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NATIONAL, PETROCHEMICAL COMPANY STANDARDS

MATERIAL STANDARD FOR LOW VOLTAGE SWITCHGEARS/MCC'S NPCS--MS--EL--02 REVISION : 0

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1 SCOPE

- 1.1 This standard covers the minimum requirements for design, testing, rating and supply of low voltage switchgear/MCC up to 1 KV, 3 phase, 4 wire, 50 Hz, for using in petrochemical plants.
- 1.2 This standard is supplemented by data sheets, schedule sheets, one line diagrams and interconnection diagrams on which the operating conditions and special requirements will be listed in detail.
- 1.3 In case of conflict between document listed below, the one appearing first in sequence of this listing will proceed over the following ones.
- a) Purchase order
 - b) Schedule sheets/data sheets
 - c) All the drawings attached to the requisition
 - d) This material standard
 - e) Other specifications and standards referred to in the above documents
 - f) Vendor drawings.
- 1.4 Compliance by the manufacturer with the provisions of this standard does not relieve him of the responsibility of furnishing unit of proper design, mechanically suited to meet operating guarantees at the specified operating conditions.
- 1.5 Such deviations from this standard which the manufacturer may consider advisable, shall be submitted in writing to purchaser, together with his quotation, in order purchaser may approve or reject such deviations.
- 1.6 Exceptions other than those included in the above mentioned documents shall not be considered.
- 1.7 Standard designs and models are preferred, provided they meet the requirements of this standard, serve the intended purpose, and can be shown to have at least three years of proven successful service in the field.
- 1.8 All documentation shall be issued, using SI metric system of measurement according to NPCS-ES-GN-03.
- 1.9 The English language shall be used for all correspondence documents, catalogs, drawings and nameplates. All other languages are not acceptable.

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1.10 In the reference numbers of this standard, purchaser means National Petrochemical Company of Iran "NPC".

2 STANDARDS AND CODES

2.1 Design, testing and rating of the switchgear and the MCCs shall conform with the requirements of the latest editions of the following IEC publications:

- | | |
|---------------|---|
| IEC-51 | Recommendations for Direct Acting Indicating Electrical Measuring Instruments and Their Accessories . |
| - IEC-144 | Degree of Protection of Enclosures for Low Voltage Switchgear and Control Gear. |
| IEC-157-I | Low Voltage Switchgear and Controlgear. |
| IEC-158-1 | Low Voltage Controlgear. |
| - IEC-185/186 | Current and Voltage Transformers. |
| - IEC-228 | Conductors of Insulated Cables. |
| - IEC-255 | Electrical Relays. |
| - IEC-292-1 | Low Voltage Motor starters. |
| - IEC-439 | Factory Built Assemblies of Low-Voltage Switchgear and Controlgear. |
| - IEC-269 | Cartridge Fuses. |
| - IEC-337 | Control Switches. |
| - IEC-529 | Classification of Degrees of Protection. |
| - IEC-73 | Colours of Indication Lights and Push-Buttons. |

Other relevant IEC publications, supplemented by this standard, switchboard schedules, and single line drawings.

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2.2 The equipment as a whole may conform with the national standards of the country of manufacture, provided these standards are based on the IEC recommendations.

2.3 Vendor shall state in the quotation the standards to which the equipment conforms. If these are the national standards, then the vendor shall state in the quotation, the deviations (if any) from the relevant IEC recommendations.

3 SERVICE AND ENVIRONMENTAL CONDITIONS

3.1 The switchboard/MCC will be installed in substation rooms which will be ventilated and air conditioned to provide clean, dust free air; ambient temperature will be within the limits of IEC 439.

3.2 Climate conditions, design temperatures, relative humidity, atmospheric details and altitude will be specified in the requisition. The switchboard/MCC shall stand these conditions while in transport, storage and installation.

3.3 The switchgear shall be able to perform unaffected by horizontal seismic acceleration forces caused by quakes corresponding to uniform building code (U.B.C.) zone 3,

4 DESIGN AND CONSTRUCTION

4.1 GENERAL REQUIREMENTS

4.1.1 The switchboard/KC shall be of the indoor, metal enclosed type and in accordance with the requirements of IEC publication 439.

4.1.2 The switchgear and motor control centers shall be of the air insulated, multi-tiered type, free-standing, self-supporting, floor mounting, flush fronted and dead-front design with all equipment installed inside vertical steel structures, suitably subdivided into arc-proof compartment at least for:

a) The horizontal busbars

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- b) Incoming feeders
- c) Bus-tie cubicle
- d) Starters and outgoing feeders.

4.1.3 . Each line-up of switchgear and MCC shall be suitable and prepared for future extension at either end without any drilling, welding or cutting of the equipment. Unless otherwise noted, MCCs shall be for front-access only.

4.1.4 The total enclosure shall have the degree of protection IP41 as defined in IEC publication 144, without using the floor of the switchroom as part of the enclosure. It shall not be possible to insert a standard test finger into any apparatus containing Live parts with any unlockable door open or unit withdrawn.

4.1.5 Individual panels of the switchboard/MCC shall be self-ventilating.

4.1.6 Temperature rise of current-carrying parts shall be limited to the values stipulated in IEC 157, i.e. 65°C for silver-plated contacts, 75°C for silver-plated connections, and 50°C for all other exposed parts under rated current and the environmental conditions which will be listed in the requisition.

4.1.7 Thermal rating for all current-carrying parts shall be a minimum of 1 second for the rated symmetrical short circuit current, but not less than 150% of that time which is required to clear the faults at the maximum rated symmetrical short circuit level. If the maximum short-circuit time must be extended, the I^2t value shall remain constant.

4.1.8 Structural main frames, section frames and forming shall provide strength and rigidity. The structures, including doors and panels shall be capable of withstanding the magnetic forces and the thermal effects created by the maximum specified fault current without any damage to equipment and danger to operating personnel. The switchgear shall be supplied with the base channels and holding down bolts, nuts and washers.

4.1.9 The design of the vertical structures, and the placement of starters and feeders shall be such as to avoid heat build-up in the top of the cubicles.

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- 4.1.10 Auxiliary voltages shall be as follows
- | | |
|--|----------|
| Control voltage | 110 V AC |
| Alarm voltage (for LV switchgear section) | 110 V DC |
| Close and trip voltage (for LV switchgear section) | 110 V DC |
| Space heater voltage | 220 V AC |
- 4.1.11 The equipment shall be capable of proper operation for voltage deviations of $\pm 10\%$ and frequency deviations $\pm 5\%$. In addition, contactors and relays shall be able to ride through voltage dips of 80% nominal, such as those experienced during motor starting and suitable for maximum fault current of the system.
- 4.1.12 Similar parts shall be interchangeable wherever practicable. Electrically identical components shall be mechanically interchangeable.
- 4.1.13 The switchboard/MCC and all components contained therein shall be rated in accordance with the requirements of the relevant IEC publications for the service conditions and electrical system specified in the switchboard schedule sheets and single line drawings. Ratings shall not be dependent upon the use of cooling fans.
The rated diversity factor shall not be less than 0.9
Re: IEC 439 paragraph 4.6.
- 4.2 SAFETY AND RELIABILITY
- 4.2.1 Switchgear and motor control centres shall offer a maximum degree of safety under all normal operating and fault conditions. In particular, it must be impossible to unwillingly, i.e. without the use of tools, touch live parts of gear, or to perform operations that may lead to arcing faults.
- 4.2.2 Arc-barriers shall be arranged such that the propagation of a possible arc is hindered in at least the following locations:
- Across or around incoming circuit-breakers, whether in the DISCONNECTED or in the OPERATING position.
 - Across or around bus-tie breakers.
 - From one vertical MCC section to another.

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- 4.2.3 All circuit breaker, starter and feeder units shall be provided with safety interlocks in accordance with the requirements of IEC publication 439.
All interlocks shall be mechanical in nature.
- 4.2.4 All interlocks that prevent potentially dangerous maloperations must be constructed such that they can not be defeated easily.
- 4.2.5 The vertical busbars (droppers) shall be arranged such that accidental finger contact with live parts, when the breaker or starter modules are withdrawn, is prevented.
- 4.2.6 It shall not be possible to open the doors of breaker and starter compartments when the breaker or switch is in the ON position. In the OFF position, the breaker operating mechanism or the control circuit shall be lockable.
- 4.2.7 With starter doors open and the main disconnect switch OFF, there shall be no exposed live parts within reach of the operator. Line-side fuse or breaker terminals shall be concealed or -insulated for this purpose.
- 4.2.8 The switchboard/MCC shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure **absolute safety during operation**, inspection and maintenance.
- 4.2.9 All doors providing access to control circuitry, and the rear of instruments and relays shall include padlocking provisions.
- 4.2.10 Switchgear and control. gear shall be designed to minimize any risk of *short circuit* and to ensure personal and operational safety during all operating conditions, inspection;; and maintenance.
- 4.2.11 The assembly shall be suitable for continuous operation at full load for at least 20,000 hr without maintenance which would require the bus bar and dropper system to be **de-energized**.
- 4.3 BUSBARS
- 4.3.1 Busbars shall be manufactured from hard drawn, high conductivity Copper, Silver or Tin coated.
- 4.3.2 All busbars shall be fully insulated and shall be color coded- RED, YELLOW, BLUE, BLACK. The insulation shall be flame retardant non-hygroscopic and rated at 660 V.



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They shall be designed for the full rated current at the maximum ambient temperature specified in the requisition, without exceeding their temperature rise limits. Design of the busbars shall be such that future extension of the switchgear to either side is possible.

4.3.3

The main busbars shall be of the same cross sectional area throughout the length of the switchboard/MCC.

4.3.4

The main busbars and the drowndroppers shall be capable of withstanding, without damage, the magnetic forces and the thermal effects created by the maximum specified fault current.

4.3.5

Busbars shall be encased in separate compartments within the switchboard/MCC.

4.3.E

Arc propagation barriers shall be provided to prevent arcs occurring in circuit breakers from flashing to the main busbars.

4.3.7

Where bus section (tie) breakers are specified, they shall be so arranged that one complete section of busbars and associated connections can be made dead and safe to work on while the adjoining section of busbars is still alive.

4.3.8

All horizontal busbar-joints shall be Tin or Silver-plated.

4.3.9

A Copper earth bus, rated for the maximum available earthfault current for 1 second, shall run the entire length of the switchgear, with connecting points at each feeder point and at each end of the switchgear.

4.3.10

A neutral bus of at least 50% phase-current rating shall extend the entire length of the switchgear and shall be insulated from the phase bus system and from earth potential.

The neutral bus shall also extend into each feeder cable or bus connection compartment. A means of disconnection (e.g. a bolted link) shall be provided to isolate the neutral bus from the source neutral for testing purposes.

4.3.11

Phase and neutral busbar joints shall be provided with clip-on shrouds to permit access to the joint bolts for routine maintenance tightening.

4.4

POWER CIRCUIT BREAKERS

4.4.1

Air-circuit breakers in draw-out type design are required. The closing mechanism shall be of the stored-energy, spring operated type, either manual or motor operated.