms symmetrical amperes.[Connectors shall have 200 ampere bushing interface[for surge arresters][as indicated].]

****
NOTE: Include the following paragraph only when the activity requires additional grounding elbows and feed-thru inserts.
****

[b. Provide[[one][_____] set[s] of three grounding elbows][and][[one][_____] set[s] of three feed-thru inserts]. [Grounding elbows][and][feed-thru inserts] shall be delivered to the Contracting Officer.

][2.3 Surge Arresters

IEEE C62.11, rated[[3][6][9][10][12][15][_____] kV][as indicated], fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide arresters on switched ways as indicated.

][2.4 SF6 Refill Cylinders

****
NOTE: Include the following paragraph only when the activity requires additional SF6 refill cylinders.
****

Provide [two][_____] SF6 refill cylinders, minimum size of 6 pounds of SF6; include regulator, valves, and hose for connection to the fill valve of the switch.

]2.5 SOURCE QUALITY CONTROL

2.5.1 Switchgear Design and Production Tests

****
NOTE: Include IEEE C37.60 and IEC 62271-111 when the switchgear will have fault interrupting switched ways.
****

****
NOTE: Add reference to IEC 60265-1 and IEC 62271-111 for projects located in Europe only after verifying that at least three manufacturers of this switchgear comply with this standard.
****

Furnish reports which include results of design and production tests performed according to IEEE C37.74[, IEC 60265-1][and IEC 62271-111 or IEEE C37.60]. Production tests shall be performed by the manufacturer on each switchgear assembly to ensure that design performance is maintained in production.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

****
NOTE: Where rock or other soil conditions prevent obtaining a specified ground value, other methods of grounding should be specified. Where it is impractical to obtain indicated ground resistance

values, the designer should make every effort, within reason, to obtain ground resistance values as near as possible to the indicated values.
****

NFPA 70 and IEEE C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms. When work, in addition to that indicated or specified, is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section [33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION][_____][at each corner of switchgear pad][as indicated].

3.2.2 Switchgear Grounding

Connect #4/0 bare copper conductor ground loop, not less than 610 mm 24 inches below grade, to the upper end of the ground rods by exothermic welds or compression connectors. Provide #4/0 bare copper conductors connecting the switchgear grounding provisions to two different ground rods.

3.2.3 Connections

Make joints in grounding conductors and ground loop by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in [Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION][_____].

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount switch on concrete slab. Slab shall be at least 300 mm 12 inches thick, reinforced with a 152 by 152 - MW19 by MW19 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 100 mm 4 inches from the top of the slab. Slab shall be placed on a 150 mm 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 100 mm 4 inches above finished grade. Edges above grade shall have 15 mm 1/2 inch chamfer. Slab shall be of adequate size to project at least 200 mm 8 inches beyond equipment.

Stub up conduits, with bushings, 50 mm 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with switch cable training areas. Concrete work shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.4 FIELD QUALITY CONTROL

3.4.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS and referenced ANSI standards.

Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 Switchgear

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Check for proper anchorage, alignment, required area clearances, and grounding.

(4) Perform mechanical operator tests in accordance with manufacturer's instructions.

(5) Verify that insulating SF6 gas pressure or dielectric fluid level is correct.

(6) Inspect all indicating devices for proper operation.

****
NOTE: Include the following option when key interlocking is specified.
****

[(7) Test interlock systems for proper operation and sequencing.

] b. Electrical Tests

(1) Perform contact-resistance tests.

[(2) Trip fault interrupters by operation of overcurrent control[and remote trip].

] (3) Perform insulation-resistance tests.

(4) Perform an over-potential test on each switched way pole with the switched way in the open position in accordance with the manufacturer's instructions.

[(5) Set fault interrupter overcurrent control in accordance with government provided settings. Request settings from government, in writing, a minimum of 30 days prior to scheduling electrical tests.

]3.4.1.2 Grounding System

a. Visual and Mechanical Inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements

in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.4.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that devices are in good operating condition and properly performing the intended function. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times for checks and tests.

-- End of Section --