



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

MATERIAL STANDARD
FOR
MEDIUM VOLTAGE SWITCHGEARS/MCC'S
NPCS-MS-EL-01
REVISION : 0

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1 SCOPE

- 1.1 This standard covers the minimum requirements for design, testing, rating and supply of medium voltage switchgear/MCC from 1 KV up to 66 KV, 3 phase, 3 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 are listed in detail.
- 1.3 In case of conflict between documents 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 standard
 - e) Other specifications and standards referred to in the above documents
 - f) Vendor drawings,
- .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.
- .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.
- .6 Exceptions other than those included in the above mentioned documents shall not be considered.
- .7 Standard designs and models from vendors manufacturing program 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 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, drawings, catalogs and nameplates. All other languages are not acceptable.
- 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 MCC's shall conform with the requirements of the latest edition of the following IEC publications:
- IEC-51 Recommendations for Direct Acting Indicating Electrical Measuring Instruments and Their Accessories.
 - IEC-56-6 H.V. Alternating Current Circuit Breaker.
 - IEC-185/186 Current Transformer/Voltage Transformers.
 - IEC-255 Electric Relays.
 - IEC-280 Alternating Current Watthour Meters.
 - IEC-298 H.V. Metal Enclosed Switchgear and Controlgear.
 - IEC-470 High Voltage Alternating Current Contactors.
 - IEC-529 Classification of Degrees of Protection Provided by Enclosures.
 - IEC-632-1 High Voltage Motor Starters.
 - IEC-694 Common Clauses for High Voltage Apparatus.
 - IEC-129 AC Disconnectors (Isolators).

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- IEC - 265 AC Switches above 1 Kv.
- IEC - 282 HV Fuses.
- IEC-337 Control Switches.

Other relevant IEC publications, supplemented by this standard, the single line drawings, and switchgear schedule sheets.

2.2 The equipment as a whole may conform with the national standards of the country of manufacturer 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, the proposal shall detail 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 quake: corresponding to Uniform Building Code (U.B.C.) zone 3.

4 DESIGN AND CONSTRUCTION

4.1 GENERAL REQUIREMENTS

4.1.1 The switchgear shall be of the indoor, metal clad type as defined in the IEC publication 298.

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- 4.1.1.2 The switchgear shall be of the freestanding, self-supporting, floor mounting, flush fronted and deadfront design with all equipment installed inside vertical steel structures, suitably subdivided into individual arc-proof compartment, at least for:
- a) Busbars;
 - b) Circuit breaker or motor starters
 - c) Cable connection;
 - d) Low voltage equipment.
- 4.1.1.3 Each line-up of switchgear shall be suitable for future extension on either end without any drilling, cutting or welding of the existing equipment.
- 4.1.1.4 The switchgear shall have the degree of protection IP 4X as defined in the IEC publication 298 and an enclosure of IP 41 as defined in the IEC publication 529, 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 in the withdrawn position.
- 4.1.1.5 Individual panels of the switchboard shall be self-ventilating.
- 4.1.1.6 Temperature rise of current carrying parts shall be limited to the values stipulated in IEC 694, 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.
- 4.1.1.7 BIL (Basic Insulation Level) and power frequency withstand capability for the entire switchboard shall be in accordance with IEC 694, Table 1.
- 4.1.1.8 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 for the maximum rated symmetrical short circuit level. If the maximum short-circuit time must be extended, the I^2t value shall remain constant.



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- 4.1.9 Structural main frames, section frames and formings shall provide strength and rigidity. The structures, including doors and panels, shall be capable of withstanding the magnetic forces, blast forces and the thermal effects created by the maximum specified fault current without danger to operating personnel or damage to the equipment. The switchgear shall be supplied complete with the base channels and holding-down bolts, nuts and washers.
- 4.1.10 Auxiliary voltages shall be as follows:
- | | |
|--------------------------|----------|
| Control Voltage | 110 V DC |
| Alarm Voltage | 110 v DC |
| Close and trip voltage : | 110 V DC |
| Space heater voltage | 220 V AC |
- 4.1.11 The equipment shall be capable of proper operation for voltage deviation of $\pm 10\%$ and frequency deviation of $\pm 5\%$. 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 Motor starters shall form an integral part of the switchboard and transition pieces shall be provided as necessary to ensure a continuous line-up of switchgear.
- 4.1.13 Each panel shall be provided with integral grounding facilities.
- 4.1.14 The incoming circuit breaker panels shall have facilities to ground either the busbars or the incoming cables. An adequate protection of position selectors shall be provided to prevent inadvertent grounding of the busbars. Interlocks shall be provided to inhibit transfer or switching of power to a grounded bus section.
- 4.1.15 The low voltage equipment compartment shall be metal enclosed with a front access door that is suitable for the installation of indicators and control devices. All low voltage wiring that requires the connection of field cables, shall be terminated on a freely accessible terminal strip inside the low voltage compartment. Wiring to door mounted equipment shall be arranged and suitably routed to prevent stressing of the conductors when opening the door to its extreme stop.



- 4.1.16 Every incoming line section shall contain switch board metering, relaying and instrument transformers as specified on the data sheets. In general this metering shall include one ammeter with a 4 position, ammeter switch to measure total current per phase, one voltmeter with a 4 position voltmeter switch, wattmeter, watthour and power-factor meter.
- 4.1.17 Automatically operating safety shutters shall be installed as required by applicable standards. These shutters shall positively prevent an operator accidentally touching live parts when the breaker truck is withdrawn, and shall: simultaneously achieve the isolation of compartments.
- 4.1.18 Spare panel shall be equipped with fully rated busbars/risers, shutters, doors, etc., and supply side equipment as detailed on the data sheets to enable the compartment to be readily equipped as a complete panel without the need to de-energise or dismantle the equipment.
- 4.1.19 The switchboard 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.
- 4.2 SAFETY AND RELIABILITY
- 4.2.1 Switchgear that offers a maximum degree of safety to personnel under all normal operating and fault conditions shall be supplied. In particular, it shall be impossible to unwillingly, i.e. without the use of tools, touch live parts of the switchgear, or to perform operations that lead to arcing faults. In addition, if arcing faults do occur, due to external reasons, the equipment must afford complete protection against injury to personnel in the vicinity of the faulty equipment.
- 4.2.2 Interlocks that prevent potentially dangerous mal-operations, shall be constructed such that they can not be defeated easily, i.e. the operator must use -tools to override them.
- 4.2.3 The breaker truck shall be padlockable in the "Test" and the "Disconnect" positions.



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- 4.2.4 Storage springs of breakers shall be enclosed with the breaker truck removed from the cubicle, or they shall be automatically discharged upon removal of the truck.
- 4.2.5 It shall not be possible to rack in or rack out the circuit breaker when in the closed position.
- 4.2.6 The switchboard shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure equipment and personnel safety during operation, inspection and maintenance.
- 4.2.7 All doors providing access to control circuitry, and the rear of instruments and relays, shall be lockable. Door stops shall be provided to lock doors in the open position. A stop release, shall be provided not higher than 2 m above the floor.
- 4.2.8 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, inspections and maintenance.
- 4.2.9 The assembly shall be suitable for continuous operation at full load for at least 27,000 hr without maintenance which would require the busbar and dropper system to be deenergized.
- 4.3 **BUSBARS**
- 4.3.1 Busbars shall be manufactured from hard drawn, high conductivity Copper. Bus connections shall be Silver plated, deposited by electro-plating.
- 4.3.2 All busbars including those in cable connection boxes, etc., shall be insulated and shall be coded and phased as specified in the requisition. The insulation shall be non-hygroscopic, flame resistant and non-tracking in the presence of corona.
- 4.3.3 Main busbars shall be of the same cross sectional area throughout the length of the switchboard.
- 4.3.4 Busbars shall be braced to withstand, without damage, the magnetic forces and the thermal effects created by the maximum specified fault current.
- 4.3.5 Main busbars shall be encased in separate compartments within the switchboard.
- 4.3.6 Arc shields 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 Busbar joints shall be provided with clip-on shrouds to permit access to the joint bolts and nuts for routine maintenance tightening.
- 4.3.9 All bolted bus joints shall be Silver plated.
- 4.3.10 The busbar compartment shall be effectively sealed from other compartments to prevent the ingress of contamination and ionized gases that could lead to an arc-fault. The sealing method chosen shall be effective whether the circuit breaker truck is fully inserted, is in the DISCONNECT position, or is removed.
- 4.3.11 A continuous earth bus shall extend through the entire length of the switchgear with connecting points in each cubicle. This earth bus shall be Copper of adequate cross-section to withstand the available earth fault current for 1 second, (but not less than 150% of that time which is required to clear the faults for the maximum rated symmetrical short circuit level) and having a minimum size 200 mm" .
- 4.4 CIRCUIT BREAKERS
- 4.4.1 Circuit breakers shall be electrically operated 3 pole, vacuum or SF6 type. They shall conform to IEC publication 56 in terms of rating, testing and performance.
- 4.4.2 Breaker operating mechanisms may be solenoid or electric motor operated stored energy type with provisions for manual operation in case of control power failure. Also provision for slow closing/opening of the contacts for inspection and adjustment shall be provided. All breakers shall be mechanically trip-free and have anti-pumping circuits. After loss of control power, the springs of the operating mechanism shall be capable of performing a sequence of OFF-ON-OFF operations.
- 4.4.3 Trip and release coils shall be as what will be specified on the data sheets. In addition, a manually operable mechanical closing/tripping (for motor starter only tripping) and test push-button shall be available, and all breakers shall be suitable for remote-control. Mechanical indicators shall be provided to show the ON/OFF position of the breaker contacts.