



Group Instruction for Supply

GIS 12-102

Low Voltage Metal Enclosed Switchgear (IEEE
C37.20.1)

REVISION FOR REVIEW

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Foreword

This is a revised issue of Engineering Technical Practice (ETP) GIS 12-102. This Group Instruction for Supply (GIS) reflects experience gained in implementing low voltage metal enclosed switchgear since the publication of the first issue of this ETP in July 2006.

This also includes the requirements for arc flash energy mitigation techniques associated with low voltage metal enclosed switchgear.

Due to extensive editorial changes, revisions are not identified by a bar in the left margin, as is normal practice.

REVISION FOR REVIEW



Introduction

- a. Requirements for low voltage AC metal enclosed switchgear are based on IEEE C37.20.1 2002, Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear, as amended by C37.20.1a 2005.
- b. Requirement statements of this GIS are modifications to IEEE C37.20.1.
- c. Modifications to IEEE C37.20.1 are identified as Add, Modify to Read, or Delete.
- d. Paragraph numbers in this GIS correspond to IEEE C37.20.1.
- e. Paragraphs of IEEE C37.20.1 that are not revised by this GIS remain applicable.

REVISION FOR REVIEW



1. Scope

Add

- a. Vendor shall be knowledgeable of the requirements of this GIS and those referenced in 2. Any changes or alterations to the equipment to make it meet these requirements shall be solely at the expense of vendor.
- b. If proposed equipment cannot fully meet the requirements of this GIS, such exceptions shall be clearly stated in writing. No exceptions shall be allowed, unless approved by the BP electrical engineer.

2. Normative references

Add

ANSI C37.16 Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.

ANSI C37.17-1997, American National Standard for Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.

ANSI C37.20.7, Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults.

ANSI/IEEE C37.23, Standard for Metal-Enclosed Bus.

ANSI/IEEE C37.90-2005, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

BP DS 12-102, Data Sheet for Low Voltage Metal Enclosed Switchgear (IEEE C37.20.1).

Code of Federal Regulations (CFR) - Title 46, Shipping, Part 110-113 (Sub-Chapter J) Electrical Engineering.

NEMA 250, Enclosures for Electrical Equipment.

UL 1066, Low-Voltage AC and DC Power Circuit Breakers Used In Enclosures.

UL 1479, Standard for Safety Fire Tests of Through-Penetration Firestops.

UL 1558, Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

3. Terms and definitions

3. Definitions

3.1 General

Add

3.1.16 blank space: A cubicle with main bus, blank door, and no secondary devices. Steelwork needs to be performed such that the blank space can be equipped in the field without cutting or welding.

3.1.17 empty space: Cubicle with a main bus, blank door, and no secondary devices. An empty space is not easily converted to receive a circuit breaker in the future.

3.1.18 fully equipped space: Same as spare, except without a removable breaker.



3.1.19 main bus: Group of conductors that serves as a common connection for all power circuits in the assembly. This includes all interconnections to and between the main breaker(s) and the tie breaker(s).

3.1.20 spare: A completely ready to operate unit, including the drawout breaker and required secondary devices, fully wired and not designated for use at the time of purchase.

5. Ratings

5.1 General

Add to end

Specific ratings of the switchgear shall be specified by BP on DS 12-102.

Nominal 600 V power circuit breakers should have short circuit rating of 65 kA minimum, unless otherwise specified on DS 12-102.

5.2 Voltage and insulation levels

5.2.1 Rated maximum voltage and insulation levels for LV AC switchgear

Add to end

Switchgear shall be suitable for a minimum of 600 VAC as specified by BP on DS 12-102.

5.4 Rated current

5.4.1 Rated continuous current

Add

Continuous current rating of any circuit breaker shall not be based on forced air cooling.

5.4.2 Continuous current rating

Add

Continuous current rating of the main bus shall be as shown on DS 12-102.

5.4.3 Rated short-time withstand current

Add to end

Switchgear assembly shall be suitable and rated to withstand the mechanical forces exerted during short time short circuit conditions if connected to a power source having a fault current of 65 000 A symmetrical at rated voltage, unless otherwise specified on DS 12-102.

5.4.4 Rated short-circuit withstand current

Add to end

Switchgear assembly shall be suitable and rated to withstand the mechanical forces exerted during short circuit conditions for at least four cycles on a 60 Hz basis if connected to a power source having a fault current of 65 000 A symmetrical at rated voltage, unless otherwise specified on DS 12-102.

Add

5.4.5 Short circuit bracing

Main bus bracing shall be at least 65 000 A symmetrical at 480 V.



5.5 Temperature limitations

5.5.1 Limiting temperature

Add to end

Switchgear shall be specifically designed for a maximum temperature rise of 65°C (149°F) above a maximum 40°C (104°F) ambient temperature, unless otherwise specified on DS 12-102.

5.5.3 Temperature limits for buses and connections

Add

Bus connections shall be silver surfaced unless tin plated surface is requested on DS 12-102.

5.6 Current transformer ratings (LV AC switchgear)

Add

5.6.4 Current transformer burden

- a. If CTs are supplied separately, instrument transformers should be selected for a minimum of twice the burden carried by them in the equipment as designed.
- b. Fault currents will be supplied by the BP electrical engineer or BP representative.
- c. After the return of approved shop drawings, the vendor shall promptly submit calculations. The calculations shall:
 1. Demonstrate compliance with the burden requirements.
 2. Include all circuit element impedances (such as lead resistance).
 3. Be made for three phase and ground faults at the fault levels noted on DS 12-102 or single line drawings, as a minimum.
 4. Include saturation curves for the CTs used.
 5. Be made at the maximum burden setting for the relays used.
- d. Current transformer relaying accuracy classes shall be submitted with quotations.

5.7 Phase current transformer accuracies

Add

For relaying applications, accuracies tabulated in ANSI C37.20.2-2005, Table 4 (under the heading "relaying accuracy"), shall be the minimum that is specified.

Add

5.9 Arc resistant switchgear

5.9.1 Arc resistant preference

- a. Unless otherwise specified, vendor shall provide a quotation for Type 2 arc resistant switchgear that is designed, constructed, and tested to withstand the effects of an internal arcing fault in accordance with IEEE C37.20.7.
- b. If arc resistant switchgear is not specified, vendor proposal shall include the available methods and associated cost of arc flash reduction. If the application of these methods requires different grade of equipment or different equipment layout than shown on DS 12-102, vendor shall provide an alternate proposal including cost, features, layout, and other technical information necessary for evaluation.

**5.9.1.1 Arc duration**

Arc resistant design shall:

- a. Be capable of withstanding arcing durations for a minimum of 0,5 s (30 cycles) at rated power and frequency of equipment.
- b. Not be based on the function of high speed fault detectors that are sensitive to light, pressure, or heat.

5.9.1.2 Design testing

The arc resistant design testing shall be performed in accordance with IEEE C37.20.7 using the maximum short circuit current available for the system or device rating as the perspective current available at the incoming bus terminals of the test sample.

5.9.1.3 Arc resistant switchgear doors

- a. Doors shall be:
 1. Equipped with arc containment latches.
 2. Capable of withstanding the effects of an internal arcing fault as proven by successful testing in accordance with IEEE C37.20.7.
- b. No special tools shall be required to latch the compartment door or engage the arc resistant function.
- c. It shall be possible to open doors for access to controls or terminals for field control connections without compromising the integrity of the arc resistant design of the switchgear.

6. Tests**6.3 Production tests**

Add

Written certification of production tests shall be provided.

6.3.4 Electrical operation and control wiring tests**6.3.4.1 Control wiring continuity**

Modify to Read

Correctness of the control wiring of a switchgear assembly shall be verified by both:

- 1) Actual electrical operation of the component control devices (functional test).
- 2) Individual circuit continuity checks by electrical circuit testers.

6.4 Conformance tests

Modify to Read

- a. After production testing has been completed, mechanical performance tests shall be performed in accordance with ANSI C37.51-2003, section 5.8.
- b. Written certification of conformance tests shall be provided.

Add

6.6 Functional tests

- a. Functional tests shall be performed on assembly with removable elements installed.



- b. Functional tests shall demonstrate proper operation of all local, remote, and automatic trip and close logic, including auto transfer logic for main-tie-main configurations.

6.7 Witnessing of tests

- a. BP reserves the right to inspect and witness testing of equipment prior to shipment.
- b. Notice shall be given at least 2 wk prior to time equipment is ready for final testing at factory.

7. Construction

7.1 General requirements

Add

- a. Switchgear assembly shall be completely factory built, assembled, wired, and tested.
- b. Electrical equipment supplied shall be new and of current design.
- c. Switchgear structure shall be:
 - 1. A free standing unit.
 - 2. A rigidly braced, self supporting framework.
 - 3. Made of standard steel members arranged for mounting circuit breakers, buses, transformers, relays, and instruments.
- d. Enclosure shall meet NEMA 250 Type 12 requirements or NEMA 250 Type 1 requirements with an overall drip shield. Required enclosure rating shall be specified on DS 12-102.
- e. Electrical and/or mechanical interlocks between various switchgear breakers shall be provided as indicated on one line diagrams.
- f. Unless shown otherwise on the drawings, incoming line, generator, and tiebreakers shall be installed one high in individual switchgear vertical sections.
- g. Unless shown otherwise on drawings, a maximum of four feeder circuit breakers shall be installed in one switchgear vertical section. If vertical sections contain multiple feeder circuit breakers, the breaker runback buses of each breaker shall be staggered with respect to the other breaker runback buses, such that field power cable connections can be made with minimum cable bending.

7.1.1 Buses and primary connections

Modify to read

- a. Buses and primary connections shall be hard drawn, high conductivity copper.
- b. Bolted connections shall be:
 - 1. Torqued in accordance with manufacturer recommendations for each size of hardware.
 - 2. Sealed with paint or other visible mark to indicate that proper torque has been applied.
- c. Documentation providing torque values applied to bolted connections shall be provided.
- d. Cable shall not be used as bus.
- e. Use of metal enclosed cable bus shall be:
 - 1. Limited to indoor use.



2. Assembled and installed by others within an environmentally controlled electrical building or controlled environment only.
- f. Main bus shall be same rating and physical size in sections of an assembly. Tapered bus is not permitted.
- g. Contact area of bus connections, except ground bus, shall be silver surfaced.
- h. Hardware used on conductors shall be:
 1. High tensile strength.
 2. Zinc or cadmium plated.
- i. Bus joints shall have Belleville type washers.
- j. Main and ground bus shall be designed for inline splice of future sections to eliminate the need to field weld, cut, or drill the existing bus.
- k. Rigid bus connections from main bus to potential transformer primaries are preferred. If cable connections are used, cable shall be fully braced for the rated bus short circuit current.
- l. Removable bolted cover plate(s) shall:
 1. Be provided for the main bus, ground bus, and control wiring extension to future sections.
 2. Provide ample space for ease of bus splice assemblies.
- m. Power (phase) bus shall be fluidised bed epoxy insulated or approved equal. Type of insulation shall be identified on DS 12-102.
- n. Bus joints shall be covered by insulating materials at the factory, unless impractical due to shipping requirements. If interconnecting bus joints are made in the field, insulating material shall be supplied for application in accordance with switchgear manufacturer instructions.
- o. Insulating materials shall be flame retardant and tracking resistant.
- p. Switchgear shall have bus supports made of wet process glazed porcelain or cycloaliphatic epoxy material.
- q. Bus joints shall be accessible in the field for periodic inspection and bolt torquing.
- r. Bus barriers shall be bolted and removable for inspection and maintenance.

7.1.1.3 Cable terminations

Add

- a. Cable and metal enclosed bus connection terminals shall be located in rear section of the switchgear.
- b. Incoming cable support rail(s) shall be provided such that incoming cables are supported every 406 mm (16 in).
- c. Connection points shall be located to facilitate:
 1. Placement of conduit and/or cable glands.
 2. Field installation of cables.

7.1.2 Grounding

Add

- a. Ground bus shall be at least 6 mm by 51 mm (0,25 in by 2 in) copper.