

Supplementary Specification to IEC 62271-200 High-voltage Switchgear and Controlgear

NOTE This version (S-620J) of the specification document provides the justification statements for each technical requirement, but is otherwise identical in content to S-620.

Revision history

VERSION	DATE	PURPOSE
1.1	January 2022	Issued for Public Review
1.0	October 2018	First Edition

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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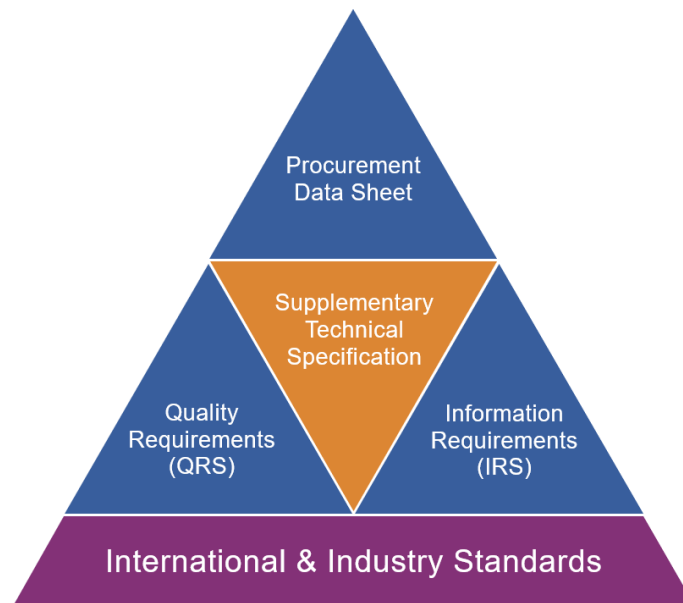
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Introduction

The purpose of this specification is to define a minimum common set of requirements for procurement of high-voltage switchgear and controlgear assemblies in accordance with IEC 62271-200, Edition 3.0, May 2021, for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.



JIP33 Specification for Procurement Documents Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-620: Supplementary Specification to IEC 62271-200 High-voltage Switchgear and Controlgear

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to IEC 62271-200, following the IEC 62271-200 clause structure. Clauses from IEC 62271-200 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to IEC 62271-200 defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

IOGP S-620D: Procurement Data Sheet for High-voltage Switchgear and Controlgear

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-620L: Information Requirements for High-voltage Switchgear and Controlgear

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-620Q: Quality Requirements for High-voltage Switchgear and Controlgear

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS follows that of IEC 62271-200 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) user defined requirements (procurement data sheet, IRS, QRS);
- d) this specification;
- e) IEC 62271-200.

1 Scope

Replace fourth list item with

- indoor installation.

Justification

The majority of assemblies included in the scope of this specification are intended for use indoors as per industry design philosophies, therefore the additional effort required to include outdoor assemblies also is considered disproportionate in relation to the potential benefits realized. Refer to the 80% guidance applied throughout JIP33.

Replace third paragraph with

This specification:

- addresses both three-phase air insulated switchgear (AIS) and three-phase gas insulated switchgear (GIS) with either fixed, removable or withdrawable parts or combinations thereof;

Justification

As per parent standards however "fluid-filled" compartments is replaced with "gas insulated switchgear" as this is deemed more specific and appropriate for the applications typically procured for by our industry. The description relating to removable or withdrawable parts provides further definition to the parent standard.

Add new list item

- for IEC 61850 digital interfaces, establishes minimum default selections from the options given in IEC 62271-3;

Justification

IEC 62271-3 provides the options considered appropriate for HV switchgear from those identified in IEC 61850, this specification aligns with those to ensure rationalization with regards to HV assemblies.

Add new list item

- specifies additional requirements for generator circuit-breakers to IEC/IEEE 62271-37-013.

Justification

Generator circuit breakers are prolific in our industry and the inclusion of this feature in S-620 ensures alignment with IEC/IEEE 62271-37-013 and rationalizes selection criteria for this application.

Add to subclause

This specification does not cover:

- high-voltage switchgear and controlgear assemblies installed outdoors, other than bus duct and outdoor termination bushings;
- detailed user requirements for electrical control and management systems (ECMSs);
- detailed requirements for optional switchgear condition monitoring systems;
- integrated power semiconductor systems;

- integrated high-voltage variable (adjustable) speed drives to IEC 61800-5;
- ring main units;
- explosion protected "Ex" equipment (incorporating a type of explosion protection covered by the IEC 60079 series of standards);
- direct current (DC) uninterruptible power supply systems for auxiliary power.

Justification

The above was agreed to be excluded from scope when S-620 was framed in initial specification development in 2018. In the intervening period no justification or evidence has been brought to the attention of the workgroup, either from purchasers or suppliers to revisit this list. Therefore it should remain as is, as per JIP33 specification maintenance guidelines.

2 Normative references

Add to clause

IEC 60038, *IEC standard voltages*

IEC 60051-1, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts*

IEC 60051-2, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 2: Special requirements for ammeters and voltmeters*

IEC 60051-3, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 3: Special requirements for wattmeters and varmeters*

IEC 60092-101, *Electrical installations in ships - Part 101: Definitions and general requirements*

IEC 60099-4, *Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems*

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60255, *Electrical relays – All parts as applicable*

IEC 60269-1, *Low-voltage fuses – Part 1: General requirements*

IEC 60269-2, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K*

IEC 60282-1, *High-voltage fuses – Part 1: Current-limiting fuses*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60644, *Specifications for high-voltage fuse-links for motor circuit applications*

IEC 60688, *Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals*

IEC 60947-51, *Low-voltage switchgear and controlgear – Part 51: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC TR 61000-5-2, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling*

IEC TR 61000-5-5, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 5: Specification of protective devices for HEMP conducted disturbance*

IEC 61511-1, *Functional safety – Safety instrumented systems for the process industry sector – Part 1: Framework, definitions, system, hardware and application programming requirements*

IEC 61554, *Panel Mounted Equipment – Electrical Measuring Instruments – Dimensions for Panel Mounting*

IEC 61850, *Communication networks and systems for power utility automation*

IEC 61869-1, *Instrument transformers – Part 1: General requirements*

IEC 61869-2, *Instrument transformers – Part 2: Additional requirements for current transformers*

IEC 61869-3, *Instrument transformers – Part 3: Additional requirements for inductive voltage transformers*

IEC 61869-5, *Instrument transformers – Part 5: Additional requirements for capacitor voltage transformers*

IEC 61869-6, *Instrument transformers – Part 6: Additional general requirements for low-power instrument transformers*

IEC 61869-10, *Instrument transformers – Part 10: Additional requirements for low-power passive current transformers*

IEC 61869-11, *Instrument transformers – Part 11: Additional requirements for low power passive voltage transformers*

IEC 61892-1, *Mobile and fixed offshore units – Electrical installations – Part 1: General requirements and conditions*

IEC 61892-3, *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment*

IEC 62052-11, *Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment*

IEC TR 62061-1, *Guidance on the application of ISO 13849-1 and IEC 62061 in the design of safety-related control systems for machinery*

IEC 62271-1:2017, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear*

IEC 62271-3, *High-voltage switchgear and controlgear – Part 3: Digital interfaces based on IEC 61850*

IEC 62271-4, *High-voltage switchgear and controlgear – Part 4: Handling procedures for sulphur hexafluoride (SF₆) and its mixtures*

IEC 62271-200:2011, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC/IEEE 62271-37-013, *High-voltage switchgear and controlgear – Part 37-013: Alternating current generator circuit-breakers*

IEC 62271-102, *High-voltage switchgear and controlgear – Part 102: High-voltage alternating current disconnectors and earthing switches*

IEC 62271-106, *High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor starters*

IEC 62271-206, *High-voltage switchgear and controlgear – Part 206: Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

3 Terms and definitions (IEC 62271-1 Clause 3)

3.5 Parts of switchgear and controlgear

Add new term

3.5.122

bus coupler

functional unit that contains a mechanical switching device, which electrically connects together two bus sections

Add new term

3.5.123

bus section

number of functional units normally connected together in service by a physically continuous main busbar

4 Normal and special service conditions

Add to subclause

Outdoor portions of bus ducts and outdoor bushings shall be in accordance with IEC 62271-1, 4.1.3.

Justification

Original S-620 scope framing excludes outdoor assemblies, however section 1 paragraph 5 details that bus duct and outdoor termination bushings are included. Therefore this reference to IEC 62271-1 4.1.3 specifies the environmental conditions to be applied to outdoor bus duct and outdoor termination bushings.

5 Ratings (IEC 62271-1 Clause 5)

5.2 Rated voltage (U_r)

5.2.1

Add to subclause

The assembly shall be rated to withstand with a three-phase nominal system voltage variation not exceeding $\pm 10\%$ in accordance with IEC 60038.

Justification

$\pm 10\%$ aligns with the IEC default value stated in IEC 60038 Table 3. It is also acknowledged that IEC 61892-1 Table 1 states $\pm 6\%$, however if we standardise on $\pm 10\%$ this should be as per manufacturer standard offering in most cases and therefore satisfies offshore application also. Note: This has been transferred from the DS to the TRS to improve standardization.

5.2.2

Add to subclause

The assembly shall be rated to operate with a system voltage transient variation not exceeding +/-15 % with 1,5 s recovery time in accordance with IEC 61892-1.

Justification

+/-15 % aligns with the IEC 61892-1 Table 1. Note: This has been transferred from the DS to the TRS to improve standardization.

5.2.3

Add to subclause

The assembly shall be rated to operate with a system voltage maximum variation not exceeding +/-20 % in accordance with IEC 61892-1.

Justification

+/-20 % aligns with the IEC 61892-1 Table 1. Note: This has been transferred from the DS to the TRS to improve standardization.

5.2.4

Add new subclause

The assembly shall be rated to operate with a power system supply voltage harmonic content not exceeding 6,5 % total harmonic distortion (THD).

Justification

The parent standard is silent on maximum power system supply voltage harmonic content, however this value gives further scope definition to the supplier with regards to the rating of the assembly. The value of 6,5 % aligns with IEC 61000 Table 2 planning levels for power system supply voltage harmonic content. This value is unchanged from the previous revision of S-620 and has not been raised as an issue by suppliers or purchasers.

Add NOTE

NOTE The THD values of 6,5 % is in accordance with IEC TR 61000-3-6:2008, Table 2 planning levels.

Justification

Provides the user with confirmation regarding the origin of 6,5 % THD and hence the product they are specifying being in accordance appropriate IEC standards.

5.3 Rated insulation level (U_d , U_p , U_s)

Add to subclause

Main busbars, branches and fixings installed in air filled compartments shall be insulation covered with a facility for inspection.

Justification

Uninsulated main busbars and branches present a risk of arc flash and electric shock which could be fatal, especially in high voltage applications. Not only do insulated busbars and branches prevent inadvertent or accidental contact by personnel, they also protect against short circuit caused by equipment failure, dropped objects, foreign body ingress, moisture ingress and wildlife. Insulated busbars have been a mandatory requirement by many for decades and contribute to a safe working environment for personnel in our industry.

5.5 Rated continuous current (I_r)

In first sentence of first paragraph, replace "addition" with

additions

Justification

"additions" made plural as S-620 has further requirements. This is very much an editorial change only.

Add to subclause

AIS assemblies with a rated continuous current less than or equal to 3 150 A shall not depend on forced ventilation.

Justification

Reduces variants and optimizes reliability for this range of assemblies due to the omittance of fans, which are prone to failure, especially bearing failure, which is common in this application when they are mounted vertically. This has been in version 1 of S-620 and has not been raised as an issue by either suppliers or purchasers during this time. The value of 3150 A is considered a realistic threshold for AIS assemblies as at higher current ratings, it is not always possible to avoid use of forced cooling if other aspects such as IP rating are to be maintained.

Add to subclause

GIS assemblies with a rated continuous current less than or equal to 2 500 A shall not depend on forced ventilation.

Justification

Reduces variants and optimizes reliability for this range of assemblies due to the omittance of fans, which are prone to failure, especially bearing failure, which is common in this application when they are mounted vertically. This has been in version 1 of S-620 and has not been raised as an issue by either suppliers or purchasers during this time. The value of 2500 A is considered a realistic threshold for GIS assemblies as at higher current ratings, it is not always possible to avoid use of forced cooling if other aspects such as IP rating are to be maintained.

Add to subclause

Main busbars shall be rated for the current inclusive of derating factors throughout.

Justification

This reduces ambiguity where all derating factors are applied prior to confirming main busbar continuous rating. By stating this applies to the entire length confirm the rating is consistent throughout and prevents supplier reducing busbar capacity at the extremities of the assembly. This reduces variations and prevents

complexities for the user when performing system calculations and confirming system capabilities and characteristics.

Add to subclause

Busbars in air insulated or gas-air mixture filled compartments shall be manufactured from hard drawn, high conductivity electrolytic copper.

Justification

Hard drawn copper has lower electrical resistance, lower power loss, lower voltage drop and higher ampacity. so therefore provides optimal performance with regards to high voltage power distribution. It also requires minimal maintenance compared to aluminium, which is also offered by suppliers. This is partly due to the busbar being manufactured from oxygen free copper, as opposed to aluminium, which is prone to oxidation, therefore needs regular monitoring. Also aluminium typically required more CSA for the equivalent current than copper, hence this can result in a larger footprint of switchboard. It should be noted that aluminium is lighter, but this generally doesn't outweigh the benefits stated above.

5.6 Rated short-time withstand currents (I_k , I_{ke})

5.6.102 Rated short-time phase-to-earth withstand current (I_{ke})

Replace second sentence with

The value of rated short-time phase to earth withstand current (I_{ke}) shall be at least 87 % of the rated short-time withstand current (I_k) of the main circuit.

Justification

The parent standard acknowledges that For systems with isolated neutral, the maximum single-phase-to-earth fault current could theoretically reach levels up to 87 % of the three-phase rated arc fault current (single-phase-to-earth fault current under conditions of double-earth fault). However, double-earth faults at independent locations in the proximate vicinity of a single-phase-to-earth fault subjected assembly have a very low probability. In the interests of standardisation and reduction of variants this requirement makes this mandatory as per previous version of S-620.

5.7 Rated peak withstand current (I_p , I_{pe})

5.7.102 Rated peak phase to earth withstand current (I_{pe})

Replace second sentence with

The value of rated peak phase to earth withstand current (I_{pe}) shall be at least 87 % of the rated peak withstand current (I_p) of the main circuit.

Justification

The parent standard is silent on the lower limit for peak phase to earth withstand current. The value of 87% is aligned with guidance provided in IEEE 3002.3-2018 which advises that peak phase to earth currents are typically 87% of rated peak currents.

5.8 Rated durations of short circuit (t_k , t_{ke})

5.8.102 Rated duration of phase to earth short circuit (t_{ke})

Replace second sentence with

The value of rated duration of phase to earth short circuit (t_{ke}) shall be equal to the rated duration of short circuit (t_k) of the main circuit.

Justification

Specifying the rated duration of the short time phase to earth withstand current rating is equal to that of the main circuit ensures consistency with regards to assessing the performance criteria of the assembly. This also assists with power system analysis where modelling does not become unnecessarily complex. This requirement has been carried over from S-620 version 1, where it has not been raised for consideration by suppliers or purchasers during the 2021 review.

5.103 Ratings of the internal arc classification (IAC)

5.103.2 Types of accessibility

Add to subclause

Equipment shall be accessible from the front, except for cable termination chambers.

Justification

To increase standardisation access will be from the front of the enclosure, this is the most common standard offering for O&G applications and is within the > 80% range. It is noted that it is impractical to access cable termination chambers from the front in many instances, hence this detail is also addressed in this specification.

Add to subclause

Components in back-to-wall mounted high-voltage switchgear and controlgear assemblies shall be accessible from the front only.

Justification

All equipment inside the enclosure will be accessible from the front, this negating the possibility that some equipment may be inaccessible in this arrangement, where the rear of the assembly access is impossible due to it backing on to a wall.

6 Design and construction

6.1 Requirements for liquids in switchgear and controlgear

Replace subclause with

Liquids shall not be used as a switching or an insulating medium.

Justification

Liquid (typically oil) immersed circuit breakers have been slowly phased out of use in the oil and gas industry. The reasons for this include increased maintenance requirements (oil levels and regular testing of

the oil's insulating properties) and environmental issues around the risks associated with oil leaks and oil disposal. These issues can be eliminated by utilising air or gas units.

6.3 Earthing of switchgear and controlgear

6.3.101 Earthing of the high-voltage conductive parts

Add to subclause

Facilities for earthing the high-voltage conductive parts shall be provided on the incoming side of supply (generator/transformer) circuits and on the outgoing (cable) side of feeder/load circuits in accordance with Figures 1 to 7 to the provided loss of service continuity (LSC) category.

Justification

Whilst the features described may be considered as standard offerings its necessary to be explicit as these are instrumental for personnel safety and align with established operational procedures of OpCos. Figure 8 has been excluded as it refers to the bus-section and Figure 9 has been excluded as it is categorised as "No LSC" which is doesn't align with this specification.

Add to subclause

Facilities for earthing the high-voltage conductive parts of each bus section shall be provided via the incoming supply functional units or via dedicated busbar earthing compartments.

Justification

Reduces variants by standardizing earthing facilities and ensuring these are aligned with user's operational procedures and equipment.

Add to subclause

Earthing devices shall be arranged for manually initiated operation only.

Justification

Operating procedures generally are written to support manually initiated operation. One of the benefits of this is the operator physically checks the earth has been made.

Add NOTE

NOTE Contactor feeder functional units serving circuits without back-feed may have outgoing circuit earthing automatically applied following a manually initiated isolation action or functional unit withdrawal.

Justification

It is acknowledged that 6.3.101 can be deemed unnecessary for the application described in this above note, therefore this provides the supplier with guidance with regards to this to ensure a pragmatic approach.

6.3.102 Earthing of the enclosure(s)

Add to subclause

A hard-drawn high conductivity copper earth bar shall be installed along the length of the assembly.

Justification

Provision of an earth bar spanning the entire length of the assembly is common-place and ensures a uniform product where earthing points are provided locally to all cubicles and components, hence minimizing connector lengths and contrived routing of these interconnector where this feature would otherwise not be provided. This feature also ensures access to the earth bar is optimized, this is a benefit for future operations and maintenance. It is acknowledged this is a standard offering amongst suppliers, however the inclusion of this requirement ensures this practice will continue and new supplier are aware of this.

Add to subclause

Earth bar ends shall have provision for bolted connection of an external earth cable connection.

Justification

Provides flexibility for future expansion and project work where connection to an established earth point is available. This cost of this feature is deemed minimal, however it can be of significant value to the user when required.

Add new subclause

6.3.105 Earthing for withdrawable type switchgear

6.3.105.1

For busbar earthing via a withdrawable truck mounted earthing switch, the manufacturer shall provide a dedicated earthing truck for every high-voltage switchboard assembly.

Justification

It is possible that the withdrawable truck mounted earthing switch (where applicable) may not always be provided with the assembly as it may be specified separately. This can lead to it being missed during procurement, which can cause delays and disruption to projects. This could be deemed "motherhood" but is considered of value for the avoidance of doubt from the suppliers.

6.3.105.2

Insertion of the withdrawable busbar earthing device shall only be possible for incoming supply functional units or dedicated busbar earthing compartments.

Justification

This is for safety to ensure the withdrawable truck mounted earthing switch cannot be mistakenly inserted into a compartment for which it was not intended, as the outcome of this could result in an inadvertent short circuit to earth.

6.3.105.3

Application of an earth connection to high-voltage conductive parts shall only be possible when the main circuit switching device within the functional unit is isolated and not in the service position.

Justification

This is a safety measure to ensure application of an earth connection to live high-voltage conductive parts cannot be mistakenly made, as the outcome of this could result in an inadvertent short circuit to earth.

6.3.105.4

Insertion of a withdrawable main circuit switching device into the service (circuit) position shall not be possible when the earthing provision within the same functional unit is connected.

Justification

This is a safety measure to ensure application of an earth connection to live high-voltage conductive parts cannot be mistakenly made, as the outcome of this could result in an inadvertent short circuit to earth.

Add new subclause

6.3.106 Earthing for non-withdrawable (fixed) type switchgear

6.3.106.1

Facilities for incoming and outgoing circuit earthing shall be via the functional unit circuit-breaker or by an integrated three-position switch.

Justification

Aligns with OpCo electrical safety rules, operating philosophies and isolation procedures and ensure safety measures relating to switchboard earthing are consistent which enhances safety.

6.3.106.2

The bus coupler functional unit shall incorporate the busbar earthing system and provide integrated facilities for earthing associated bus sections.

Justification

Integration of the busbar earthing system in the bus coupler ensures that earth connections are always made according to the bus coupler status with no further actions to be performed by the user. This also ensure that earth connections are made in real time with the conductors. This integrated feature can also minimize additional maintenance and potential faults.

6.3.106.3

Application of an earth connection to high-voltage conductive parts shall only be possible when the main circuit switching device within the same functional unit, is isolated and not in the service (circuit) position.

Justification

This is a safety measure to ensure application of an earth connection to live high-voltage conductive parts cannot be mistakenly made, as the outcome of this could result in an inadvertent short circuit to earth.

6.3.106.4

De-isolation and closing of the main circuit switching device shall not be possible when the earthing provision within the same functional unit is applied.

Justification

This is a safety measure to ensure application of an earth connection to live high-voltage conductive parts cannot be mistakenly made, as the outcome of this could result in an inadvertent short circuit to earth.

Add new subclause**6.3.107 Voltage detecting and indicating systems****6.3.107.1**

Where specified, voltage detecting and voltage presence indicating system shall be of the capacitive three-phase voltage type to confirm the presence and absence of main circuit voltage in accordance with IEC 62271-213 and IEC 62271-215.

Justification

Provides definition and minimum requirements for voltage detecting systems which are considered fundamental for personnel safety. Version 1 of S-620 made reference to IEC 61243-5 which has now been withdrawn and IEC confirms it has been partially replaced by IEC 62271-213 and IEC 62271-215.

6.3.107.2

Where specified, voltage detectors and voltage presence indicators shall be adjacent to the connection (cable) compartment on incoming circuits and outgoing feeders, and on the front of bus coupler panels.

Justification

Provides definition with regards to the coverage of voltage indication on the voltage detection system. The presence of indication at each incoming feeder, outgoing feeder and bus coupler is imperative and whilst IEC 62271-213 and IEC 62271-215 describe the functionality of these systems they are silent on where they should be located.

6.3.107.3

Where voltage indicating and detection systems are specified, measuring test points for connection of an external phase comparator (phasing-out) instrument shall be provided.

Justification

To facilitate confirmation of phase rotation sequence (this activity is known as phasing out) which is essential when connecting two systems. It is common practice to perform this using external phase comparator instruments.

6.4 Auxiliary and control equipment and circuitsAdd new subclause**6.4.1 General (IEC 62271-1 Subclause 6.4.1)****6.4.1.1**

Incoming auxiliary and control power supplies shall initiate an alarm on loss of availability.

Justification

Loss of availability must be brought to the attention of the operator immediately so measures can be taken to limit potential loss of production or service.

6.4.1.2

Functional unit auxiliary and control supplies shall be protected by dedicated MCBs.

Justification

Functional unit auxiliary circuits which derive their power supply from an external source shall be connected via auxiliary switch contacts which can be de-energized if the main circuit switching device is isolated. This is a safety function which also ensures production/service is not interrupted with regards to surrounding functional units.

6.4.1.3

Auxiliary and control supply MCBs shall incorporate an auxiliary contact to initiate a trip remote alarm.

Justification

Whist this facility is common place on most MCBs this requirement ensures this definition is within the specification and therefore removing the potential for where this facility may not be provided, due to cost cutting by supplier or lack of foresight.

6.4.1.4

Failure of the functional unit tripping circuit supply shall inhibit main circuit-breaker/contactors closure and initiate local and remote alarms.

Justification

Prevents the main circuit being energized where the tripping circuit is compromised, which would result in an unsafe system.

6.4.1.5

Low-voltage fuses shall conform to IEC 60269-1 and IEC 60269-2.

Justification

Provides definition to minimum standards of fuses. Where fuses do not comply to a minimum standard there is risk they may not operate with the required time, as per circuit design, there is also the risk they cause nuisance tripping, which is detrimental to production/service and incurs additional unnecessary costs. IEC 60269-1 and 2 are recognised as the industry standard for LV fuses.

6.4.1.6

Auxiliary and control circuits powered from an external source shall be clearly identified.

Justification

Safety feature to protect personnel from exposure to live terminals. Electrocution due to contact with live terminals where multiple power supplies are present is well documented and this will go some way to mitigate this hazard.

6.4.1.7

Circuits operating at above safety extra low voltage shall incorporate removable links or isolation facilities.

Justification

Safety feature to define the voltage at which isolation provision is to be included.

Add new subclause**6.4.2 Auxiliary components****6.4.2.1**

Protection, control, indication, metering, supervisory input/output and communication functions shall be provided by multifunction IEDs.

Justification

Multifunction IEDs are favoured to discrete relay and supporting components due to the perceived improved reliability, user functionality, interface capabilities and reduced footprint.

6.4.2.2

Plug-in type auxiliary components shall be provided with retaining clips.

Justification

Ensures auxiliary components plug-in auxiliary components are securely seated and are not able to disconnect spuriously due to vibration or other and/or other external influences.

Add new subclause**6.4.3 Actuators and indication****6.4.3.1**

The colour and marking of actuators (push buttons) shall be in accordance with IEC 60204-1.

Justification

Consistency with regards to colouring and marking is a safety factor to aid operator familiarity with equipment. IEC 60204-1 Safety of machinery - Electrical equipment of machines - Part 1: General requirements.

6.4.3.2

Where colour defines function, actuators shall be green for start/on and red for stop/off.

Justification

Consistency with regards to colouring and marking is a safety factor to aid operator familiarity with equipment. IEC 60204-1 Safety of machinery - Electrical equipment of machines - Part 1: General requirements.

6.4.3.3

Colour coding of status on indication components and colour HMI screens shall be in accordance with Table 105.

Justification

Consistency with regards to status indication of equipment throughout industries and organisations is fundamental in ensuring operator safety.

Add new Table 105**Table 105 – Colour coding of status indicator**

Colour	Meaning	High-voltage – Assembly application	
	Safety of persons or environment	Circuit-breaker	Motor starter / contactor feeder
Red	Danger	Closed (On)	Running (On)
Yellow	Warning/caution	Tripped	Tripped
Green	Safe	Open (Off)	Stopped (Off)
Blue	Mandatory significance	Trip circuit healthy (or unhealthy)	Not applicable
White	No specific meaning assigned	Voltage indication (Heater On)	Motor heater on
NOTE Colours detailed in the table are in accordance with IEC 60073.			

NOTE Colour coding of status indicator does not apply to IEDs or protection relays with a suite of status LEDs which are all the same colour.

Justification

IED indication cannot be changed and it's assumed that personnel referring to status of IED will be competent to understand status regardless of colour, Also in most cases this status of the IED will be replicated on the main display, which will be in conformance with the above requirement(s).

6.4.3.4

Discrete indication lamps shall be light emitting diode (LED) types.

Justification

Rationalizes spares inventory and mitigates wrong lamp/voltage being installed.

6.4.3.5

Discrete indication lamps shall operate at the same voltage for interchangeability purposes except those directly connected to heater supply circuits

Justification

For heater supply circuits it is common for the status lamp to be in series with the heater to provide. This practice minimizes the risk of the heater being mistakenly assumed as 'off' by reducing the amount of components which are susceptible to failure in the circuit.

Add new subclause**6.4.4 Auxiliary contacts****6.4.4.1**

Auxiliary circuit connections on withdrawable devices shall be by self-aligning contacts or a multi-conductor cable with plug and socket arrangement.

Justification

Withdrawable devices which do not require manual disconnection on a terminal-by-terminal basis, for example by unscrewing them from a terminal block, can be removed and reinstalled without the need for specialist tools. This also negates the risk of incorrect reconnection, also the time taken to perform this operation is minimized.

6.4.4.2

High-voltage switching device volt free auxiliary contacts shall be directly activated by the main operating mechanism.

Justification

By being directly operated by the main operating mechanism the chances of false indication are minimized, this is fundamentally in the interests of safety.

6.4.4.3

High-voltage switching device volt free auxiliary contacts shall be a minimum of class 2 in accordance with Table 8 of IEC 62271-1.

Justification

Reduces variants and standardizes on rating of contact class. Class 2 is deemed a pragmatic standard as the lower class (3) is limited to 200 mA rated continuous current and this is likely to be insufficient for a number of typical applications. Class 2 is rated at 2 A. For info, Class 1 is rated at 10 A

6.4.4.4

Slave relay contacts shall be terminated at the low-voltage control compartment.

Justification

Reduces amount of equipment in the high voltage compartments, which is a safety consideration to protect personnel during O&M activities.

6.4.5.1 General requirements for auxiliary and control circuit components

6.4.5.1.1

Control and auxiliary device utilization categories shall be in accordance with IEC 60947-5-1.

Justification

Standardizes requirements for control and auxiliary devices installed in enclosures to ensure a defined standard for equipment, by complying to: IEC 60947-5-1 Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices.

6.4.5.1.2

AC switching elements shall be utilization category AC-15.

Justification

Standardizes requirements for control and auxiliary devices installed in enclosures to ensure a defined standard for equipment. AC-15 is applicable to control of A.C. electromagnetic loads in accordance with 60947-5-1.

6.4.5.1.3

DC switching elements shall be at least utilization category DC-13.

Justification

Standardizes requirements for control and auxiliary devices installed in enclosures to ensure a defined standard for equipment. DC-13 is applicable to the control of D.C. electromagnetics in accordance with 60947-5-1.

6.4.5.1.4

Rated operational currents (I_e) shall be at least 5 A at 230 V AC rated operational voltage and 1 A at 110 V DC rated operational voltage.

Justification

Standardizes requirements for control and auxiliary devices installed in enclosures to ensure a defined standard for equipment, by complying to: IEC 60947-5-1 Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices.

6.4.5.2 Heating elements

6.4.5.2.1

Space heaters internal to assemblies shall have a degree of protection of at least IP2X in accordance with IEC 60529.

Justification

A safety feature to prevent personnel from coming into contact, with directly or indirectly e.g. by contact via a hand tool or inspection apparatus. IP2X stands for an IP rating 2 for solids with no testing performed for liquids.

6.4.5.2.2

Space heaters internal to assemblies shall incorporate a mechanical guard where heater surface temperature exceeds 60 °C.

Justification

Prevents personnel from being injured from contact with heater surface. 60 °C is deemed as the maximum temperature metal can reach for which no injury will be incurred in accordance with IEC 60950-1.

6.4.5.2.3

Assembly space heaters and motor space heaters shall be individually powered from external discrete sources.

Justification

Facilitates isolation of individual bus sections for maintenance purposes.

6.4.5.2.4

Assembly and motor space heaters shall be protected by a 30 mA residual current device with volt free contact wired to terminals.

Justification

Life-saving device to prevent personnel from electric shock and protection against electrical fires. 30 mA is industry standard.

6.4.5.2.5

Motor space heater auxiliary circuits shall be energized when the main circuit switching device is open, in the service and the test position.

Justification

This feature is inherent to the switchboard cubicle operating philosophy therefore must be communicated to the supplier. Most likely more prevalent in our industry where motors are located in environments where space heaters are required.

6.4.5.2.6

Assembly space heater supplies shall have a front of panel indicating LED lamp with a label engraved "Heater supply on".

Justification

Safety function to alert persons personnel accessing the assembly that whilst the main contactor may be isolated, the space heater remains energised. Consistent with S-560.

6.10 Pressure/level indication**Add to subclause**

Local indication and alarms with remote interfaces shall be provided.

Justification

Safeguards against undetected low pressure.

6.12 Locking devices

Busbar section earthing switches shall be interlocked to prevent closure in advance of securing incomers, interconnectors and back-feed circuits in the out-of-service position.

Justification

Safety feature to prevent a short circuit to earth occurrence where a connection to earth via the bus coupler earth switch is made whilst the busbar remains connected to an energized power source.

Add to subclause

Facilities shall be provided for padlocking high-voltage compartment doors closed.

Justification

Typical industry wide measures to protect personnel from electric shock and in some cases to facilitate cooperation with local electrical safety rules and insulation procedures.

Add to subclause

Facilities shall be provided for padlocking disconnectors and circuit-breakers in the open position.

Justification

Typical industry wide measures to protect personnel from electric shock and in some cases to facilitate cooperation with local electrical safety rules and insulation procedures.

Add to subclause

Facilities shall be provided for padlocking safety shutters closed when withdrawable functional units are removed.

Justification

Typical industry wide measures to protect personnel from electric shock and in some cases to facilitate cooperation with local electrical safety rules and insulation procedures.

Add to subclause

Facilities shall be provided for padlocking earth switches and circuit-breakers.

Justification

Typical industry wide measures to protect personnel from electric shock and in some cases to facilitate cooperation with local electrical safety rules and insulation procedures.

Add to subclause

Switching device local/remote selector switches shall be lockable in "local" and "remote" positions.

Justification

The ability to lock the control position in both 'local' and 'remote' positions depending on operational requirement is imperative as if the status was changed without authorization it could adversely affect plant production, operation and integrity.

6.16 Gas and vacuum tightness

Add to subclause

The relative leakage rate F_{rel} for SF6 and SF6 mixtures shall not be greater than 0,1 % per year.

Justification

This is an environmental consideration which is supported by OpCos and met by supplier with no further comments or concerns raised in reviews performed to date. IEC 62271-1:2017 requires a less onerous value

of 0,5 % per year, however as part of ongoing environmental industry goals the above is deemed appropriate.

6.101 General requirements for assemblies

Add to subclause

Assemblies specified for marine installation shall be in accordance with IEC 60092-101.

Justification

IEC 60092-101 Electrical installation in ships - Part 101: Definitions and general requirements is an industry recognised minimum standard and ensures consistency of supplier offerings for marine applications. It is an established benchmark to identify suitability and has been proven to meet purchaser requirements.

Add to subclause

Assemblies specified for offshore installation shall be in accordance with IEC 61892-3.

Justification

IEC 61892-3 Mobile and fixed offshore units - Electrical installations - Part 3: Equipment requirements is an industry recognised minimum standard and ensures consistency of supplier offerings for mobile and fixed offshore applications. It is an established benchmark to identify suitability and has been proven to meet purchaser requirements.

Add to subclause

Assemblies shall be rated for continuous operation at rated load under normal service conditions for at least 45 000 h (5 years).

Justification

De-energisation of switchgear can be disruptive to plant operations and in our industry the loss of production is significant. Therefore a minimum period of operation allows shutdown and operational interruptions to be planned with a degree of confidence, as suppliers take the necessary measures to be able to confirm compliance with this requirement. This requirement also provides added definition to the mode of operation between maintenance, to ensure no ambiguity exists.

Add to subclause

During the continuous operation period of 45 000 h (5 years), the main busbars and the distribution busbars (dropper system) shall not require de-energizing for maintenance or inspection.

Justification

De-energisation of switchgear can be disruptive to plant operations and in our industry the loss of production is significant. Therefore a minimum period of operation allows shutdown and operational interruptions to be planned with a degree of confidence, as suppliers take the necessary measures to be able to confirm compliance with this requirement. This requirement also provides added definition to the mode of operation between maintenance, to ensure no ambiguity exists.

6.102 Enclosure

6.102.1 General

Replace first sentence of fifth paragraph with

The enclosure shall have a degree of protection of at least IP3X in accordance with IEC 60529.

Justification

Previous version of S-620 stated IP3XW shall be minimum, however the supplementary letter 'W' is not verified and has been questioned by suppliers as to its value. Therefore it is proposed to revert to IP3X and provide add IP3XW to the data sheet selections, its appreciated this must be agreed by the workgroup before a final decision is reached. The protection level of IP3X is greater than the parent standard level of IP2X, however IP3X is met as standard by all suppliers consulted in this process, therefore it is deemed to be prudent to have this as a minimum.

6.102.2 Covers and doors

In first sentence of second bullet of subclause b), replace “with provision for locking” with

with provision for padlocking

Justification

Padlocking is a standard method of isolating compartments and most OpCo isolation procedures and electrical safety rules are written as such. Therefore this is the practice operators are familiar with.

Add to subclause

Doors or covers with mounted electrical components shall have supplemental equipotential bonding in accordance with IEC 60364-4-41.

Justification

Ensures earth paths are not reliant on conductivity of hinges, mounting screws and brackets to provide continuity to main earth points. Whilst this may be considered as a motherhood requirement, it is critical and is not explicitly stated in either IEC 62271-200 or IEC 62271-1, therefore its inclusion here is deemed as warranted.

Add to subclause

On floating offshore, mobile offshore or marine installations, doors shall be securable in the open position.

Justification

Manufacturers standard offerings may well not be provided with facilities for securing doors in the open position. Whilst this is acceptable for onshore or fixed offshore assets, where there is a potential for pitch and roll it is imperative doors can be locked in the open position so when work or inspections are being performed in the functional compartment, there is not the risk of doors swinging closed.

6.103 High voltage compartments

6.103.1 General

Add to first paragraph after list

For GIS assemblies, the minimum LSC category shall be LSC2.

Justification

LSC2 is defined as '3.6.102 category LSC2 <of a functional unit> category of functional units having at least a separate accessible compartment for the high-voltage connection of that functional unit (called connection compartment), such that, when this compartment is open, at least one busbar may remain energized and all other functional units of the assembly may be operated normally. This is intended to allow maximum continuity of service of the network during access to the high-voltage compartments inside the assembly. It means that opening of accessible high-voltage compartments in a functional unit is possible while keeping the other functional units of the same section energized.

Add to first paragraph after list

For AIS circuit-breaker functional units, the minimum LSC category shall be LSC2B.

Justification

LSC2B is defined as '3.6.104 category LSC2B <of a functional unit> category of functional units of category LSC2A, where the high-voltage connections (e.g. cable connections) to the functional unit may remain energized when any other accessible high-voltage compartment (other than its connection compartment and the busbar compartment of single-busbar assemblies) of the corresponding functional unit is open'. In addition to the requirements of LSC2A, the high-voltage connections (e.g. cables) to the functional unit being accessed may be kept energized. This implies that there also is a point of disconnection, as well as proper partitioning, between the accessed compartment and the high-voltage connections.

Add to first paragraph after list

For AIS contactor feeder functional units, the minimum LSC category shall be LSC2A.

Justification

Inspection of equipment.

Add to fourth paragraph

Busbar compartments shall not contain more than one busbar section.

Justification

Enables busbars to be taken out of service and worked on without causing further disruption with the need to isolate adjacent busbars in the same section.

Add to fourth paragraph

Busbar risers on different sides of a bus coupler switching device shall be in separate compartments.

Justification

Enables busbars to be taken out of service and worked on without causing further disruption with the need to isolate adjacent busbars in the same section.

6.103.2 Fluid-filled compartments (gas or liquid)

6.103.2.4 Pressure relief of fluid-filled compartments

Add to subclause

Compartments shall be provided with a pressure-relief device.

Justification

Fundamental safety feature to safely disperse of excess pressure from compartments.

6.103.3 Partitions and shutters

6.103.3.2 Metal partitions and shutters

Add to subclause

Accessible shutters preventing access to normally live parts, shall be marked in accordance with ISO 7010, Graphical Symbol W012 "Warning; Electricity".

Justification

Safety measure to ensure personnel exposed to assembly internals are aware of live terminals, where they are located behind accessible shutters.

Add to subclause

Three-phase shutters for main conductors shall have a manually operated facility, securable in the open position, for inspection and testing.

Justification

Assists with inspection and maintenance with regards to inspection of busbar to cubicle connections. Aligns with many pre-determined maintenance procedures which exist within OpCo organisations.

Add to subclause

For withdrawable parts, accessible shutters shall be identified in accordance with Table 106.

Justification

Standardizes how these are identified, therefore preventing any cross terminology which may cause confusion resulting in an incident. Note the language used will be application specific and therefore specified in the data sheet with the examples in Table 106 being the default.

Add new Table 106

Table 106 – Identification of accessible shutters

Equipment	Text
Busbars	BUSBAR
Incoming unit supply circuit	SUPPLY
Outgoing unit feeder cables	CIRCUIT

6.104 Removable parts

Add to subclause

Where specified, facilities for remote testing of withdrawable main circuit units shall be provided by means of extension umbilicals or specific test modules.

Justification

Makes explicit the requirement for provision of those test facilities to perform remote testing. These are necessary for performing testing and inspection during the lifetime of the equipment, however may be deemed as outside the basic scope of supply, unless specifically requested.

Add to subclause

Withdrawable main circuit units shall only be interchangeable between positions of same electrical function, rating and duty.

Justification

Ensures units which are of the same dimensions cannot be installed in cubicles where a variation in their specification may introduce a safety issue or cause damage to equipment. The word 'rating' has been added as it without this the requirement is not deemed concise enough as per its intended function.

6.106 Internal arc fault

Add to subclause

The internal arc classification (IAC) of the assembly shall be all sided protection FLR.

Justification

FLR as defined in the parent standard refers to the sides of the assembly which are IAC classified. Suppliers have confirmed no issues with regards to standardizing this specification. This in turn standardizes the safety rating of all applications which enhances safety of personnel and provides OpCo's with consistency in this field.

Add to subclause

Internal arc tests shall be for a rated three-phase arc fault current (I_A) value at least that of the specified short-time withstand current (I_k) for at least an arc fault duration of 0,5 s.

Justification

Defines minimum requirement for internal arc type tests which is relevant to the application for which the assembly will be installed.

Add new subclause

6.107 Labelling and identification

6.107.1 General

6.107.1.1

Graphical symbols, safety colours, safety signs and registered safety signs shall be in accordance with ISO 7010.

Justification

Standardizes signage to ensure operator familiarity maintained which is a safety consideration where personnel may otherwise be presented with inconsistent safety signage.

6.107.1.2

Text-only warning labels shall have white characters on a red background.

Justification

Standardizes signage to optimise legibility.

6.107.1.3

Informative labels shall have black characters on a white background.

Justification

Standardizes signage to optimise legibility.

6.107.1.4

Assemblies shall be provided with a front mounted label incorporating the equipment tag number.

Justification

Standard practice for industry asset equipment to be 'tagged' this requirement ensures any drilling/mounting is under the approval of the supplier.

6.107.1.5

Removable hardware shall be labelled to facilitate identification of its functional unit.

Justification

It is possible to have more than one identical unit removed, and therefore it is possible these could be reinserted into compartments which they weren't originally intended.

6.107.2 Circuit labels

Functional units shall have a front of panel circuit designation label and for assemblies with rear access, an identical label repeated at the rear containing the following information:

- a) functional unit compartment number;
- b) tag number of connected equipment;
- c) service description of connected equipment;
- d) circuit kW or kVA rating.

Justification

Minimum requirement for information of labels on front of functional units. As per current industry minimum and all information is required to align with existing operating and insulation procedures.

6.107.3 Identification of main and auxiliary circuit conductors

Conductor identification of main and auxiliary circuits shall be in accordance with Table 107. Identification of main and auxiliary circuit conductors.

Justification

Standardisation of conductor identification is integral to safety and aligned with IEC 60335 Annex A, however Table 107 further reduce variants in accordance with current industry practices.

Add new Table 107

Table 107 – Identification of conductors

Conductor	Main circuit marking	Auxiliary circuit marking	Supplementary colour marking (when used)
AC circuits			
Phase 1	L1	L1	Brown
Phase 2	L2	L2	Black
Phase 3	L3	L3	Grey
Neutral		N	Blue
Protective earth	PE and/or earth symbol	PE and/or earth symbol	Yellow/Green
DC circuits			
Positive pole		(+)	Red
Negative pole		(-)	White
NOTE Colouring and marking above is in accordance with Annex A of IEC 60445.			

6.107.4

Pre-drilled holes shall be provided at free ends of bus bars for future on-site extension.

Justification

Pre-drilling is important when needed, because it avoids metal filings potentially entering into the assembly during the expansion process and drilling in the field.

Add new subclause

6.108 Main circuit switching devices

6.108.1 Isolating switching devices (disconnectors)

6.108.1.1

Disconnectors and earthing switches shall comply with IEC 62271-102.

Justification

Whilst the parent standards references IEC 62271-102 on numerous occasions it doesn't apply this standard in its entirety to disconnectors and earthing switches. This requirement ensures complete compliance with

IEC 62271-102 which ensures the equipment it covers is to a defined standard, which the parent standard doesn't fully achieve.

6.108.1.2

Switches shall comply with IEC 62271-103.

Justification

Whilst the parent standards references IEC 62271-103 whilst detailing testing requirements it doesn't apply this standard in its entirety to switches. This requirement ensures complete compliance with IEC 62271-103 which ensures the equipment it covers is to a defined standard, which the parent standard doesn't fully achieve.

6.108.2 Circuit-breakers

6.108.2.1

Circuit-breakers shall be at least class S1 in accordance with IEC-62271-100.

Justification

IEC 62271-100 defines two separate class according to the type of the system. These are circuit-breaker class S1 circuit-breaker intended to be used in a cable system and circuit-breaker class S2 circuit-breaker used in a line-system. This ensures relevant and standardized type tests are performed on the circuit breakers. Whilst version 1 of this specification offered the selection of class S2 in the data sheet it is proposed this is outside the 80% of purchases which will be cable systems in most applications in the O&G industry.

6.108.2.2

Circuit-breaker operating mechanisms shall have spring stored energy.

Justification

Spring stored circuit breakers are deemed to require less maintenance than the alternative hydraulic systems which are also prevalent. Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained.

6.108.2.3

Circuit-breaker operating mechanisms shall have a spring charging motor.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to.

6.108.2.4

Circuit-breaker operating mechanisms shall have a closing release coil with an interlock to inhibit closing if a trip condition exists.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to. The interlock facility prevents the closing when a potentially unsafe condition is identified.

6.108.2.5

Circuit-breaker operating mechanisms shall have a spring charged/discharged indicator.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to. The status of the spring is not evident from the front of panel without this facility.

6.108.2.6

Circuit-breaker operating mechanisms shall have a manual spring charge facility.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to. The manual spring charge facility provides a secondary means of charging where the motor is unavailable.

6.108.2.7

Circuit-breaker operating mechanisms shall have an anti-pumping device.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to.

6.108.2.8

Circuit-breaker operating mechanisms shall have a shunt trip coil release of energized-to-trip type.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to. The energize to trip feature negates the occurrence of trips due to loss of supply to the control circuit.

6.108.2.9

Circuit-breaker operating mechanisms shall have a mechanically operated position indicating device showing the position of the main circuit contacts, marked "OPEN" and "CLOSED".

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to. Mechanically operated indicators are much less likely to give erroneous indications and in most cases make it impossible to do so. This is a critical safety factor for operators to establish circuit breaker status.

6.108.2.10

Circuit-breaker operating mechanisms shall have an operations counter.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to.

6.108.2.11

Withdrawable circuit-breakers with identical rating and duty shall be physically interchangeable between receiving compartments of matching rating and duty.

Justification

Standardizes circuit breaker features to that which align with our industries requirements and ensures operator familiarity is maintained, as this is critical to safety. Also aligns with existing OpCo operating and isolation procedures which must be adhered to. This allows for circuit breaker interchangeability where a spare may not be immediately available and operations have prioritized service requirements. It increases flexibility of operations but this can only be for identical units otherwise there is a safety risk where protection afforded by the circuit breaker is not in accordance with circuit design.

6.108.2.12

Circuit-breakers shall have at least two spare normally open (52a) auxiliary contacts wired to terminals in the outgoing terminal block.

Justification

Provides a minimum level of interfacing with site systems so circuit breaker status indication can be integrated.

6.108.2.13

Circuit-breakers shall have at least two spare normally closed (52b) auxiliary contacts wired to terminals in the outgoing terminal block.

Justification

Provides a minimum level of interfacing with site systems so circuit breaker status indication can be integrated.

6.108.2.14

Withdrawable circuit-breakers shall have two spare "in service" position auxiliary contacts wired to terminals in the outgoing terminal block.

Justification

Provides a minimum level of interfacing with site systems so circuit breaker status indication can be integrated.

6.108.2.15

Withdrawable circuit-breakers shall have two spare "out of service" position auxiliary contacts wired to terminals in the outgoing terminal block.

Justification

Provides a minimum level of interfacing with site systems so circuit breaker status indication can be integrated.

6.108.3 Generator circuit-breakers

Generator circuit-breakers shall conform to IEC/IEEE 62271-37-013.

Justification

Whilst the parent standards references IEC/IEEE 62271-37-013 whilst detailing testing requirements it doesn't apply this standard in its entirety to switches. This requirement ensures complete compliance with IEC/IEEE 62271-37-013 which ensures the equipment it covers is to a defined standard, which the parent standard doesn't fully achieve.

6.108.4 Motor starters and contactor feeders

6.108.4.1

Contactors shall be in accordance with IEC 62271-106.

Justification

Whilst the parent standards references IEC 62271-106 with regards to testing it doesn't apply this standard in its entirety to alternating current contactors, contactor-based controllers and motor -starters. This requirement ensures complete compliance with IEC 62271-106 which ensures the equipment it covers is to a defined standard, which the parent standard doesn't fully achieve.

6.108.4.2

No-load operating cycle mechanical endurance shall be at least 0,1 for latched contactors in accordance with IEC 62271-106, 5.105.

Justification

These are defined as preferred ratings (which are 0,01, 0,03, 0,1, 0,3 & 3 in IEC 62271-106, 5.105 and the values of 0,1 and 0,3 are pre-existing industry minimum requirements which are recognised as offering an optimum balance between reliability, durability and cost. These have not been identified as significant cost adders by supplier in the recent user review and to compromise these may result in compromised equipment availability.

6.108.4.3

No-load operating cycle mechanical endurance shall be at least 0,3 for unlatched contactors in accordance with IEC 62271-106, 5.105.

Justification

These are defined as preferred ratings (which are 0,01, 0,03, 0,1, 0,3 & 3 in IEC 62271-106, 5.105 and the values of 0,1 and 0,3 are pre-existing industry minimum requirements which are recognised as offering an optimum balance between reliability, durability and cost. These have not been identified as significant cost adders by supplier in the recent user review and to compromise these may result in compromised equipment availability.

6.108.4.4

Classification of acceptable damage shall be type c in accordance with IEC 62271-106, 5.107.3.4 for the largest fuse size rated for the fuse holder.

Justification

Type c is the least damage category of Types a, b and c and is defined as "damage shall be confined to the main contacts of the starter (which may require replacement or the breaking of welds". This ensure that in the event of a current exceeding the maximum take-over current of the starter the damage to the switching device will be the least onerous to rectify. This will reduce operations downtime and has not been identified as a significant cost adder by suppliers.

6.108.4.5

Motor starter contactors shall be rated for continuous and intermittent duty of at least class 12 in accordance with IEC 62271-106, 5.102.2.

Justification

Class 12 is defined as up to 12 operating cycles per hour which is optimal for typical applications within the O&G industry. This remains unchanged from the previous version of S-620 and has not been identified as a cost adder by suppliers during the user review.

6.108.4.6

Contactor feeders shall be mechanically latched with an electrical trip coil and guarded manual release.

Justification

Mechanical latching is considered safer than arrangement which is reliant on an electrical supply and this is a well-established practice in switchboard design. The electrical trip coil feature facilitates automated tripping whilst guard on the manual release affords protection against inadvertent tripping by personnel.

Add new subclause

6.109 Voltage transformers

6.109.1

All voltage transformers shall be in accordance with IEC 61869-1.

Justification

This requirement ensures compliance with IEC 61869-1 which ensures the voltage transformer general requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.109.2

Inductive voltage transformers shall also be in accordance with IEC 61869-3.

Justification

This requirement ensures compliance with IEC 61869-3 which ensures the inductive voltage transformer requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.109.3

Capacitive voltage transformers shall also be in accordance with IEC 61869-5.

Justification

This requirement ensures compliance with IEC 61869-5 which ensures the capacitive voltage transformer requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.109.4

Low power voltage transformers shall also be in accordance with IEC 61869-6.

Justification

This requirement ensures compliance with IEC 61869-6 which ensures the low power voltage transformer requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.109.5

Low power passive voltage transformers shall also be in accordance with IEC 61869-11.

Justification

This requirement ensures compliance with IEC 61869-11 which ensures the low power passive voltage transformer requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.109.6

Voltage transformer accuracy class shall be at least class 1,0 for measuring applications and class 3P for protection applications in accordance with IEC 61869-3.

Justification

Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.109.7

Voltage transformer shall be of dry insulation type with an earthed screen between the primary and secondary winding.

Justification

Dry insulation ensures minimal maintenance. The earthed screen keeps harmonics away from sensitive equipment and provides a shield which avoids transfer of surge/impulse voltages passing through inter-winding capacitance.

6.109.8

Withdrawable voltage transformers shall be protected by HRC fuses on the primary side accessible on withdrawal of the VT or have a current self-limiting protective feature.

Justification

Circuit protection aligns with typical industry protection philosophies where HRC fuse characteristics afford short circuit and overload protections.

6.109.9

Voltage transformers shall be protected by MCBs on the secondary windings with an auxiliary contact for trip indication.

Justification

Circuit protection aligns with typical industry protection philosophies where MCB characteristics, whilst having a slower response time, offer a reset facility and this requirement reduces variants.

6.109.10

Withdrawable voltage transformers shall have automatic shutters operated by the racking mechanism.

Justification

This is a safety feature which ensures the shutters are only opened in readiness for acceptance of the function unit conductors, this no need for manual intervention whilst the shutters negate insertion of foreign object under normal circumstances. this may seem motherhood, but this is standard practice and by being formalized, ensures for those less familiar with this, that its documented for the benefit of all parties.

6.109.11

Withdrawable voltage transformers automatic shutters shall be padlockable in the withdrawn position.

Justification

Aligns with many OpCo isolation procedures and electrical safety rules. A safety function which ensure by mechanical isolation the unit is not put back in service until all necessary steps are taken.

6.109.12

Disconnectable voltage transformers shall be padlockable in the disconnected position.

Justification

Aligns with many OpCo isolation procedures and electrical safety rules. A safety function which ensure by mechanical isolation the unit is not put back in service until all necessary steps are taken.

6.109.13

Three phase voltage transformers shall incorporate star connected windings with the secondary star point earthed at a single point via an accessible removable link.

Justification

Reduces variants with the specification defined above being the default offering as is industry norm where this configuration offers many perceived advantages. Whilst it should also be noted that there are some perceived disadvantages to this configuration its accepted that the Y-Y offering accounts for >80% of applications.

Add new subclause

6.110 Current transformers

6.110.1

All current transformers shall be in accordance with IEC 61869-1.

Justification

This requirement ensures compliance with IEC 61869-1 which ensures the current transformer general requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.110.2

Inductive current transformers shall also be in accordance with IEC 61869-2.

Justification

This requirement ensures compliance with IEC 61869-2 which ensures the inductive current transformer requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.110.3

Low power current transformers shall also be in accordance with IEC 61869-6.

Justification

This requirement ensures compliance with IEC 61869-6 which ensures the low power current transformer requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.110.4

Low power passive current transformers shall also be in accordance with IEC 61869-10.

Justification

This requirement ensures compliance with IEC 61869-10 which ensures the low power passive current transformer requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.110.5

Current transformer accuracy class shall be at least class 1,0 for measuring incoming applications, class 3,0 for measuring outgoing applications and class 5P for protection applications in accordance with IEC 61869-2.

Justification

Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.110.6

Current transformers connected to external circuits shall have shorting links located at the outgoing terminals.

Justification

Shorting links enable the short-circuiting in measuring circuits, thus ensuring the protection of personnel. This operation is required before any servicing work or opening of circuits if the primaries are live. In protection circuits, the short-circuiting device affords protection by preventing potential increases in voltage from induction by fixing the common point to the earth potential.

6.110.7

Current transformer secondary windings shall be connected to earth via a single disconnecting link.

Justification

The grounding of the transformer is critical in the perspective of safety and the correct operation of the protective relays.

6.111 Surge arrestors

Where specified, metal oxide surge arresters to IEC 60099-4 shall be installed on the circuit side of the main circuit switching device within an enclosure compartment.

Justification

Standardises specification of metal oxide surge arresters to a recognised standards accepted by OpCos and complied to by suppliers.

Add new subclause

6.112 Indication and measuring devices

6.112.1 General

6.112.1.1

Discrete indicating and measuring device dimensions shall be in accordance with IEC 61554.

Justification

This requirement ensures compliance with IEC 61554 which confirms dimensions of panel mounted electrical measuring instruments are to a defined standard. This ensures that replacement, upgraded or additional instruments will be of the same size, thus negating additional rework for installation. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.1.2

Discrete indicating and measuring devices shall be flush mounted with a non-reflective display.

Justification

This ensures are readable regardless of site conditions where reflection and glare are problematic. Flush mounting ensures dimensions of assemblies are a reality where hardware such as pallet trucks, trolleys, and general access are at a premium. This also minimises obstructions where opening doors and work is performed. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.1.3

Indicating functions shall have an accuracy class of at least 2,5 S for digital instruments in accordance with IEC 60051-1.

Justification

2,5 accuracy class refers to the percentage of the inherent error of the measuring device with respect to full scale deflection. For example, if the class of accuracy is 2,5 that means an error of 2.5 volts in a full scale 100 volt reading. This is the essential minimum agreed amongst the S-620 workgroup during development of version 1 and no feedback has been received from either OpCos or suppliers which gives cause to reconsider this. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.2 Analogue instruments

6.112.2.1

Analogue devices shall display black print on a white background identifying actual primary circuit values.

Justification

Black on a white background ensures standardization and legibility of the device. This reduces variants and is typically the default offering. To deviate from this may cause issues for operators and is not considered a cost adder.

6.112.2.2

External zero adjustment shall be provided.

Justification

External zero adjustment allows for effective readjustment by the user where the instrument is found to be out of its original design range. This is a cost effective and instantaneous alternative to an otherwise intrusive repair which may affect production.

6.112.2.3

Analogue voltmeters and ammeters shall be in accordance with IEC 60051-2.

Justification

This requirement ensures compliance with IEC 60051 which ensures special requirements for direct acting indicating analogue electrical measuring instruments and their accessories are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.2.4

Analogue ammeters and voltmeters shall be provided with a selector switch incorporating an off position.

Justification

This requirement ensures compliance with IEC 60051 which ensures special requirements for direct acting indicating analogue electrical measuring instruments and their accessories are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.2.5

Ammeter selector switches shall be "make before break" type.

Justification

When ammeters are current transformer fed the switch must have make-before-break contacts when switching between phases, as an open circuit could generate dangerously high voltages.

6.112.2.6

Maximum current demand indicators with a period of 30 min shall be provided for incomers and outgoing feeders in accordance with IEC 62052-11.

Justification

A maximum demand indicator provides the user with confirmation of the maximum current drawn by the particular interval of time. This is beneficial when monitoring characteristics which may not be evident in real time. this negates the need to attach monitoring devices which may require access to unit internals. Ensures compliance with IEC 62052-11 which ensures general requirements for metering equipment testing is to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.2.7

The lower scale reading for analogue ammeters on non-motor circuits shall not be less than 20 % of rated load.

Justification

Reduces variants by standardizing lower scales and keep consistency by identifying a realistic value. This provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.2.8

Analogue wattmeters and varmeters shall be in accordance with IEC 60051-3 for three-phase unbalanced loads.

Justification

This requirement ensures compliance with IEC 60051-3 which ensures direct acting indicating analogue electrical measuring instruments and their accessories with special requirements for wattmeters and varmeters requirements are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.3 Energy metering

Static energy meters shall be rated for three-phase unbalanced loads and be in accordance with IEC 62052-11.

Justification

This requirement ensures compliance with IEC 62052-11 which ensures general requirements for metering equipment testing is to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.112.4 Transducer outputs

Transducer outputs shall be in accordance with IEC 60688 and wired to terminals in the outgoing terminal block.

Justification

This requirement ensures compliance with IEC 60688 which ensures electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering. Wiring to an outgoing terminal block provides an accessible interface for the user to connect to site systems.

Add new subclause

6.113 Protection devices

6.113.1

Protection relays shall be of multi-function IED type in accordance with IEC 60255.

Justification

Negates the need for numerous discrete relays and capitalizes on technology advances. Also supports packaging benefits where a smaller assembly can ultimately be achieved. "Unless defined otherwise by the user in the data sheets" is not as per phase 3 JIP33 terminology and reference to the data sheet shows that rather than providing an alternative it only offers the option of deviating from manufacturers standard offering with regards to make and model of IED. IEC 6225 standardizes measuring relays and protective equipment.

6.113.2

HMI and front of panel mounted relays shall be flush mounted.

Justification

Flush mounting ensures dimensions of assemblies are a reality where hardware such as pallet trucks, trolleys, and general access are at a premium. This also minimizes obstructions where opening doors and work is performed. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

6.113.3

The portion of the device providing the protection function shall be demountable without the need to disconnect secondary wiring.

Justification

Negates the requirement for intrusive work in the assembly which could potentially cause operational disruption.

6.113.4

Inductive CT connections shall be automatically shorted when the device is removed.

Justification

High voltages will occur when the secondary circuit of an energized current transformer is open circuit, so their terminals must be short-circuited if the ammeter is to be removed or when a CT is not in use before powering up the system.

6.113.5

Protection relays shall have facilities for calibration and injection testing from front of the functional unit and without disconnection of secondary wiring.

Justification

Negates the requirement for intrusive work in the assembly which could potentially cause operational disruption.

6.113.6

A main circuit trip shall not be initiated in the event of loss of power supply to the relay.

Justification

Requirement minimizes operational disruption and confirms to the supplier the protection philosophy for the site which is deemed typical for the O&G industry.

6.113.7

Main circuit fuse protection shall conform to IEC 60282-1 or IEC 60644 for motor circuits.

Justification

This requirement ensures compliance with relevant standards to provide fuses which are to a defined standard. Reduces variant and provides an essential minimum which is as per existing industry best practice and previous version of S-620 which suppliers have not identified as a cost adder to their standard offering.

Add new subclause**6.114 Cable terminations****6.114.1 Terminals for external conductors****6.114.1.1**

Separate termination compartments for high-voltage and low-voltage connections shall be provided.

Justification

Standard practice for HV switchgear and ensures personnel can perform work safely on LV apparatus without being in proximity of HV terminals and conductors.

6.114.1.2

Where high-voltage terminations employ palm cable lugs, high-voltage cable termination (bar) conductors shall be pre-drilled by the manufacturer.

Justification

Stipulating pre-drilled bars ensures the drilling is as per the supplier approved specification, and negates on-site work scopes, where the work may not be performed by personnel as familiar with this type of work, as it would be if it were performed by the supplier.

6.114.1.3

Where high-voltage terminations utilize cable glands, undrilled gland plates shall be provided.

Justification

This is preferred as site run cables may lend themselves to enter the assembly at particular points on the gland plate, which can only be determined once the assembly is in situ.

6.114.1.4

Where single core line conductors have been specified, gland plates shall be of a non-magnetic material.

Justification

Where cables are run as "singles" the assembly gland plate must not be of a non-magnetic material to prevent over heating of the gland plate caused by a higher magnetic flux and as a result, higher eddy current circulation. This is universally recognized, however the requirement does not appear in the parent standard, therefore this must be included in S-620 to ensure this is always provided.

6.114.1.5

High-voltage terminations employing proprietary separable insulated connector systems shall be deadbreak connectors.

Justification

IEC define deadbreak connectors as separable connector designed to be connected and disconnected on de-energized circuits only. This is a safety feature to minimise risk to personnel.

6.114.2 Terminals for control and auxiliary circuits

6.114.2.1

Wiring for external connections shall be brought out to individual terminals on a terminal block.

Justification

Provides a defined interface point for user tie-ins.

6.114.2.2

Terminal blocks shall be grouped by function and operating voltage, separated using barrier plates or earthed terminals.

Justification

This is good practice and aids operability including commissioning, inspection and testing. This is also a safety related feature where variations in voltage is apparent between terminals.

6.114.2.3

Functional groups, voltage levels and discrete terminals shall be identified by labels.

Justification

Not stated in the parent standard and a fundamental requirement to aid operability, commissioning, inspection and testing.

6.114.2.4

Terminals remaining live following a functional unit isolation shall display a warning label.

Justification

A safety measure to mitigate personnel inadvertently coming in touch with live terminals.

6.114.2.5

Terminals associated with external sources of supply shall display a warning label.

Justification

A safety requirement to alert personnel that external isolations are necessary in order to make the equipment safe.

6.114.2.6

Spare I/O contacts of protection/auxiliary relays shall be wired to terminal blocks and numbered.

Justification

Ensures future modifications associated with additional I/O capacity can easily reference the spare contacts and utilised without the need for any modifications or changes to the existing equipment, they can be simply tied into.

6.114.2.7

Terminals associated with inductive CT circuits shall be provided with shorting links.

Justification

Shorting links enable the short-circuiting of inductive current transformers, thus ensuring the protection of personnel. This operation is required before any servicing work or opening of circuits if the primaries are live. The short-circuiting device affords protection by preventing potential increases in voltage from induction by fixing the common point to the earth potential.

6.114.2.8

Instrument circuits requiring dedicated earthing shall be in accordance with IEC TR 61000-5-2.

Justification

Ensures the supplier is aware of instances where instrument or IS earths are necessary and take the appropriate actions. IEC TR 61000-5-2 relates to Electromagnetic Compatibility (EMC) - Part 5: Installation and Mitigation Guidelines - Section 2: Earthing and Cabling.

Add new subclause

6.115 Interfaces

6.115.1 Interface with external equipment packages and control systems

Emergency shutdown interface relays shall be safety integrity level (SIL) rated in accordance with IEC 61511-1.

Justification

Compliance with IEC 61511-1 Functional safety – Safety instrumented systems for the process industry sector – Part 1: Framework, definitions, system, hardware and application programming requirements gives requirements for the specification, design, installation, operation and maintenance of a safety instrumented system (SIS), so that it can be confidently entrusted to achieve or maintain a safe state of the process.

6.115.2 Application of communication protocols to protective functions

6.115.2.1

Digital interfaces shall conform to IEC 62271-3.

Justification

IEC 62271-3 High-voltage switchgear and controlgear – Part 3: Digital interfaces based on IEC 61850 provides an application of the horizontal standard series IEC 61850 which details layered power utility communication architecture, for high voltage assemblies. This facilitates a standardized approach to digital interfaces based on IEC 61850.

6.115.2.2

Signals and values for protective functions exchanged by IEDs on the same IEC 61850 station bus network shall function independently of servers, firewalls and additional communications infrastructure.

Justification

Protective functions are critical to safety, therefore the amount of infrastructure they are reliant upon must be minimized. Since it is possible to configure signals and values for protective functions in the manner described in the above requirement, which has not been identified as an issue by suppliers, then this is approach should be adopted.

8 Routine tests

8.6 Design and visual checks

Add to subclause

8.6.1

Visual inspection shall validate assembly layout in accordance with the manufacturer drawings.

Justification

Validates accuracy of supplier drawings and finished product to ensure no discrepancies exist.

Add to subclause

8.6.2

Visual inspection shall validate functional unit and assembly labelling.

Justification

Labelling is a critical safety feature for applying isolations and identifying for operations and maintenance, so these must be accurate and it is not unusual for discrepancies to exist.

Add to subclause

8.6.3

Visual inspection shall validate interchangeability of removable parts in accordance with 6.104.

Justification

This is the only way to verify the requirements in 6.104.

Add to subclause

8.6.4

Visual inspection shall validate operation of padlocking facilities, interlocks, mechanisms and limit switches.

Justification

Hands on validation to ensure the operation is as per design and user's requirements.

Add to subclause

8.6.5

Visual inspection shall validate integrity of internal wiring connections and earthing.

Justification

Ensures internal wiring and associated workmanship is to a standard which is acceptable to those inspecting it.

Add to subclause

8.6.6

Visual inspection shall validate wiring in accordance with final wiring diagrams.

Justification

Ensures consistency between drawing and equipment.

11 Transport, storage, installation, operation and maintenance (IEC 62271-1 Clause 11)

Add new subclause

11.6 Special tools

11.6.1

Special tools for the assembly installation, operation and maintenance shall be shipped together with the assembly.

Justification

Standardises how these are provided and minimises permutations of how they are shipped. This is of value where construction and commissioning teams are required to work effectively for a pre-planned site visit duration and lost time due to missing critical equipment is historically a common occurrence in the O&G industry. It is acknowledged the revised wording has changed the intent of this requirement somewhat, however it is now more assertive and to concise.

11.6.2

Operational removable or withdrawable parts weighing more than 25 kg shall be provided with labels confirming the actual weight.

Justification

This provides a safe means of unit/equipment removal whilst recognising lifting guidelines. 25 kg is consistent with other JIP33 specifications. The second part of this requirement has been removed as it is not deemed essential minimum requirement and where agreement is sought between purchaser and manufacturer, this is outside the scope of this specification.

11.6.3

Where a capacitive three-phase voltage indicating or voltage detecting system is fitted, an external phase comparator instrument shall be offered.

Justification

Ensures the user has the required equipment from the outset to operate the assembly as it is intended. This is of value as the identification of this instrument from other vendors may time consuming and may ultimately not be compatible or available, so this ensures this scenario is negated.

13 Influence of the product on the environment

Add to clause

Handling of SF6 during manufacture, transport, installation and commissioning shall be in accordance with IEC 62271-4.

Justification

These procedures are regarded as minimum requirements to ensure the safety of personnel working with SF6 (see Annex B) and to minimize the SF6 emission to the environment. Whilst IEC 62271-1 refers to IEC 62271-4: High-voltage switchgear and controlgear – Part 4: Handling procedures for sulphur hexafluoride (SF6) and its mixtures (see below) it doesn't explicitly state the above requirement, hence this is deemed necessary for the reasons above.

Add new Annex E

Annex E (normative) **Additional requirements for fault current limiter assembly**

E.1 General

This annex specifies requirements, additional to the main body of this specification, for fault current limiters, incorporated within an assembly or forming a free-standing fault current limiter assembly.

Justification

Introduction to Annex DD which defines the scope and definition of the content.

E.2 Ratings – rated normal current and temperature rise

E.2.1 Rated normal current (I_r)

The rated continuous current (I_r) of the fault current limiter shall not be less than the rated continuous current of the associated incoming circuit, bus sections or bus coupler.

Justification

Stipulates minimum requirement for current rating of fault current limiter, ensuring it is appropriately rated for assembly components for which it is associated.

E.2.2 Rated short-time withstand currents (I_k)

The rated short time withstand current (I_k) and the rated short time phase to earth withstand current (I_{ke}) of the fault current limiter shall not be less than the rated short time withstand currents of the associated incoming circuit, bus sections or bus coupler.

Justification

Stipulates minimum requirement for short time withstand current ratings of fault current limiter, ensuring it is appropriately rated for assembly components for which it is associated. The rated short time withstand current (I_k) and the rated short time phase to earth withstand current (I_{ke}) of the fault current limiter shall not be less than the rated short time withstand currents of the incoming circuit, bus sections or bus coupler with which it is associated.

E.2.3 Rated peak withstand current (I_p)

The rated peak withstand current (I_p) and the rated peak phase to earth withstand current (I_{pe}) of the fault current limiter shall not be less than the rated peak withstand currents of the associated incoming circuit, bus sections or bus coupler.

Justification

Stipulates minimum requirement for rated peak withstand current ratings of fault current limiter, ensuring it is appropriately rated for assembly components for which it is associated.

E.2.4 Rated durations of short circuit (t_k)

The rated duration of short circuit current (t_k) and the rated duration of phase to earth short circuit current (t_{ke}) of the fault current limiter shall not be less than the rated durations of short circuit currents of the associated incoming circuit, bus sections or bus coupler.

Justification

Stipulates minimum requirement for rated duration of phase to earth short circuit of fault current limiter, ensuring it is appropriately rated for assembly components for which it is associated.

E.3 Design and construction

E.3.1 Earthing of the high-voltage conductive parts

The fault current limiter assembly shall provide an earthing facility on the incoming and outgoing side of main circuit conductors.

Justification

This provides approved earthing points for safety of personnel performing maintenance and testing activities on the fault current limiter.

E.3.2 Auxiliary and control equipment

E.3.2.1

Fault current limiter protective function circuits shall prevent common mode failures between phases, including sensors, signal treatment and triggering system.

Justification

Reliability of the FCL and its associated impact on the system is considered and this requirement ensures that any failures are limited to a single phase and will not cause the other phases lose their protection.

E.3.2.2

Fault current limiter protective function circuits shall provide an external function where operation is disabled when a system fault level is within an acceptable range.

Justification

There may be instances where fault levels have been deemed acceptable and the user wants to disable the fault limit to continue service of the electrical system, after an assessment has been performed.

E.3.2.3

Operation selector switches shall be lockable and located front of panel.

Justification

Provides facility for isolation, which is used for maintenance, testing and operational purposes. Remote monitoring facility supports remote operation and may be incorporated in site control systems.

E.3.2.4

A watchdog module shall be provided to continuously monitor triggering unit functions.

Justification

Provides a means of monitoring status of the triggering systems which can potentially provide early warning of any potential issues, which can then be acted upon in a timely manner, thus reducing likelihood of a larger issue.

E.3.2.5

Triggering systems shall be powered by separately protected auxiliary circuits.

Justification

Reliability of the FCL and its associated impact on the system is considered and this requirement ensures that any failures are limited to a single phase and will not cause the other phases lose their protection.

E.3.2.6

Triggering units shall operate independently of each other.

Justification

Reliability of the FCL and its associated impact on the system is considered and this requirement ensures that any failures are limited to a single phase and will not cause the other phases lose their protection.

E.3.2.7

Front of panel operation selector switches shall feature "on", "inhibited" and "off" positions with auxiliary contacts for status remote indication.

Justification

Provides facility for isolation, which is used for maintenance, testing and operational purposes. Remote monitoring facility supports remote operation and may be incorporated in site control systems.

E.3.3 Isolating switching devices (disconnectors)

The fault current limiter assembly shall provide isolation points on the incoming and outgoing sides of main circuit conductors.

Justification

This provides approved isolation points for safety of personnel performing maintenance and testing activities on the fault current limiter.

E.3.4 Interlocking devices**E.3.4.1**

Circuit-breakers installed in series with the fault current limiter shall be opened automatically when the fault current limiter is triggered.

Justification

Provides additional circuit protection and isolation of the device until the condition which triggered operation is addressed.

E.3.4.2

Circuit-breakers installed in series with the fault current limiter shall be interlocked to prevent closure when interrupting elements are activated and the fault current limiter triggering unit is not reset.

Justification

Safety feature to prevent injury to personnel, until the condition which triggered operation is addressed and the circuit disruption functions have been returned to "in-service" status.

E.3.4.3

Access to the fault current limiter compartment shall be prevented unless in series circuit-breakers are open.

Justification

A safety feature which ensures personnel accessing the fault current limiter enclosure cannot do so unless it is in an un-energized state.

E.3.4.4

Access to the fault current limiter compartment shall be prevented unless the other series downstream switching devices or isolators (where present) are in the open position.

Justification

Safety measure to prevent back feeding from downstream devices.

E.3.4.5

Access to the fault current limiter compartment shall be prevented unless incoming and outgoing sides of the main circuit conductor are earthed.

Justification

A safety feature which ensures personnel accessing the fault current limiter enclosure cannot do so unless it is in an un-energized and earthed state.

E.3.4.6

Series switching devices or isolators shall be interlocked to prevent closure when fault current limiter earths are connected.

Justification

Closure of switching devices or isolators when systems earths are connected could result in a short circuit to earth condition, with serious consequences for personnel and damage to equipment.

E.3.5 Design and visual checks

In addition to switchgear assembly inspections, fault current limiters shall have functional checks of the measuring unit, the triggering (firing) and indication unit, excluding final elements.

Justification

Defines specific additional requirements for functional testing to be performed as part of routine testing to confirm the fault current limiter is operational as per design before it's handed over to the purchaser.

E.4 Transport, storage, installation, operation and maintenance

E.4.1 Special tools

E.4.1.1

Special tools for fault current limiter installation, operation and maintenance shall be shipped together with the assembly.

Justification

Standardises how these are provided and minimises permutations of how they are shipped. This is of value where construction and commissioning teams are required to work effectively for a pre-planned site visit duration and lost time due to missing critical equipment is historically a common occurrence in the O&G industry. It is acknowledged the revised wording has changed the intent of this requirement somewhat, however it is now more assertive and to concise.

E.4.1.2

A test unit and leads shall be provided for commissioning and function testing.

Justification

Ensures testing can be performed using instruments and equipment approved by the supplier.

E.4.1.3

Three-phase copper bars shall be provided, attachable at the active elements point of connection, of a current rating equal to the assembly busbars.

Justification

Ensures equipment, which is adequately rated, and approved for use by the supplier is provided.

E.4.2 Basic input data by the manufacturer

The triggering value of the fault current limiter shall be set according to the specified minimum and maximum short circuit fault level.

Justification

Ensures operating parameters are aligned with user equipment specification by the supplier.

Bibliography

Add to Bibliography

- [15] IEC 60073, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*
- [16] IEC 60445:2017, *Basic and safety principles for man machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*
- [17] IEC TR 61000-3-6, *Electromagnetic compatibility (EMC) – Part 3-6: Limits – Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*

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