



# IRANIAN PETROLEUM STANDARD

# IPS

**MATERIAL AND EQUIPMENT STANDARD**

**FOR**

**MEDIUM AND HIGH VOLTAGE**

**SWITCHGEAR AND CONTROLGEAR**

**FIRST EDITION**

**JUNE 2004**

**DEPUTY MINISTER  
FOR  
ENGINEERING & TECHNOLOGY  
RESEARCH AND STANDARDS**



## FOREWORD

This Standard is intended to be used within and for Iranian Ministry of Petroleum (N.I.O.C, N.I.G.C, N.P.C., N.I.O.R.D.C. and other affiliate organizations and companies) and has been prepared on the basis of the recognized standards, scientific publications, technical documents, accumulated knowledge and experiences in petroleum industries at national and international levels.

Iranian Petroleum Standards are prepared by Iranian Petroleum Standards Organization reviewed and amended by the relevant technical standard committees to incorporate acceptable comments made by oil, gas and petrochemical experts.

Standards are finally approved by the “Standards High Council” of Iranian Ministry of Petroleum.

Iranian Petroleum Standards (IPS) are subject to amendment withdrawal, if required, thus the latest edition of IPS shall be applicable.

Any comment or recommendation submitted to the “Iranian Petroleum Standards Organization” will be evaluated in the relevant technical committee and will be considered in the next revision, upon approval.

## GENERAL DEFINITIONS:

Throughout this Standard the following definitions shall apply.

**“COMPANY”** : Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company etc.

**“PURCHASER”** : Means the “Company” Where this standard is part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract documents.

**“VENDOR”** and **“SUPPLIER”** : Refers to firm or person who will supply and/or fabricate the equipment or material.

**“WILL”** : Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

**“MAY”** : Is used where a provision is completely discretionary.

**“SHOULD”** : Is used where a provision is advisory only.

**“SHALL”** : Is used where a provision is mandatory.

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<b>CONTENTS:</b>	<b>PAGE No.</b>
<b>1. SCOPE .....</b>	<b>2</b>
<b>2. REFERENCES .....</b>	<b>2</b>
<b>3. SERVICE CONDITIONS .....</b>	<b>3</b>
<b>4. APPLICATION .....</b>	<b>4</b>
<b>5. GENERAL REQUIRMENTS .....</b>	<b>4</b>
5.1 Enclosure .....	4
5.2 Busbars .....	5
5.3 Wiring, Terminals and Markings.....	6
5.4 Safety Considerations and interlocks.....	7
<b>6. MAJOR COMPONENTS.....</b>	<b>8</b>
6.1 Circuit Breakers.....	8
6.2 Motor Controllers .....	10
<b>7. AUXILIARY COMPONENTS .....</b>	<b>12</b>
7.1 Motor Control Stations .....	13
7.2 Instruments .....	13
7.3 Protective Relays .....	14
7.4 Current Transformers .....	14
7.5 Voltage Transformers .....	15
7.6 Anti-condensation Heaters .....	15
7.7 Accessories .....	15
<b>8. TESTS AND INSPECTION .....</b>	<b>16</b>
<b>9. SPARE PARTS .....</b>	<b>17</b>
<b>10. DOCUMENTATION.....</b>	<b>17</b>
<b>11. SHIPMENT .....</b>	<b>18</b>
<b>12. GUARANTEE.....</b>	<b>18</b>
 <b>APPENDICES:</b>	
<b>APPENDIX A MEDIUM AND HIGH VOLTAGE SWITCHGEAR AND CONTROLGEAR DATA SHEET.....</b>	<b>19</b>
<b>APPENDIX B ADDITIONAL REQUIREMENTS FOR OUTDOOR MEDIUM AND HIGH VOLTAGE SWITCHGEAR .....</b>	<b>21</b>

## 1. SCOPE

**1.1** This standard specification covers the minimum requirements for design, manufacture, and quality control of medium and high voltage AC switchgear and controlgear assemblies referred to in this specification as the switchgear.

**1.2** The switchgear will be installed in oil, gas and petrochemical industries in Iran under the environmental and service conditions specified herein.

**1.3** The general requirements are given in this specification; the specific requirements of individual cases will be given in request for quotation and / or purchase order.

**1.4** This standard specification will be supplemented by a single line diagram and other attachments when necessary.

**Note:** The standard specification for switchgear IPS-M-EL-140(0) is withdrawn, and replaced by the following two standard specifications which are issued as revision(1).

- IPS-M-EL-143(1)                      Low voltage switchgear and controlgear
- IPS-M-EL-144(1)                      Medium and high voltage switchgear and controlgear

## 2. REFERENCES

**2.1** The medium and high voltage switchgear shall be designed, manufactured, inspected and tested in accordance with the applicable sections of the latest edition of the following International Electrotechnical Commission "IEC" standards. This standard specification is primarily based on IEC recommendations 60298, 62271 and 60470.

- IEC 60038                              IEC Standard Voltages
- IEC 60044-1                            Current transformers
- IEC 60051                              Direct acting indicating analogue electrical-measuring instruments and their accessories
- IEC 60073                              Coding of indicating devices and actuators by colors and supplementary means
- IEC 60079-1                            Electrical Apparatus for Explosive Gas Atmosphere, Flameproof Enclosure "d"
- IEC 60079-10                           Electrical Apparatus for Explosive Gas Atmosphere, Classification of Hazardous Areas
- IEC 60186                              Voltage transformers
- IEC 60265                              High voltage switches
- IEC 60282                              High voltage fuses
- IEC 60298                              AC metal enclosed switchgear and controlgear for rated voltages above 1kV and up to and including 52 kV
- IEC 60420                              High voltage a.c. switchfuse combination
- IEC 60445                              Identification of equipment terminals
- IEC 60470                              High voltage a.c. contactors and contactor-based motor starters

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IEC 60521	Class 0.5, 1 and 2 alternating current watt-hour meters
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60644	High voltage fuse links for motor circuit application
IEC 60688	Electrical measuring transducers for converting ac. Electrical quantities to analogue or digital signals
IEC 60694	Common clauses for high voltage switchgear and controlgear standards
IEC 60947-5	Control-circuit devices and switching elements
IEC 60947-6	Multiple function equipment
IEC 60947-7	Ancillary equipment
IEC 62271-100	High voltage alternating current circuit breakers
IEC 62271-102	High voltage alternating current disconnectors and earthing switches
API RP505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as class 1, zone 0, zone 1 and zone 2

**2.2** Definitions of general terms conform to international electrotechnical vocabulary IEC 60050 (chapters 441 and 151).

**2.3** Where standards other than IEC are specified (such as ANSI C37.2), it is understood that the equivalent IEC standard is acceptable.

**2.4** Any deviation from this specification and the above mentioned references shall be clearly mentioned in the vendor's proposal.

### **3. SERVICE CONDITIONS**

**3.1** The switchgear specified herein will generally be installed indoor in substation rooms, which will be ventilated and/or air conditioned.

**3.2** As far as the area classification is concerned the substation rooms and other indoor locations where the switchgear will be installed are considered safe area. This standard specification specifies the equipment suitable for safe area indoor installation.

**3.3** In case where the switchgear will be installed outdoor, which will be indicated in data sheet Appendix A, this standard specification shall be supplemented with additional requirements and/or modifications stipulated in Appendix B "Additional requirements for outdoor medium and high voltage switchgear".

**3.4** Unless otherwise stated in data sheet, the ambient air temperature for indoor equipment does not exceed + 40°C. The lower limit of the ambient air temperature for indoor equipment is - 5°C.

**3.5** Unless otherwise indicated in data sheet, the altitude of the site of installation does not exceed 2000 meter.

**3.6** The relative humidity in the vicinity of the equipment will be stated in data sheet.

**3.7** The conditions during transport and storage will be a temperature range of -25°C to 55°C and relative humidity of up to 98%. The equipment subjected to these extreme conditions without being operated shall not be damaged and shall operate normally under the specified conditions.

#### **4. APPLICATION**

**4.1** The voltage levels adapted in the oil, gas and petrochemical industries of Iran are based on the IEC recommendation No 60038.

**4.2** The medium voltage system is 6kV and the high voltage system is 10kV and 20kV. For special cases upon the approval of company representative 30kV could be adapted as high voltage.

**4.3** The highest system voltages according to IEC recommendations is 7.2kV for 6kV systems, 12kV for 10kV systems, 24kV for 20kV systems and 36kV for 30kV systems.

**4.4** Unless otherwise indicated in data sheet, appendix A the neutral point of medium voltage and high voltage systems are earthed through current limiting resistors.

**4.5** The medium voltage switchgear (MV switchgear) is rated 6kV and will be fed from generator/s or transformer/s with secondary voltage of 6kV. (The primary voltage of transformer/s is 10kV, 20kV or 30kV). The MV switchgear includes circuit breakers and contactor type motor starters with associated control, measuring, protective and regulating devices as specified in this specification and/or indicated in the single line diagram/s.

**4.6** The high voltage switchgear (HV switchgear) is rated 10kV, 20kV (or 30kV when approved by company representative) and will be fed from the power generation and/or power distribution system/s. The HV switchgear includes only circuit breakers which are used as incomer, bus tie breaker, feeder breaker, and motor starter when appropriate, together with the required auxiliary components as specified in this specification and/or indicated in the single line diagram/s.

**4.7** The incomer circuit breakers of the medium voltage and high voltage switchgears, if more than one, shall be closed at normal operation. The tie breaker/s can be closed at normal operation, or can be open which shall close automatically when one of the incomer breakers opens. The mode of operation of the tie breaker/s will be decided by company representative and shall be indicated in the single line diagram/s and/or data sheet. The protection scheme and intertripping of incomers and tie breakers with upstream breakers shall be included accordingly.

**4.8** Single line diagram/s attached to this specification show/s only the major components of the switchgear. Control circuit schematic diagrams, wiring diagrams, schedule sheets and interconnection diagrams will be attached when necessary.

#### **5. GENERAL REQUIRMENTS**

##### **5.1 Enclosure**

**5.1.1** The enclosure for medium voltage and high voltage switchgear assemblies shall be suitable for indoor installation.

**5.1.2** The enclosure shall be metal enclosed, metal clad type, as defined in IEC 60298 and shall be self supporting, free standing, floor mounted consisting of steel structure/s enclosed by sheet steel with minimum thickness of 2.5mm. Components shall be accessible from the front of the switchgear.

**5.1.3** All equipment shall be installed inside the enclosure, suitably subdivided into separate functional units or compartments. The internal partitions shall be metallic and shall be earthed.

**5.1.4** Unless otherwise specified in data sheet, the indoor enclosure shall provide a degree of protection of IP 41 according to IEC 60529 without using the floor of the switchroom as part of the enclosure. The partitions between functional units and shutters for the busbar side and cable side

shall at least provide a degree of protection of IP 4X. (The IP rating for outdoor enclosure is indicated in appendix B).

**5.1.5** The height and the depth of the enclosure shall be as per manufacturer standard and shall be indicated in data sheet. Switches, buttons and operating handles shall be installed at a height of not more than 180cm.

**5.1.6** The enclosure together with bus bars and wirings shall be extendable at both ends without the need to cut or drill any part of the enclosure.

**5.1.7** Spare functional units complete with all equipment and auxiliaries shall be included in the medium and high voltage switchgears.

**5.1.8** Medium voltage switchgears shall include around 10% of contactor type motor starter units as spare units. The spare units shall be equipped with all necessary components. The size of spare units shall be selected equal to the starter sizes of which at least three units are installed in the switchgear assembly, with priority for sizes of which more units are included.

**5.1.9** For high voltage switchgears two spare circuit breaker units shall be included, one installed on each end of the assembly. For high voltage switchgears with five or less than five functional units, only one similar unit shall be included as spare unit.

**5.1.10** The switchgear enclosure shall be self ventilating. The design of the structures and the placement of the components shall be such as to avoid heat build-up in the top of the cubicles.

**5.1.11** The enclosure shall be designed such that anti-condensation heaters will not be required in the environment specified. Where such heaters are specified in data sheet appendix A, they shall conform to article 7.6 of this specification.

**5.1.12** The enclosure shall be properly degreased, phosphatized, cleaned and painted from inside and outside. The painting shall be done by means of electrostatic powder coating based on epoxy and polyester resins. The thickness of paint coating shall be 60 to 80 microns and shall be cured in accordance with powder manufacturer specification. The color of the enclosure will be decided by company representative. Manufacturer's standard painting system, if different from above shall be agreed by company representative.

**5.1.13** All incoming and outgoing cables will enter the switchgear from trenches or floor cut-outs. If busducts are specified for incomers, they enter the switchgear from above. In case incomers are specified to be via busducts, the switchgear supplier shall provide flanged entry to the switchgear with insulated copper bars extending to the flange point. The size of copper bars shall be agreed by company representative.

**5.1.14** The incoming and outgoing power and control cables will be terminated in suitable cable glands (cable glands will be supplied by others). Undrilled gland plates shall be provided in the switchgear assembly for this purpose. Where single core cables are to be used the gland plate shall be non-magnetic.

**5.1.15** The auxiliary wires shall be terminated in terminal blocks as specified in article 5.3.

**5.1.16** Lifting lugs shall be provided on enclosure/s for ease of handling.

**5.1.17** Foundation bolts and installation instructions shall be provided by the vendor.

## **5.2 Busbars**

**5.2.1** Unless otherwise indicated in single line diagram/s the switchgear shall be equipped with a single busbar system. Busbars shall be manufactured from hard drawn, high conductivity copper.



**5.2.2** Busbars shall be designed for the full rated current at the maximum ambient temperature specified without exceeding their temperature rise limits. Design of the busbars shall be such that future extension of the switchgear to either side will be possible.

**5.2.3** Power busbars shall be fully insulated with flame retardant non-hygroscopic insulation material and shall be color coded. Suitable insulation shall be provided for the bolted joints. The insulation of busbar joints and connections shall be removable for inspection purposes. Bus bar joints and connections shall be corrosion protected by silver-plating and secured to prevent loosening.

**5.2.4** Unless otherwise indicated in data sheet the color or the color coding of the busbars insulation shall be red, yellow and blue for phase busbars, from top to bottom and from left to right when facing the front of the switchgear.

**5.2.5** The main horizontal busbars shall be of the same cross sectional area throughout the length of the switchgear. The cross section and the continuous ampere rating of the main horizontal busbars shall be indicated in data sheet/s.

**5.2.6** Vertical busbars, if any, shall be of the same cross sectional area throughout their length and their current rating shall be equal to the sum of the maximum full load ratings of the outgoing functional units connected to that busbar.

**5.2.7** The horizontal and vertical busbars shall be capable of withstanding, without damage, the magnetic forces and the thermal effects created by the maximum specified short circuit current for at least one second. The busbars short circuit withstand current shall be indicated in data sheet.

**5.2.8** Main horizontal busbars shall be in separate compartment. The vertical busbars shall also be in separate compartment and can be installed behind functional units of each vertical section. The vertical busbars shall be arranged such that accidental contact with live parts shall be impossible when the breaker/s or starter modules are withdrawn.

**5.2.9** Where bus section (tie) breaker/s 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. Integral earthing arrangements for each section of busbars shall be provided, such that the isolated busbars could be earthed.

**5.2.10** An earth busbar, rated for the maximum available earth fault current shall run the entire length of the switchgear. Adequate provisions shall be fitted to connect the cables screen and/or armor to the earth busbar. The earth busbar shall be equipped with suitable connectors or bolts to be connected to earth copper conductors at both ends. The size of the earth busbar and earth conductors shall conform to IEC 60298. The size of earth copper conductors which are generally 70mm<sup>2</sup> or greater will be shown on single line diagram/s.

### **5.3 Wiring, Terminals and Markings**

**5.3.1** All internal wiring shall be continuous from terminal to terminal with no splicing.

**5.3.2** Wiring shall be stranded copper conductor with flame retardant PVC insulation. Minimum conductor sizes shall be 2.5 mm<sup>2</sup> for control and protection, and 1.5 mm<sup>2</sup> for signal wiring.

**5.3.3** Where wiring is run through a metal sheet or barrier, bushing or other mechanical protection shall be provided.

**5.3.4** All internal power cables and wires shall be suitable for the largest continuous current rating of the functional unit and the short circuit current as limited by fuses or circuit breakers.

**5.3.5** The sizes of earth wires shall be according to the recommendations of IEC 60298.

**5.3.6** Where applicable, flexible wires shall be used for connection of door mounted equipment to the cubicle mounted equipment. Such wiring shall be wrapped with flexible PVC coil or installed in flexible conduit and shall be firmly clamped at both ends to prevent movement at terminations.

**5.3.7** Covers and/or doors with electrical apparatus attached to them shall be connected to the switchgear frame via bonding conductors.

**5.3.8** All wiring shall be numbered on each end with permanently embossed wire markers of the heat shrinkable type or slip-on ferrules. Wire numbers shall match the manufacturer's interconnection drawings.

**5.3.9** All wires shall have cable lugs and shall be terminated in clamp type terminals such that direct contacts between screw, bolt or nut and cable lugs are avoided. For current transformers secondary wiring, ring type cable lugs shall be used.

**5.3.10** The terminals shall be identified by suitable permanent numbers in accordance with the relevant wiring diagrams. Terminal marking shall comply with IEC 60445.

**5.3.11** Not more than two wires shall be connected to any one terminal. Links shall be provided where more connections are required at one point.

**5.3.12** Wiring in various circuit breakers, starter and feeder cubicles performing the same common function shall bear the same wire and terminal numbers.

**5.3.13** The control terminal blocks shall include 10% spare terminals.

**5.3.14** Nameplates shall comply with IEC 60694 and information on the nameplates shall be approved by company representative. Nameplates shall be made of durable corrosion resistant material. The nameplates shall at least contain the following information: Manufacturer's name or trade mark, type designation or serial number, applicable rated values and number of relevant standard.

**5.3.15** Labels on withdrawable units shall be duplicated on the withdrawable part and the fixed part.

**5.3.16** when operation of certain items of the switchgear needs sequential actions such as the release of interlocking features, instruction plates shall be provided near the point of operation.

#### **5.4 Safety Considerations and interlocks**

**5.4.1** The medium voltage or high voltage switchgear and controlgear shall offer a maximum degree of safety under all normal operating and fault conditions. It must be impossible to unwillingly, without the use of tools, touch live parts of the switchgear or to perform operations that may lead to arcing faults.

**5.4.2** The switchgear assembly shall be suitable for continuous operation at full load for at least 20,000 hrs without maintenance.

**5.4.3** Circuit breakers, and contactor units shall be provided with required safety interlocks in accordance with the functions of such equipment in the overall electrical system and shall conform with the requirements of IEC publication 60298. Interlocks shall be mechanical in nature.

**5.4.4** In addition to mechanical interlocks, motor starters shall be equipped with electrical interlocks in the control circuitry, such that it will not be possible to withdraw the starter unit when the starter is in the ON position. A micro switch operated by the movement of the withdrawable unit shall trip the starter prior to withdrawing the starter unit.

**5.4.5** The reversing and two speed motor starters shall be equipped with suitable mechanical interlocks, in addition to the electrical interlocks in the control circuitries.

**5.4.6** All interlocks that prevent potentially dangerous maloperations must be constructed such that they can not be easily defeated. If any mechanical interlock is capable of being defeated without the use of tools, provision shall be made for padlocking. The requirements for interlocks and/or padlocking shall be approved by company representative.

**5.4.7** When a withdrawable unit has been removed from the switchgear assembly, the live parts inside the fixed compartments shall be protected against touch. Shutters shall be provided to cover the busbar side and cable side disconnected contacts automatically. The shutters shall be mechanically operated by the movement of the withdrawable units. The shutters for the busbar side shall be equipped with padlock facilities in their closed position. For some units as may be required such as incomers and bus tie units padlock facilities shall be provided for both busbar side shutters and cable side shutters. Earthed metallic shutters are preferred. Shutters shall be colored red for busbar side and yellow for cable side.

**5.4.8** Each functional unit of the switchgear assembly and each section of the busbars shall have integral facilities for earthing. Earthing arrangement for each section of busbars can be provided in each incomer circuit breaker and/or at the bus tie circuit breaker. Earthing switch shall be provided on the cable side of all functional units. The operation of the earthing switch shall be interlocked with the functional unit switching devices so that it can be manually closed only when the relative switching device is not in service position. Padlocking facilities for locking the earthing devices in closed position shall be provided. Earthing method of functional units and busbar sections shall be approved by company representative prior to manufacturing.

**5.4.9** Temperature rise of current-carrying parts shall be limited to the values stipulated in IEC60694 and derated in accordance with environmental conditions specified in data sheet.

**5.4.10** The complete switchgear assembly shall be capable to withstand the thermal and dynamic stresses resulting from short circuit currents. The supplier shall state the short circuit withstand current of the assembly namely busbars, circuit breakers, starters etc. at quotation stage.

**5.4.11** All the metallic non-current carrying parts of the switchgear including the main structure shall be bonded together and connected to the earth busbar. Doors shall be bonded to the main structure by means of flexible copper connections.

## **6. MAJOR COMPONENTS**

### **6.1 Circuit Breakers**

**6.1.1** In the medium voltage and high voltage switchgear, circuit breakers shall be used as incomer/s to the switchgear, bus coupler/s, feeders and when indicated in the single line diagram/s, as motor starters.

**6.1.2** Circuit breakers shall be three pole withdrawable complete with vacuum interrupters and self aligning disconnecting devices.

**6.1.3** The contacts of vacuum interrupters shall be made of proper material such as chrome-copper or equivalent in order to assure low chopping levels of current and produce no harmful overvoltages.

**6.1.4** SF6 circuit breakers can be proposed as an alternative option. The use of SF6 circuit breaker is subject to the approval of company representative.

**6.1.5** Circuit breakers shall conform to IEC publication 62271-100 in terms of rating, testing and performance and shall be suitable for uninterrupted duty (utilization category B).

**6.1.6** Rated currents of circuit breakers shall be selected conforming with IEC recommendations taking into account possible deratings as per site condition specified in data sheet. Incomer circuit breakers shall be sized to feed all the loads indicated in the single line diagram including the spare units.



**6.1.7** The short circuit capacity of circuit-breakers shall be appropriate to the specified system short circuit and power factor, and shall not be less than 25Ka symmetrical.

**6.1.8** Circuit breakers shall be capable of interrupting the specified short circuit current without the aid of replaceable current limiters or fuses.

**6.1.9** The operating mechanism of circuit breakers shall be stored energy spring operated type and shall conform to the recommendations of IEC 60694. The charging of the spring shall be by electric motor with provisions for manual charging by hand. The spring of the operating mechanism, when charged, shall be capable of performing three circuit breaker operations viz. open, close and open. Anti-pumping devices shall be included to prevent pumping actions of the mechanism.

**6.1.10** Unless otherwise indicated in data sheet/s the voltage of the spring charging motor as well as the circuit breaker close and trip voltage shall be 110V dc. 110V dc will be supplied from the substations DC power supply system. 230V ac can be utilized for the spring charging motor if approved by company representative.

**6.1.11** Tripping of circuit breakers shall be by means of manual mechanical tripping device and d.c. shunt trip coil. Electrical and manual closing release shall be provided.

**6.1.12** The circuit breakers used as motor starters will be controlled from remote motor control stations. The other circuit breakers shall be controlled either locally from the switchgear panels or from a separate remote control panel which will be installed in the substation room. The purchaser shall indicate the choice of local or remote control of such circuit breakers in data sheet/s.

**6.1.13** The local manual trip facility of each circuit breaker shall be fitted with a guard to preclude inadvertent operation.

**6.1.14** Facilities shall be provided for testing the circuit breaker closing and tripping mechanisms when the breaker is in TEST position.

**6.1.15** There shall be three distinct positions for circuit breakers. The draw out mechanism shall hold the breaker rigidly in the three positions of CONNECTED, TEST and DISCONNECTED. The breaker disconnect device shall be interlocked with the breaker trip-shaft to prevent withdrawal or insertion of the breaker from/into the cubicle with the breaker in the ON position.

**6.1.16** If moving of the breaker from or into the operating position requires undue effort by the operator, mechanical aids such as handle shall be provided as indicated in article 7.7. The breaker shall be lockable in the TSET and DISCONNECTED positions.

**6.1.17** Circuit breaker control connections (secondary disconnects) shall be via fixed, self-aligning disconnects, or via flexible cord type plug connection. Either system shall allow test-operation of the breaker in the TEST position.

**6.1.18** In addition to auxiliary contacts required for breaker operation, 2 N/O + 2 N/C similar contacts shall be provided and wired to the terminal strip. If additional auxiliary contacts are required, it will be indicated in data sheet.

**6.1.19** All low-voltage wiring to and from the circuit breaker shall be terminated on an easily accessible terminal strip within the breaker compartment with label numbering. Each terminal and each wire shall be clearly identified by the same symbols or numbers used in the circuit diagrams.

**6.1.20** Circuit breakers of identical rating and control voltage shall be completely interchangeable. It shall not be possible to interchange breakers of different ratings.

**6.1.21** Circuit breakers shall have mechanical indicators to show their contact positions and spring charging status. They shall also be fitted with red and green indicating lights as per IEC 60073 recommendations to show whether the breaker is in closed or open position. In addition, a yellow indicating light shall be provided to show trip on fault condition.

**6.1.22** Each circuit breaker shall be provided with a trip circuit supervision system complete with a white indicating lamp to indicate that the trip circuit and trip circuit supply are healthy.

**6.1.23** Each circuit breaker shall be equipped with required indicating instruments and protective relays as specified in this standard specification and/or indicated on single line diagram/s. The relays function numbers are according to ANSI standard C37.2 (IEEE C37.2).

**6.1.24** Spare circuit breakers shall be provided as specified in paragraph 5.1.9.

## **6.2 Motor Controllers**

**6.2.1** The medium voltage and high voltage switchgear shall include withdrawable motor starters installed in individual compartments. The numbers and sizes of motor starters will be indicated in the single line diagram/s and/or data sheet.

**6.2.2** Unless otherwise indicated in single line diagram/s the motor starters for single speed, two speed and reversing motors shall be direct-on-line.

**6.2.3** Star delta or auto transformer reduced voltage motor starting may be employed, following the electrical system study. Such requirements will be shown on single line diagrams.

**6.2.4** Motor starter installed in medium voltage switchgear are intended to control 3 phase 6Kv electrical motors. 6Kv motors rated 150Kw to 1000Kw shall be controlled by contactor type motor starters and 6Kv motors rated above 1000Kw shall be controlled by circuit breakers specified in article 6.1.

**6.2.5** Motor starters installed in high voltage switchgear are intended to control 3 phase 10Kv electrical motors. 10Kv motors shall be controlled by circuit breakers specified in article 6.1.

**6.2.6** Contactor type motor starters which are only employed in MV switchgear shall be in accordance with the requirements of IEC 60470 and shall consist of the following:

- HRC power fuses
- Electrically operated vacuum contactor
- Appropriate protective relays
- Other protection and/or control devices and indicating instruments shown on the single line diagram/s and/or specified in this specification

**6.2.7** Main power fuses shall be of the current limiting HRC type in accordance with IEC 60282-1. The selection of fuse rating shall be such as to carry the specified starting current of the motor for the specified run-up time.

**6.2.8** The fuses shall incorporate striker pins which shall trip the contractor via an operating mechanism, in case of operation of any one fuse.

**6.2.9** Contactors shall be three pole magnetically operated vacuum type rated for utilization category AC3. For motors in inching or reversing services contactors with utilization category AC4 shall be used.

**6.2.10** The contacts of vacuum contactors shall be made of proper material such as chrome-copper or equivalent in order to assure low chopping levels of current and produce no harmful overvoltages.

**6.2.11** All motor starters with vacuum interrupters either circuit breaker or contactor shall be equipped with suitable surge protection devices.

**6.2.12** The contactors shall be capable of interrupting motor locked rotor current. Furthermore the contactors shall be sized to withstand thermal and magnetic stresses resulting from all possible short circuit currents for the maximum clearing time of HRC fuses.

**6.2.13** In addition to the auxiliary contacts required to operate the starter, two N/O and two N/C auxiliary contacts shall be provided for each contactor and shall be wired to the terminal block of the compartment.

**6.2.14** Control scheme of motor starters shall be as per the requirements, shown in control circuit schematic diagrams.

**6.2.15** The rated control voltage of contactors shall be single phase 230 volt ac supplied from a 6000/230 volt control transformer installed in each starter unit after the main power fuses. The control transformer shall be protected by suitably rated fuses on primary and secondary sides.

**6.2.16** Where the length of the control cable is more than 1000m as indicated on drawings, the control voltage shall be 110V dc instead of 230V ac. In such case the control transformer shall include a suitably sized 110V dc rectifier. The contactor for this purpose shall be operated by 230V ac through a 110V dc interposing relay. Upon the approval of company representative the control voltage of all medium voltage contactors can be selected as 110V dc. In such case the provisions of paragraph 6.2.31 shall apply.

**6.2.17** The contactor type motor starters shall be provided with testing facilities to permit testing of the starter unit when isolated from the main circuit. Test position shall be selected by means of a change over Test/Normal selector switch. In test position, the control circuit which is isolated from the main circuit shall be connected to a male plug located within each starter unit. In this position the starter can be tested when control voltage is supplied to such male plug.

**6.2.18** Unless otherwise indicated on drawings, one 230V ac test voltage supply unit shall be provided for each busbar section. The test voltage supply unit shall be accommodated in a dedicated compartment and shall include a 6000/230V control transformer protected by suitably sized fuses on primary and secondary sides. The 230V test voltage shall be connected to two pole sockets (at least two numbers) mounted on the compartment door. The control transformer and fuses shall be rated to supply the control circuits of two largest starter units.

**6.2.19** Flexible cords with matching plugs and sockets shall be supplied for connecting test voltage to the male plugs in each starter unit as specified in 6.2.17. The flexible cords shall be of sufficient length to connect the test voltage to all starter units on each section of the switchgear for testing purposes.

**6.2.20** Motor starters shall be equipped with start/stop control stations according to the requirements of article 7.1 of this specification. When indicated in data sheet or single line diagram/s, the control stations shall be supplied by the switchgear supplier.

**6.2.21** Stay-put type stop/reset push-button accessible from outside of the starter compartment shall be provided on the front of all motor starters. Unless otherwise indicated in single line diagram/s no start push button is required on the starter compartment, (except for testing as per paragraph 6.2.17).

**6.2.22** Each starter module shall be equipped with the following pilot lights installed on the door of the starter compartment. Red to show the ON condition, green to show OFF condition and yellow pilot light to show FAULT condition.

**6.2.23** Starter modules of identical rating and control scheme shall be fully interchangeable. Units which are mechanically identical but electrically different shall not be interchangeable e.g. it shall not be possible to install a motor starter unit into a space for a feeder unit of the same size.

**6.2.24** Contactor type motor starters shall include overload relays supplied from appropriate current transformers, instantaneous earthfault relay supplied from a core balance current



transformer, single phasing protection relay and under voltage time delay tripping relay as specified in paragraph 6.2.26. Earth fault relays shall be set to trip the contactors at 10% of the full load motor current. For selected motor starters indicated in single line diagram/s anti-restart protection relay shall also be included.

**6.2.25** Circuit breaker type motor starters, used for starting motors above 1000Kw shall be equipped with the same protective relays specified in 6.2.24 with anti-restart protection relay to be included in all such starters. Motor starters above 1000Kw shall additionally include motor differential protection relay. The current transformers for such relay which will be installed in the motor terminal box shall be suitable for the area classification zone in which the motor will be installed. The current transformers shall be supplied by switchgear supplier in coordination with the relevant motor supplier.

**6.2.26** An under voltage relay shall be provided in each section of the switchgear. The operation of the under voltage relay shall be instantaneous and the drop out voltage shall be adjustable between 50% to 85% of the system voltage. The pick up voltage shall be at least 85% of the system voltage. Under voltage relays shall reset automatically and shall be equipped with manual resettable operation indication. Under voltage relays shall energize time delay tripping relays adjustable between 0.2 to 5 second located in incomer circuit breaker/s and all motor starters. Motor starters with time delay tripping relay shall be equipped with restart relay when indicated in the single line diagram/s, otherwise space for future installation of restart relay shall be foreseen.

**6.2.27** Motor starters shall also include other protective or control relays stipulated by the process requirement and indicated in the single line diagram/s.

**6.2.28** Relays shall be according to article 7.3 of this specification. Microprocessor type motor protection relays are preferred.

**6.2.29** All motor starters shall be provided with one ammeter installed on the starter front panel. This ammeter shall be fed from a current transformer installed on the middle phase. Starters shall also be fitted with a 1 Ampere secondary current transformer for remote indication of motor current. The ammeter fed from this current transformer will be installed in the relevant motor control station.

**6.2.30** Each motor starter either circuit breaker or contactor type shall be equipped with a motor heater supply circuit such that the motor heater is automatically switched ON when the starter is in OFF position. This circuit shall consist of a single pole miniature circuit breaker wired through a normally closed auxiliary contact of the circuit breaker or contactor and terminated in a terminal block for the purchaser's connection. Means shall be provided to bypass this contact when the starter is withdrawn or removed. The voltage of the motor heaters will be 230V single phase, and will be supplied from the substation low voltage system. One common 230V supply will be provided for each busbar section. Wattage of the motor heaters will be shown on single line diagram/s.

**6.2.31** For cases where the purchaser specifies 110V dc to be used as contactors control voltage the following shall apply.

- a) All contactors coils shall be rated 110V dc.
- b) The 110V dc voltage shall be supplied from the substations DC power supply system with suitably sized protective fuse in each motor starter unit.
- c) Each motor starter unit shall include time delay under voltage protection relay with adjustable setting.
- d) It shall be possible to connect 110V dc to the starter unit in order to test the starter when isolated from the main circuit.

**6.2.32** Spare motor starters shall be provided as specified in paragraph 5.1.8.

## **7. AUXILIARY COMPONENTS**

### **7.1 Motor Control Stations**

**7.1.1** Motor control stations will be located near the motors which they control. If motor control stations are to be supplied together with the switchgear it shall be indicated in data sheet.

**7.1.2** The motor control station shall at least include start-stop pushbuttons together with suitable ammeter. The ammeter can be located adjacent to or be incorporated in the associated control station. It shall be possible to lock the control station in stop position.

**7.1.3** Separate current transformers shall be mounted in the motor starter compartments to be connected to ammeters at motor control stations in accordance with the requirement of article 7.4.

**7.1.4** Terminals shall be provided in the starter compartments to be connected to the ammeter and push buttons installed on the motor control stations.

**7.1.5** Motor control stations, shall be suitable for outdoor installation in classified areas and shall be according to the relevant IPS standard. (Area classification conforms to the recommendations of IEC 60079-10 and API RP505).

**7.1.6** Motor control stations in areas classified as zone 1 and zone 2 shall be flameproof Exd according to IEC 60079-1.

**7.1.7** "Local-remote" or "hand-auto" selector switches shall be provided on the doors of the starter compartments, when indicated on the single line diagram/s.

### **7.2 Instruments**

**7.2.1** Indicating and measuring instruments shall be provided as shown on single line diagrams and/or data sheet.

**7.2.2** All instruments shall be manufactured in accordance with the requirements of IEC publication 60051.

**7.2.3** Where indicated in the single line diagram/s and or data sheet, 4-20mA output transducer/s complying with IEC 60688 shall be provided for selected analogue signals to be transmitted to a remote supervisory system such as distributed control system (DCS).

**7.2.4** Instruments shall be flush mounting type and shall have an enclosure with a degree of protection of IP41 for indoor application. (IP55 for outdoor application)

**7.2.5** Instruments shall not be damaged by the passage of fault currents in the primary of current transformers or voltage variations on the system within the specified system characteristics.

**7.2.6** Ammeters and voltmeters shall be of the accuracy class 1.5.

**7.2.7** The accuracy class of watt-hour meters shall be class 2.5. The accuracy class of watt-hour meters used for measurement of power to or from outside sources shall be class 1.5.

**7.2.8** Ammeters for motor duty shall be suitable to withstand the motor starting currents and shall have a compressed overload scale of at least 6 times the full load motor current. Scales for such ammeters shall be selected so that the full load current appears around the middle of the full angular deflection. Full load motor current shall be indicated by a red line on the ammeter scale.

**7.2.9** Meters installed on the switchgear shall be of the square pattern type preferably 72x72 mm. 96x96 mm meters are acceptable. Scales shall be in actual values.

### **7.3 Protective Relays**

**7.3.1** The protection function numbers shown on single line diagram/s will be according to the latest edition of ANSI standard C37.2 (IEEE C37.2).

**7.3.2** All relays with the same function shall be interchangeable. The relays shall be such that, the removal of each relay automatically short circuits the relevant current transformer.

**7.3.3** Protective relays shall have provision for testing and calibration.

**7.3.4** The relaying shall be fail safe such that, failure of any relay does not jeopardize the operation of the electrical system, but alarms the operator.

**7.3.5** Relays shall be equipped with clear trip indication, visible to the operator.

**7.3.6** Relays shall be manually resettable. In cases where manual resetting of individual relays are not available, a lockout relay with manual reset facilities shall be provided. Non tripping relays, undervoltage and under frequency relays shall be self resetting with indications of operation which shall be hand reset.

**7.3.7** If programmable digital protective relays are employed, the relevant softwares together with instruction manuals and trouble shooting guidelines shall be included.

### **7.4 Current Transformers**

**7.4.1** Current transformers shall be in accordance with IEC 60044-1.

**7.4.2** The rated secondary current shall be preferably 5 Ampere for switchgear mounted protective relays and instruments, and 1 Ampere for remote mounted instruments, either directly or via intermediate current transformers. The secondary leads of current transformers for remote mounted instruments shall be short circuited by a removable link at the switchgear factory.

**7.4.3** The switchgear manufacturer shall be responsible for assessing and selecting the output rating of the current transformers.

**7.4.4** Current transformers for measuring purposes shall be of the accuracy class 1. Current transformers for remote ammeters shall be of the accuracy class 3.

**7.4.5** Current transformers for protection purposes shall be of the accuracy class 5P. The accuracy class of current transformers used for motor protection relays shall be as specified by the relay manufacturer. In such case class 10P will be acceptable. The accuracy class of differential protection current transformers shall be class X as defined in IEC60044-1.

**7.4.6** The secondary of the current transformers shall be earthed on one side. Where current transformers are connected in Wye, the Wye point shall be earthed. The wiring of the secondary circuits shall have a cross section of 2.5 mm<sup>2</sup>. Separate earth wire shall be used for measuring and protection current transformers.

**7.4.7** The secondary leads of each current transformer shall be accessible and shall be connected to test and short circuiting links.

**7.4.8** Current transformers for circuit breakers shall be installed in the stationary part of the relevant cubicle. Current transformers for contactor type motor starters shall be installed in the withdrawable part of the cubicle.

**7.4.9** Current transformers shall be capable of carrying, without injurious heating or mechanical damage, the specified fault current of the switchgear.



**7.4.10** Current transformers shall have appropriate VA rating and saturation factor. The saturation factor shall not be less than 5.

**7.4.11** The markings on the current transformers shall be in accordance with the requirements of IEC publications 60044-1.

### **7.5 Voltage Transformers**

**7.5.1** Voltage transformers shall be in accordance with IEC 60186, with secondary voltage as specified by the manufacturer of protective relays, measuring instruments, and/or control circuitry.

**7.5.2** Voltage transformers shall be withdrawable and shall be protected by disconnect type current limiting fuses on primary and secondary sides. Protective fuses for voltage transformers used with generator AVR/s may be eliminated if they are installed within the protection zone of the generator differential protection.

**7.5.3** One side of the secondary winding of single phase voltage transformers and the star point of three phase voltage transformers shall be earthed through a removable link.

**7.5.4** The voltage transformers for measuring purposes shall be of accuracy class 1 and for protection purposes shall be class 3P. Voltage transformers for use with generator AVR/s shall be of accuracy class 0.5.

**7.5.5** Voltage transformers shall be dry Epoxy-Resin or Butyl-Rubber molded type.

### **7.6 Anti-condensation Heaters**

**7.6.1** Anti-condensation heaters will not generally be required for indoor equipment. For outdoor equipment and also for special locations where such heaters are specified, they shall be rated for continuous service and shall operate on single phase voltage of 230Volt, 50Hz.

**7.6.2** The numbers and sizes of the heaters, if not shown on drawings, shall be selected by the switchgear supplier.

**7.6.3** Heaters shall be energized from a dedicated heater panel or lighting panel which shall be supplied with the switchgear. (The 400/230 volt power to such panel will be provided by the purchaser).

**7.6.4** Heater/s shall be protected by a miniature circuit breaker and an earth leakage protection device of 30mA sensitivity.

**7.6.5** A contactor/relay in combination with a thermostat shall be provided for the operation of heater/s. An indicating light (preferably blue) shall be provided on the switchgear enclosure to indicate that the relevant space heater/s is in operation.

**7.6.6** Heater/s terminals shall be shrouded.

### **7.7 Accessories**

**7.7.1** Accessories required for proper and safe operation of the switchgear shall be supplied. At least the following accessories shall be furnished for each assembly or group of assemblies in the same switch room.

- a) Device for manually charging the stored energy operating mechanism of circuit breakers.
- b) Handle for moving circuit breakers into positions.
- c) Fuse pulling device.

- d) Lifting trolley or similar device to remove circuit breakers or large starter modules from the cubicles.
- e) Adapter cables and/or flexible cords for testing the withdrawable starter modules and circuit breakers in withdrawn positions.
- f) Test cabinet for testing circuit breakers, if required (optional).
- g) Special tools for erection and maintenance if applicable.

## 8. TESTS AND INSPECTION

**8.1** The equipment under this specification shall be factory tested. Three certified copies of test reports and certificates shall be submitted to the purchaser.

**8.2** Type tests, routine tests and functional tests shall be carried out on the switchgear according to the recommendations of IEC 60298, IEC 60694, IEC 60470, IEC 60056 and the relevant IEC publications referred to therein.

**8.3** Purchaser will require the presence of his nominated representative to witness the final factory tests. The supplier shall inform the date of such tests at least four weeks in advance.

**8.4** The purchaser's inspectors shall be granted the right for inspection at any stage of manufacture and testing.

**8.5** Prior to shipment of the switchgear an insulation resistance test shall be performed between each phase against earth, with the two remaining phases connected to earth. The insulation resistance test shall be carried out in accordance with IEC 60694. Also visual inspection and spot checks shall be carried out to verify at least the following:

- The degree of protection of the enclosure;
- The degree of protection within the compartments;
- The effectiveness and reliability of safety shutters, partitions and shrouds;
- The effectiveness and reliability of operating mechanisms, padlocks and interlock systems;
- The insulation of the busbar system;
- The creepage distances and clearances;
- The proper mounting of components;
- The internal wiring and cabling system;
- The correct wiring of main and auxiliary circuits;
- The suitability of clamping, earthing and terminating arrangements;
- The correct labeling of functional units;
- The completeness of the data on the nameplates;
- The availability of the earthing system throughout the switchgear;
- The interchangeability of electrically identical components;

- The non-interchangeability of mechanically identical but electrically different withdrawable units.

## 9. SPARE PARTS

**9.1** Together with the supply of all equipment under this specification, a complete set of spare parts for commissioning shall be supplied for each switchgear. The supplied spare parts shall comply with the same specifications as the original parts and shall be fully interchangeable with the original parts without any modification.

**9.2** The vendor shall also supply a list of recommended spare parts for two years of operation.

## 10. DOCUMENTATION

**10.1** The vendor shall supply the necessary information with the quotation to enable evaluation of the submitted proposal. General documents/drawings are not acceptable unless they are revised to show the equipment proposed.

The documents to be supplied with the quotation shall at least include the following:

- a) Completed enquiry data sheet/s.
- b) Summary of exceptions/deviations to this standard specification.
- c) Brochures and catalogues containing description of typical switchgear and technical data on major and auxiliary components such as circuit breakers, contactors, relays, meters etc.
- d) List of accessories included in the bid.
- e) Preliminary dimensional drawings.
- f) Approximate shipping weights and sizes.

**10.2** The documents which shall be supplied together with the equipment shall at least include the following:

- a) Updated and completed enquiry data sheet/s.
- b) Final single line diagram/s.
- c) Schematic control circuit diagrams of each kind of circuit breaker and starter module.
- d) General arrangement drawings showing main dimensions, panels' layout, floor panel and shipping sections.
- e) Drawing/s showing the location of field wiring terminal strips and power cable connections.
- f) Information concerning interlock sequences.
- g) List of major and auxiliary components, showing complete reordering information for all replaceable parts.
- h) Recommended spare parts list for two years of operation.
- i) Test reports and performance curves of the final routine tests.
- j) Painting specification and test result/s.



- k) Applicable test certificates.
- l) Installation, operation and maintenance instruction/s.
- m) Fault finding and trouble shooting manual/s.
- n) Protective relay/s types, curves and setting ranges.
- o) Cut-off current characteristics of fuses.
- p) Total weight of the assembly and of the individual shipping sections.
- q) List of accessories and/or any special tools required for erection, operation and maintenance.

## **11. SHIPMENT**

**11.1** The supplier of the equipment under this specification is the sole responsible for packaging and preparation for shipment.

**11.2** The packaging and preparation for shipment shall be adequate to avoid mechanical damage during transport and handling.

**11.3** Each shipping section shall be provided with permanently attached identification tag containing necessary information together with the switchgear identification number indicated in data sheet Appendix A.

**11.4** Shipping documents with exact description of equipment for custom release shall be supplied, with the equipment.

## **12. GUARANTEE**

**12.1** The supplier of the equipment under this specification shall guarantee the equipment and shall replace any damaged equipment/parts resulting from poor workmanship and / or faulty design.

**12.2** The supplier shall replace any equipment failed under the following condition:

- Failure under startup and commissioning tests performed according to IEC recommendations.
- Failure under normal usage for a period of 12 months, not exceeding 18 months from the date of dispatch from the manufacturers works.

**APPENDIX A**

**MEDIUM AND HIGH VOLTAGE SWITCHGEAR AND CONTROLGEAR DATA SHEET**

The vendor shall complete and submit this data sheet with his proposal.

Items marked with asterisk will be specified by purchaser.

1.	Name of project or plant	*
2.	Switchgear identification No	*
3.	Single line diagram number	*
4.	Site elevation above sea level (m)	*
5.	Maximum room temperature, indoor	*
6.	Minimum room temperature, indoor	*
7.	Maximum outdoor ambient temperature	*
8.	Minimum outdoor ambient temperature	*
9.	Relative humidity	*
10.	Installation (indoor/ outdoor)	*
11.	Area classification zones,( in case of outdoor installation)	*
12.	Nominal system voltage, 3phase	*
13.	System voltage variation	*
14.	Nominal frequency and frequency variation	*
15.	Neutral earthing system (current limiting resistor)	*
16.	Incomers to the switchgear by duct or cable	*
17.	Enclosure degree of protection (IP code)	
18.	Plate thickness of the enclosure	
19.	Color of the enclosure	
20.	Power busbars cross section	
21.	Busbars rated current	
22.	Busbars short circuit withstand current rms symmetrical (KA)	
23.	Busbars short circuit withstand time	
24.	Busbars joints (silver plated)	
25.	Busbars insulation	
26.	Busbars colors	
27.	Total length of the switchgear	
28.	Height of the switchgear	
29.	Depth of the switchgear	
30.	Shipping weight of the switchgear/individual shipping sections	
31.	Numbers of incomer circuit breaker/s	
32.	Numbers of bus tie circuit breaker/s	
33.	Tie breaker/s mode of operation OPEN/CLOSE	*

34.	Numbers of poles and current rating of incomer and tie breakers	
35.	Circuit breakers interrupting medium (vacuum/SF6)	
36.	Circuit breakers closing mechanism (direct manual/motor driven)	
37.	Circuit breakers maximum interrupting capacity rms symmetrical	
38.	Short time current rating of circuit breakers at 1 sec. and 3 sec.	
39.	Circuit breakers breaking capacity (kA) rms asymmetrical	
40.	Circuit breakers making capacity (kA) asymmetrical	
41.	Rated interrupting time of circuit breaker	
42.	Closing time of circuit breaker	
43.	The voltage of the spring charging motor of circuit breakers	
44.	Circuit breakers closing and tripping voltage	
45.	Control of circuit breakers (local/remote)	
46.	Circuit breakers protective relays	Attach list or diagram/s
47.	Circuit breakers indicating instruments	Attach list or diagram/s
48.	Watt-hour meter for incomers (supplied or not)	
49.	Additional auxiliary contacts for circuit breakers (paragraph 6.1.18)	*
50.	Numbers and sizes of outgoing feeder breakers	Attach list or diagram/s
51.	Numbers and sizes of motor starters, circuit breaker type	Attach list or diagram/s
52.	Numbers and sizes of motor starters, contactor type	Attach list or diagram/s
53.	Contactor type motor starters control voltage	
54.	Motor starters protection relays	Attach list or diagram/s
55.	Motor starters indicating instruments	Attach list or diagram/s
56.	Motor control stations (included or not)	
57.	CT type and ratio for protection and indication	
58.	CT type and ratio for remote ammeter (on control station)	
59.	Numbers and wattage of anti-condensation heaters (if any)	
60.	4-20 mA output transducers	
61.	Manufacturer of circuit breakers	
62.	Manufacturers of 6Kv contactors	
63.	Manufacturer of protective relays	
64.	Manufacturer of indicating instruments	
65.	Type test certificates for complete switchgear and components.	To be attached
66.	Accessories	Attach list
67.	Deviation from this specification if any	Attach list

\*by purchaser

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**APPENDIX B**  
**ADDITIONAL REQUIREMENTS**  
**FOR**  
**OUTDOOR MEDIUM AND HIGH VOLTAGE SWITCHGEAR**

The IPS-M-EL-144(1) mainly specifies assemblies for indoor installation. Where this standard specification is used for the manufacture of outdoor equipment the following clauses shall also be taken into consideration.

**A. Service Condition**

- The outdoor ambient air temperatures are indicated in data sheet Appendix A. The outdoor type switchgear shall be suitable for operation at the specified ambient conditions.
- The location in which the outdoor type switchgear will be installed shall be classified as Safe Area according to the recommendations of IEC 60079-10 and API RP505.
- This standard specification does not cover the switchgears suitable for installation in hazardous areas (zone 1 and zone 2). The outdoor type switchgear specified herein could only be installed outdoor in Safe Areas.

**B. General Requirements**

**B.1 Enclosure**

- The switchgear assembly for outdoor application shall be housed in a non walk-in weatherproof cabinet or cubicle with a degree of protection of IP55W conforming to IEC 60529. Each section of the enclosure shall be equipped with a hinged front door with provision for padlocking.
- Weatherproofing of outdoor cabinet or cubicle shall be tested according to the method recommended in Annex CC of IEC 60298.
- Each section of outdoor type enclosure shall include anti-condensation heater conforming to article 7.6 of this standard specification.
- Within it section of outdoor type enclosure one lamp receptacle with on/off switch for interior illumination and one 230 Volt receptacle with integral ground fault protection for electric tools shall be provided.
- Outdoor type switchgear shall always be provided with suitable rain/sun canopy.

**B.2 Busbars**

- The busbars for outdoor type switchgear shall be silver coated and shall conform to article 5.2 of this standard specification.

**C. Major Components**

**C.1 Circuit breaker**

- Circuit breakers in outdoor switchgear shall be stored energy spring operated type and shall be equipped with manual charging mechanism. Manual operating mechanism for closing and tripping of such circuit breakers shall also be provided.

## Note to Users

The IPS Standards reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS publications are based on internationally acceptable standards and include selections from the options stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement or diversity of conditions of each project or work.

For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The users of IPS publications are therefore requested to send their views and comments, including any addendum prepared for particular cases to the Ministry of Petroleum, Standards and Research Organization. These comments and recommendations will be reviewed by the relevant technical committee and will be incorporated in the formal revision of the relevant IPS. The IPS publications are reviewed and revised approximately every five years.

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