

 Eskom	Standard	Technology
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INSULATED SWITCHGEAR (GIS)
AND ASSOCIATED AUXILIARY
EQUIPMENT**

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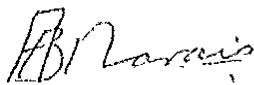
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(GIS) AND ASSOCIATED AUXILIARY EQUIPMENT**

Unique Identifier: **240-50807380**

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1. Introduction

This specification sets out Eskom's requirements for Gas Insulated Switchgear (GIS) and related equipment. The specification consists of clauses, schedules and appendices as detailed in the index to the specification. This document refers to other Eskom specifications and schedules for air insulated equipment as minimum requirements. In this document only the additional requirements applicable to GIS are addressed. All referring documents and schedules must be used in conjunction with this document.

This specification provides for the supply and installation of gas insulated switchgear at substations in Eskom's high voltage power transmission and distribution networks.

The equipment may be required for a new substation or as extensions to an existing installation as detailed in the specification.

The requirements for the GIS are based on SANS 62271-203.

Eskom shall perform technical evaluation of the tender submission using the Eskom technical evaluation criteria standard 240-87340147. The supplier shall submit all required documentation in response to this standard and the technical evaluation criteria standard

2. Supporting clauses

2.1 Scope

This specification covers the design, manufacture, performance verification, testing, supply, delivery, storage, installation, pre-commissioning and guarantee of SF6 Gas Insulated Switchgear (GIS) based on SANS 62271-203, as the main offer. Alternative environmental friendly options will be evaluated as alternative options.

The GIS shall be supplied together with all auxiliary equipment necessary for a complete installation and shall include but not limited to the following:

- Circuit Breakers
- Disconnect Switches
- Maintenance Earthing Switches
- Fast Acting Earthing Switches
- Voltage Transformers
- Current Transformers
- Bus and Elbow Sections (including the conductor)
- Cable End Enclosures
- SF6 to Air Bushings
- GIS to Transformer Direct-Connections
- Surge arresters
- Ground Connection to the Station Ground Grid
- Auxiliary Material to complete the GIS Installation (e.g. density switches, secondary cable, arc detection, online PD monitoring and hardware)
- Support Structures for the GIS
- Insulating SF6 gas
- Local Control Cubicle

- Special Tools and Equipment for Installation/Maintenance
- Spare Parts for start-up
- Technical Direction for Site Assembly and testing by a Competent Service Engineer
- All equipment and material shall be prefabricated, factory assembled, tested and shipped in the largest practical assemblies dependent on the mode of transport
- Documentation shall be provided as required in this specification and the technical evaluation criteria standard 240-87340147.
- Commissioning and field testing
- The supplier shall assist Eskom as part of this contract with the general layout design of the GIS building to ensure that the most suitable arrangement is obtained for housing, supporting and fixing of the GIS
- If the civil and GIS suppliers are different, the GIS supplier shall also provide Eskom with a complete floor plan detailing the fixing points, size of foundation, required cable trenches, wall openings, doors, transport ways and lay down areas etc. All static and dynamic loads plus dimensional tolerances shall be given on these drawings to enable the civil works design to be optimized.
- The GIS supplier shall also liaise with the civil contractor on the following issues and keep Eskom informed.
 - The earthing and Faraday cage requirements to ensure Electro Magnetic Compatibility (EMC) as per paragraph 5.13 of this document.
 - Overhead crane requirements as per paragraph 6.5 of this document

A set of technical schedules A and B accompanies this specification as well as a single line diagram indicating the layout and bus bar configuration of the proposed substation. Additional and special technical requirements are also included in schedule A. For minimum requirements the schedules A and B in the relevant referring documents must be used. In the event of any discrepancies or ambiguities between this document and the referenced documents, this document shall take precedence.

2.1.1 Purpose

This specification stipulates Eskom's requirements for indoor or outdoor compact high-voltage, alternating-current, metal enclosed insulated systems, for voltages of 44 kV and above.

2.1.2 Applicability

This document is intended for manufacturers and suppliers of SF6 Gas Insulated Switchgear (GIS) or alternative environmental friendly solutions as specified in this document and complies with the standards mentioned herein. This document shall apply throughout Eskom.

2.2 Normative/informative references

2.2.1 Normative

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

Suppliers are responsible for obtaining copies of all National Rationalised Standards (NRS), South African National Standards (SANS) and international standards referred to in this specification. Copies of the latest revision of Eskom documents will be supplied by the purchaser and will form part of the enquiry documentation. The equipment must comply with these requirements contained in these documents

- [1] ISO 9001:2000 Quality Management Systems
- [2] IEC 60529: Degrees of protection provided by enclosures (IP Code)

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- [3] IEC 62271-203: High voltage switchgear and control-gear – Part 203: Gas Insulated metal-enclosed switchgear for rated voltages above 52kV.
 - [4] IEC 62271-100: High voltage switchgear and control-gear: Part 100: High voltage alternating current circuit breakers.
 - [5] IEC 62271-102, High voltage switchgear and control gear – Part 102: Alternating current disconnectors and earthing switches.
 - [6] SANS 62271-110, High-voltage switchgear and control gear – Part 110: Inductive load switching.
 - [7] IEC/SANS 62271-209, High-voltage switchgear and control gear Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV - Fluid-filled and extruded insulation cables - Fluid-filled and dry-type cable-terminations
 - [8] IEC 62271-310, High voltage switchgear and control gear – Part 103: Electrical endurance testing for circuit breakers of rated voltage 72,5kV and above.
 - [9] IEC 62271-303, High voltage switchgear and control gear – Part 303: Use and handling of sulphur hexafluoride (SF6).
 - [10] IEC 62271-1: Common specifications for high voltage switchgear and control gear standards.
 - [11] IEC 61869-1 General requirements for Instrument Transformers
 - [12] IEC60044-1, Instrument Transformers – Part 1: Current Transformers.
 - [13] IEC60044-2, Instrument Transformers – Part 2: Inductive Voltage Transformers.
 - [14] IEC 60137, Insulating bushings for alternating voltages above 1000V
 - [15] IEC 60060: High voltage test techniques 60-1 (1989) General definitions and test requirements.
 - [16] IEC 60270, Partial discharge measurements
 - [17] IEC 60376, Specifications and acceptance of new sulphur hexafluoride
 - [18] IEC 60480: Guide for the checking of SF6 taken from electrical equipment.
 - [19] IEC 60071 Insulation co-ordination
 - [20] IEC 60099 Surge arresters
 - [21] IEC 60255 Electrical relays
 - [22] IEC 60265 High voltage switches
 - [23] IEC 60815 Guide for the selection of insulators in respect of polluted conditions
 - [24] IEC 61000 Electromagnetic compatibility (EMC)
 - [25] IEC 61634 High voltage switchgear and control gear – Use and handling of sulphur hexafluoride (SF6) in high-voltage switchgear and control gear
 - [26] IEC 61639 Direct connection between power transformers and gas-insulated metal-enclosed switchgear for voltages of 72.5 KV and above
 - [27] IEC 61850, Standard for the design of electrical automation
 - [28] IEC 60364/60479/60621, IEEE std 80 Standards IEEE Guide for Safety in AC Substation Grounding
 - [29] SANS 1091, National colour standard.
 - [30] EN 50052: 1990, Cast aluminium alloy enclosures for gas filled high voltage switchgear and control gear
 - [31] EN 50064: 1989, wrought aluminium and alloy enclosures for gas filled high voltage switchgear and control gear.
 - [32] EN 50069: 1991, Welded composite enclosures of cast and wrought.

-
- [33] IEC 60947, Low voltage switchgear aluminium alloys for gas filled high voltage switchgear and control gear.
 - [34] IEC/SANS 60840, Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test methods and requirements
 - [35] IEC/SANS 62067, Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um = 170 kV) up to 500 kV (Um = 550 kV) – Test methods and requirements
 - [36] NRS 087, Guidelines for the Management of SF6 (Sulphur Hexafluoride) for use in Electrical Equipment
 - [37] Occupational Health and Safety Act (no 85 of 1993)
 - [38] 240-114967625 Operating Regulations for High Voltage Systems
 - [39] 240-75660336 Substation and Network equipment label specification
 - [40] 240-101383919 SF6 Sampling Standard
 - [41] 240-134369472 Substation Earth Grid Design Standard supersedes
 - [42] 240-75655504 Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard
 - [43] TST 41-1064, Standard for Earthing for Substation Protection Equipment
 - [44] TST41-877, Substation Design Earthing Standard
 - [45] 240-56063756, Specification for outdoor circuit breakers for systems with nominal voltages from 44 kV up to and including 765 kV
 - [46] 240-56063815, High voltage outdoor disconnectors & earthing switch standard
 - [47] 240-56062896, Standard Specification for Outdoor Metal Oxide Surge Arresters without spark gaps for system voltages of 220kV and above
 - [48] 240-75540566, Specification for station class metal oxide surge arresters
 - [49] 240-56062765, Inductive voltage transformers Eskom specific requirements up to 132 kV in accordance with NRS 030 standard
 - [50] 240-56062864, Current transformers Eskom specific requirements up to 132 kV in accordance with NRS 029 standard
 - [51] 240-87340147, Technical evaluation criteria for gas insulated switchgear (GIS) substation equipment and mixed technology switchgear (MTS)
 - [52] IEC 6189-1, Instrument transformers – Part 1 General requirements
 - [53] SANS 62271-3/ IEC 62271-3, High-voltage switchgear and control gear — Part 3: Digital interfaces based on IEC 61850
 - [54] 240-42066934, IEC 61850 Protocol implementation document for the purposes of substation automation
 - [55] 240-64685228, Generic specification for protective Intelligent Electronic Devices (IEDs)
 - [56] 240-68107841, Eskom IEC61850 standard requirements for PICS, PIXIT and TICS
 - [57] 240-68235024, Eskom IEC 61850 station bus interoperability test standard
 - [58] 240-124520996 Switchgear training requirements from original equipment manufactures
 - [59] 240-146288697- Specification for the interfacing of the new Protection and Control equipment to the Gas Insulated Substations Bay marshalling kiosk.
 - [60] 0.52-30571 – Wiring diagram for the Bay Marshalling kiosk
 - [61] 240-151122225- Specification for New SF6 gas supplied in standard gas cylinders with technical evaluation criteria.

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[62] 240-67449796 Safe operating Practice for GIS Substations

2.2.2 Informative

[63] Substation Layout Design Guide (SLDG 46-2) compiled by Braam Groenewald

[64] 240-62773019 Specification for low voltage auxiliary electrical component standard

2.3 Definitions

2.3.1 General

Definition	Description
Buffer compartment	Additional partitioning or gas compartments that will make maintenance, repairs and bus bar extension possible and guarantee the safety of the personal when performing intrusive work. No adjacent circuits must be out of service.
Special Tools	Any purpose-built tools that is necessary to carry out erection and maintenance on GIS and its components. Typical examples of such tools are slow-closing / opening devices, contact-alignment devices, transducers and mounting hardware for such equipment on the circuit-breaker, isolator and earth switches as well as testing equipment needed to commission the GIS.
GIS Building earthing system	This refers to the earthing system designed by the manufacture of the GIS substation equipment which complies with all switching, lightning and safety requirements in accordance to the international standard
Earth mat for outdoor yard	This is the earth mat that is the responsibility of Eskom which is surrounding the GIS building and outdoor HV yard.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
ARC	Auto re-closing (i.e. and O-CO operation under command of a relay)
BZ	Bus Zone
CB	Circuit breaker
CT	Current transformer
GIS	Gas Insulated Switchgear
I	Amps
KIPTS	Natural ageing and pollution performance test procedure for outdoor insulator products
EMC	Electro Magnetic Compatibility
M	Metering
MCB	Miniature circuit breaker
MR	Multi ratio

Abbreviation	Description
MVA	Mega Volt Amps
N/C	Normally Closed
N/O	Normally open
OEM	Original Equipment Manufacturer
OHS Act	Occupational Health and Safety (OHS) Act No 85 Of 1993, as amended, of the Republic of South Africa
P	Protection
FMECA	Failure Modes, Effects and Criticality Analysis
SF6	Sulphur Hexafluoride
T	Turns
TRFR	Transformer
V	Volts
VT	Voltage transformer

2.5 Roles and responsibilities

Not applicable.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Not applicable.

3. Requirements for Sulphur Hexafluoride Metal Enclosed Equipment

3.1 SF6 Gas Density and Pressure

The maximum pressure and density of the SF6 insulating gas for the equipment offered as well as the minimum pressure and density at which safe operation of the equipment can be allowed shall be stated in Schedule B. In addition a detailed vapour pressure graph showing the relationship between the SF6 gas pressure, temperature and density shall be submitted with the tender. The maximum and minimum operating pressures shall be shown on this graph as well as the operating characteristics of the temperature - compensated gas monitoring relays to be supplied.

3.2 SF6 Gas Temperature

The maximum and minimum temperatures at which the equipment offered will safely operate without heating elements being required and shall be stated in Schedule B.

The maximum and minimum ambient temperatures of the area of installation will be stated in Schedule A.

The altitude of the installation will be stated in Schedule A.

3.3 SF6 Gas Purity

The SF6 switchgear shall be designed for use with SF6 gas complying with the recommendation of IEC 60376 at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with the requirements of IEC 60376. A certificate guaranteeing purity to IEC 60376 shall be supplied for all SF6 gas delivered to site.

The Eskom minimum specification for gas quality will be stated in schedule A. Supplier's details of the purity of SF6 gas required for safe operation of the SF6 switchgear shall be given in Schedule B. The details should include the proportional quantities of other gases and/or vapours that can be tolerated in the SF6 gas.

Before initial filling with gas the internal GIS compartments must be properly prepared in terms of cleanliness, absence of sharp edges and particles etc. and the compartments must be adequately dried and evacuated.

After initial filling of the new GIS installation to rated normal pressure and allowing for stabilization period of at least 7 days the gas in each GIS compartment must be quality tested. The following parameters shall be checked, recorded and a report submitted to Eskom after filling:

- Gas pressure
- Gas purity
- Moisture content

Gas quality must comply with OEM specification as well as Eskom Standard 240-101383919. Test results must be supplied.

Random testing for other impurities e.g. CF4, SO2 etc. may be requested.

All gas filling and testing shall be done by an accredited person.

Gas quality must be measured with recently calibrated equipment. The calibrations must be performed by a recognised calibration laboratory and copies of calibration certificates must be supplied.

Details of procedures, tests and equipment necessary for testing the purity of the SF6 gas before and after charging of the switchgear, particularly for determining the percentage of water vapour present, shall be included with the tender.

3.4 Gas Filling Connections

Gas filling connections must be male DN20 couplings.

Each compartment must have at least 2 gas connection points to allow for accurate pressure measurement during filling/evacuation.

All filling points and measurement points must be accessible without adapting the filling and measuring equipment that will be supplied with the contract.

3.5 Gas Monitoring Devices and Alarms

Temperature-compensated gas pressure (density) monitoring devices shall be provided. The devices shall provide continuous and automatic monitoring of the quantity of the gas and a separate device shall be provided for each gas compartment so that each compartment can be monitored simultaneously. A low gas alarm and low gas block device must be provided. An over pressurizing alarm (visual and audio) must be provided for each gas compartment. This will help to eliminate human errors when replenishing SF6 gas.

The monitoring devices for all compartments shall have at least a non-urgent and urgent alarm setting and in the case of circuit breakers shall have an additional lock-out setting. Alarm facias shall be mounted on the local control panel/marshalling kiosk associated with each bay. The alarm contacts will be specified in Schedule A. The number of spare terminals shall provide as per Schedule A

A means of monitoring the actual compartment pressure must be provided. The pressure indication requirement may be an analogue display or a digital readout but will be specified in schedule A.

The pressure must be indicated in kPa absolute. Analogue gauges must be displayed **red** from: 0 to urgent alarm, **yellow**: urgent alarm to non-urgent alarm, **green**: non-urgent alarm to maximum normal working pressure

Monitor devices must be removable for testing purposes without opening or closing manual valves.

3.6 Gas Treatment Devices in Gas Compartments

Means shall be provided for treating the SF6 gas using desiccants, driers, filters, etc., to remove impurities and moisture in the gas. These shall be provided as permanent facilities within the GIS.

Filters shall preferably consist of molecular sieve type 4A material and shall be properly sized for the particular gas volume and type of service e.g. circuit breakers, isolators, bus bars, instrument transformers etc.

Details of filters and filter material must be supplied with tender documentation.

3.7 Gas Compartments

The switchgear gas enclosures must be sectionalised, with gastight barriers between sections or compartments. The sections shall be so designed as to minimise the extent of plant rendered inoperative when gas pressure is reduced, either by excessive leakage or for maintenance purposes, and to minimise the quantity of gas that has to be evacuated and then recharged before and after maintaining any item of equipment. Each single-phase circuit element, e.g. circuit breaker, current transformer, isolator, earth switch, voltage transformer, transformer bushing, etc., shall be sealed in its own gas compartment.

Where balancing pipes are used between compartments, **inline particle filters** must be fitted to prevent contamination in case of a failure. The inline filter must have an exchangeable filter element and the filter, connecting pipes and fittings must be able to withstand a minimum pressure of 20 Bar. The filter element must be able to filter out particles bigger than 8 µm and withstand a sudden pressure impulse of 50 bar.

The flow rate through the filter should not be lower than 100 litres per minute with air as reference. Details of filter options must be specified in schedule B).

Each end of the balancing pipe shall be fitted with gas tight DILO DN non return valves. Where single phase bus ducts are used, the gas compartments of each single phase duct shall be completely independent of the gas compartments of the other two phases.

The three phases of each bus bar may be provided in either a single enclosure or three separate enclosures. The arrangement offered and the number of gas tight sections provided in any bus bar run shall be such as to **reduce the gas evacuating, recharging and servicing time in any bus bar gas section to a minimum.**

The design of the substation shall permit installation, extension, inspection and maintenance (preventative and corrective) with a maximum of one circuit (including any circuit requiring intervention) and one section of bus bar out of service simultaneously. Buffer compartments need to be installed to achieve personnel safety during work and dielectric withstand according to rated quantities, and must be stated in schedule B and details indicated on the gas schematic diagram. (See Annex E for proposals on buffer compartment positions). The list of type-tests and the type-test report performed on the buffer compartments shall be submitted with tender documentation. The Operating and Maintenance instruction manual shall have a section that details the safe working procedure of the above.

The list of type-tests performed and the type-test reports of the type-tests performed on the buffer compartments shall be submitted with the tender documentation.

The electrical connections between the various gas sections shall preferably be made by means of multiple contact connectors so that electrical connection is automatically achieved when bolting one section to another. The surface of the connector fingers and conductor tubes on such connections shall be silver plated.

The mass of gas (stated in kg) in all the individual compartments at rated nominal density shall be provided after the contract is awarded.

A gas schematic must be provided and all gas quantities must be stated in kg. The total mass of gas in the complete installation shall be indicated on the gas schematic diagram

3.8 Support Insulators and Section Barriers

The support insulators and section barriers/insulators shall be manufactured from the highest quality material. They shall be free from all voids and the design shall be such as to reduce the electrical stresses in the insulators to a minimum. They shall also be of sufficient strength to ensure that the conductor spacing's and clearances are maintained when short circuit faults occur. The design life of all internal solid insulation must be at least the same as the design life of the associated switchgear.

Tests shall be carried out during the manufacture of the switchgear to ensure that all insulators are free of partial discharges according to SANS 60270 and SANS 62271-203. Any additional tests must be mentioned in schedule B.

Gas section barrier/ partitioning including seals to the conductor and enclosure shall be gas-tight and shall be capable of withstanding the maximum pressure differential that could occur across the barrier, i.e. vacuum on one side and rupture disc bursting pressure on the other side.

Details of the permissible gas leakage rate across barriers / partitioning shall be indicated in section B

The outer circumference of all support or compartment separating insulators must be colour coded (painted). Generally a compartment separating insulator will be colour coded orange and an intermediate support insulator will be colour coded silver. Any deviation from these colours will be specified in schedule B.

The electrical and mechanical properties of the support insulators and gas section barriers shall be given in schedule B.

3.9 Gas Seals

All gas seals shall be designed to ensure that leakage rates are kept to an absolute minimum under all normal pressure, temperature, electrical load and fault conditions. The material of sealing elements shall be such that the seals will not deteriorate during the lifetime of the switchgear equipment when exposed to the gas and vapours, temperature variations and mechanical forces that can normally be expected to be present.

The material and method of sealing to be used shall be stated in schedule B.

The supplier shall guarantee the SF₆ gas tightness of the equipment, per compartment, for the design life of the plant. The relative leakage rate (F_{rel}) must not exceed 0.5% per annum. The frequency for the time between replenishment shall be at least 10 years. The supplier will replenish, at his own cost, any gas lost due to leaks during the design life of the plant.

The supplier will be responsible and accountable for any gas loss due to leaks in terms of environmental legislation and carbon equivalent penalties.

If any facilities are provided to detect and locate a gas leak through any section seals, e.g. by the use of an annular space between two concentric gas seals with facilities to measure any increase in pressure in this space, brief details shall be given in schedule B.

3.10 Expansion and Flexible connections

Expansion joints or flexible connections shall be provided in the metal enclosures to absorb the actual or relative thermal expansion and contraction of the SF₆ equipment as well as structures, foundations and floors on which the equipment is mounted, resulting from variations in the temperature of the switchgear equipment. Either expansion joints which will directly absorb any longitudinal expansion of the metal enclosures or flexible connections which will absorb the relative movement between adjacent items of equipment as a result of expansion are acceptable, except in the case of long bus bar or duct installations. In this case expansion joints shall definitely be provided at suitable intervals in the metal enclosures.

If expansion joints are provided, all items of equipment shall be securely fixed to the support structures, foundations or floor. If flexible connections are provided, the switchgear shall be fixed to one point only with the remainder of the equipment free to move, supported on suitable hardened rollers. Special hardened steel plates shall be provided and fixed to the support structures, foundations or floor as part of the contract, on which each roller shall run.

The expansion joints or flexible connections should be capable of absorbing other small externally applied forces, e.g. earth tremors, without damage to the equipment.

The number and position of expansion joints or flexible connections are to be determined by the supplier to ensure that the complete installation will not be subjected to any expansion stresses which could lead to distortion or premature failure of any piece of the SF₆ equipment, support structures or foundations. A gas section barrier shall be provided at each expansion joint position.

Expansion joints, flexible connections and adjustable mountings shall also be provided to compensate for reasonable tolerances in the manufacture of associated equipment to which the SF₆ switchgear may be connected and ensure that unreasonably excessive accuracy is not required when installing such equipment and constructing the associated foundations or support structures, e.g. transformers or the inter-connection of isolated sections of switchgear by means of long SF₆ bus bar or duct installations. The tolerances that can be expected in all three planes, in such cases shall be accommodated and stated in **schedule B**.

The joints shall be provided with external fittings to ensure that the flexible enclosure walls and the conductors of the expansion joint are not subjected to the normal standing longitudinal compression or tension forces that may exist in the equipment. These external fittings shall transmit all the forces across the joint and shall be symmetrically spaced around the enclosure to ensure that no bending forces are set up at the joint.

The electrical connection across the expansion joint or flexible connections shall be made by means of multiple contact connectors, preferably the same as that to be provided at the joints between the separate gas compartments (refer Clause 4.7).

The method of compensating for expansion, i.e. expansion joints or flexible connection, whether the switchgear is securely fixed at all points or mounted on rollers and the mechanical and electrical current carrying properties of the completed joint or connection shall be given in schedule B.

Manuals and drawings of all the expansion joints and flexible connections that would be provided with the equipment shall be provided at the tender stage detailing in particular the method of transmitting the normal standing tension and compression forces across the joint and the method of electrical connection. Evidence of service experience shall also be provided with the tender to confirm that the flexible enclosure walls will not fail from fatigue during the reasonable lifetime of the equipment. Should this evidence be insufficient, Eskom may require the supplier to undertake accelerated life tests on the expansion joints. The costs of such a test shall be given in the option section of schedule C.

3.11 Metal Enclosure

The metal enclosures for the SF6 gas and circuit elements shall be made from non-magnetic material to prevent losses and heating from magnetic hysteresis in the case of single-phase enclosures. The type of material and thickness shall also be such as to keep heating due to induced circulating currents to a minimum and to ensure that the enclosure is not materially weakened or punctured by a fault arc current corresponding to the maximum fault levels given in schedule A. All efforts must be made by the manufacturer to ensure that no circulating current are present.

3.12 Support and Mounting Brackets

All structural supports, brackets and guides necessary for supporting, fixing and/or locating the SF6 bus bar/ducts in position on, in or to foundations, walls of trenches or tunnels and any special structural platforms in trenches or tunnels as detailed in Schedule B, shall be provided with the SF6 bus bar/ ducts as part of this contract.

The design of the bus bar/duct fixings shall allow for any relative movement that may occur between the SF6 bus bar/duct and the foundation, trench, tunnel or platforms as a result of thermal expansion or movement and in accommodating tolerances in the position of terminal equipment and the basic support bases. The design of the associated bases for fixing to the foundations, trench and tunnel walls, etc., shall also be such that the fixing position can be easily adjusted to allow for the tolerance in the construction of these as well as the positions of the terminal equipment.

Where the metal or any metallic protective coatings of the supports, brackets and guides are dissimilar to that of the bus duct enclosure, suitable measures shall be taken against electrolytic corrosion.

If the support arrangement for the SF6 bus bar/ducts is such that there is a possibility of the three phases being electrically bonded together and a common short-circuit exists through the supports for the circulating "sheath" currents present in the enclosure metal, the metal enclosure shall also be insulated from the supports, brackets, etc. This requirement shall also apply to the situations where a common short-circuit path may exist through intermediate structural platforms which are not included in the scope of supply of this contract.

The insulation level and material shall be stated in schedule B.

All supports, brackets and guides inside the building or forming part of the GIS shall be bonded to the GIS building station earthing system.

3.13 Earthing and Common Bonding of the Metal Enclosure

All metal parts other than those forming part of any electrical circuit shall be earthed to the earthing system. Any necessary terminals on any part of the equipment required for this purpose shall be provided. Also refer to paragraph 5.13 of this document

3.14 Finish of Internal Surfaces and Cleaning

The finish of interior surfaces of the metal enclosures shall facilitate cleaning and inspection. Any paints or other coatings that may be used shall be such that they will not deteriorate when exposed to the SF6 gas and other vapours, arc products, etc. that may be present in the enclosures. They shall also not contain any substances which could contaminate the enclosed SF6 gas or affect its insulating properties over the lifetime of the plant.

The finish of the interior surfaces shall be given in schedule B.

The equipment shall be manufactured and assembled at the manufacturer's works under conditions of the utmost cleanliness and before works testing and packing for shipping, interior surfaces, insulators, barriers, etc., must be thoroughly cleaned.

Should the painting/coating of any internal surface be necessary or recommended, details must be supplied.

Flange protection may be necessary or requested. Details of flange protection options must be specified

3.15 Indication and Verification of Switch Positions

Indicators, mounted external to the equipment, shall be provided on all circuit breakers, isolators and earth switches which shall clearly show whether the switches are open or closed. The indicators shall be mechanically coupled directly to the main contact operating drive rod or linkage and shall be mounted in a position where they are clearly visible from the switch house floor or the access decks surrounding the equipment.

At least two inspection windows shall also be provided with all isolators and earth switches so that the switch contact position can be clearly verified by direct visual examination.

The method of providing external indication and direct visual examination of contact positions shall be stated in schedule B.

3.16 Pressure Relief Devices

The supplier must advise where pressure relief devices are deemed necessary and specified in schedule B. Where Pressure relief devices are not installed or deemed necessary, calculations or proof must be provided to show that it was not necessary.

Pressure relief devices must be in accordance with national legislation. The pressure relief device must also be of a type agreed to or requested by Eskom. Graphite rupture discs will not be accepted.

If the pressure relief devices vent directly into the atmosphere, suitable guards and deflectors shall be provided to prevent pieces of the diaphragm or plug from flying out, or any dangerous SF6 arc product gases escaping in a manner that could endanger personnel who may be present.

3.17 Supply of SF6 Gas

The supplier must supply the SF6 gas for the initial filling of all compartments to working pressure. The contract shall include the supply of all the SF6 gas necessary for filling and putting into commercial operation the complete switchgear installation being supplied.

All SF6 gas supplied must comply with IEC 60376.

The supplier must remove all empty or partially used SF6 gas cylinders that were used during erection unless it is agreed that the cylinders will become the property of Eskom.

The high-pressure cylinders in which the SF6 gas is shipped to and stored on site shall comply with current applicable South African legislation.

The supplier to supply Eskom with a SF6 gas handling and management procedure detailed in schedule B. The procedure must be in accordance with NRS 087. All handling of gas must comply with South African environmental legislation and International legislation applicable in South Africa.

3.18 External SF6 Gas Detecting Instruments

Instruments as specified in Schedule A, for automatically and continuously monitoring the presence of SF6 gas in the atmosphere shall be provided as an option to the main contract works. The instruments are to be placed in various positions and shall be arranged to give a remote alarm when the SF6 gas which has leaked out of the equipment is detected in these positions.

The positions and exact number of detectors will be determined by mutual agreement after the design is been finalized.

The detectors shall be provided with the necessary brackets and fittings for fixing to steel or concrete work and shall be of a robust design.

The technical details and sensitivity of the detectors shall be given in schedule B. Details of electrical cable or other connection facilities that will be required between the instruments and the alarm panels shall also be included.

The cost of supplying and fitting the detectors, connections to the alarm panels and the alarm display facilities shall be included in the section for optional work in schedule C.

3.19 Site Fabrication, Inspection, Testing and Certification of Pressure Vessels

All bus bar/ducts must be factory manufactured, inspected and tested. No on-site manufacturer or welding will be permitted. All pressure vessels shall be tested according to the regulations of the OHS Act relating to pressure vessels and manufacturer specifications.

3.20 Condition Monitoring Devices

All types on condition monitoring devices offered as options will be considered. Partial discharge and/or arc detecting facilities are required. Details of options available must be stated in schedule B.

3.21 Seismic Activity

The GIS installation must me design to withstand seismic activity up to .3g

4. Primary Electrical Equipment

4.1 Circuit Breakers

4.1.1 Minimum Requirements

As a minimum requirement refer to "Specification for outdoor circuit breakers for systems with nominal voltages from 44 kV up to and including 765 kV, Document no 240-56063756.

Eskom **prefers spring** operated circuit breakers. Other technology such as hydraulic accumulator /spring combinations might also be considered. No pneumatic operated drive circuit breakers will be accepted. New or other technology may be considered and must be stipulated in schedule B.

4.1.2 Nameplate Information for Interrupter Unit

The minimum requirements stipulated in Doc No. 240-56063756 shall be adhered to.

4.1.3 Anti-Pumping

All circuit breakers shall be provided with a means to prevent pumping while the closing circuit remains energised, should the circuit breaker either fail to latch, or be tripped during closing due to the operation of the protective relays. Any relays to accomplish this shall be continuously rated and shall be mounted in the circuit breaker mechanism box. This arrangement shall not involve paralleling of trip and close circuits and shall be to the approval of Eskom.

4.1.4 Mechanism Motors

Motors shall be designed for the operating voltage specified, and voltage dropping resistors will not be permitted.

4.1.5 Hydraulic accumulator, Hydraulic Spring or Spring Mechanism

Hydraulic accumulator, hydraulic spring or spring mechanisms shall be complete with all control equipment.

Operating oil pressure shall be maintained automatically and a pressure gauge shall be provided to give indication (MPa) of the pressure available. The pressure gauge shall be suitably damped to ensure that it is not subject to transient pressure oscillations either during pumping or during operation of the circuit breaker.

Low oil pressure shall be detected by a suitable method (acceptable to Eskom) and, dependent on the pressure of the oil, shall initiate one or more of the following but not limited to:

- a) Stop/Start pump motor
- b) Block open/close (auto reclose) if pressure is insufficient to complete an open/close operation
- c) Block closing if pressure is insufficient to complete an open/close operation
- d) Block open (Main 1 and 2) if pressure is insufficient to complete an open operation
- e) Excessive motor running time

A hydraulic oil sight glass should be visible from ground level or platform without using any tools.

4.1.6 Testing Access Terminals

Easy access with minimum or no risk shall be provided with the circuit breakers to enable functional tests to be carried out after all the switchgear has been filled with SF6.gas. The provision shall be such that it is not necessary to open up any gas compartments to make test connections to the circuit breaker primary terminals.

Full details of the test procedure shall be provided with the circuit breaker, and submitted with the tender.

4.2 Isolators and Earth Switches

4.2.1 Minimum Requirements

The SF6 metal enclosed isolators and earth switches shall comply with the general requirements of isolators and earth switches and the latest revisions of the relevant specifications referred to in Document no 240-56063815.

4.2.2 Additional Requirements

All isolators and earth switches shall be provided with motor driven mechanisms. They shall also have facilities for manual operation. Combined disconnect and earthing switch shall be of no-load break type. They shall also have facilities for electrical override as well as manual operation and the necessary operating handles or cranks shall be supplied.

Mechanical / electrical interlocks must be fitted for "revision and service". Fully close/open indication must be indicated on the operating rod in such way that it is clearly visible through the sight glass and from ground level.

All main contacts shall either be silver plated or shall have silver inserts. Each disconnect and earthing switch shall open or close only due to motor-driven or manual operation. The switch contact shall not move due to gravity or other means, even if the part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed.

4.2.2.1 Position Indicating Devices and View Ports

Electrical driven, mechanically connected position indicators shall be provided showing either open or close position and visible from ground level

Two inspection windows must be provided in the enclosure from where the fixed and moving contact can be inspected as indicated in clause 6.1.

4.2.3 Fast Acting Earthing Switch

The fast acting earthing switches shall comply with the general requirements of fast acting earthing switches and the latest revision of the IEC 62271-102 specifications. Fast acting earthing switches shall be single or three pole operated. They shall also have facilities for manual operation and the necessary operating handles or hand cranks shall be supplied.

Fast acting earthing switches shall be electrically interlocked to prevent the fast acting earthing switch from closing on an energized bus section. This should form part of the integrated interlocking system with isolators.

All contacts, male and female, shall either be silver plated or shall have silver inserts.

Each fast acting earthing switch shall open or close only due to motor driven or manual operation. The switch contact shall not move due to gravity or other means, even if the part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed

a) Operating Mechanisms:

Mechanisms shall be arranged either mechanically or electrically such that all 3 phases of any particular fast earthing switch operates simultaneously.

All mechanisms shall be equipped with a motor suitable for operating from the auxiliary supply and a set of springs for energy storage and closing. Motors shall be suitable for operating at any voltage between 85% and 110% of the rated voltage.

Manual operation shall be possible. Handles or cranks shall be provided, together with all necessary operating rods and rod guides

b) Test Facility:

Each fast acting earthing switch shall be fully insulated and connected to earth by a removable bolted link in order that the earthing switch may be used for various test purposes. The insulation shall be capable of withstanding an applied power frequency voltage of 10 kV.

4.3 Current Transformers

4.3.1 Minimum Requirements

The current transformers shall be supplied in accordance with the following general requirements and the latest revisions of NRS 029:2012 and the IEC61869-1 specifications.

4.3.2 Additional Requirements

The cores must be external to the SF6 gas compartments and preferably of the ring core type. Each current transformer shall be provided so that the enclosure current does not affect the accuracy or the ratio of the device or the conductor current being measured. Standard 6 core CT's shall be used. Core configuration shall be 2 protections, 2 bus zone and 2 metering. Position and accuracy class shall be stated in schedule A. Provision must be made to do ratio tests on the CT's by induced current without interfering with the gas system.

4.4 Voltage Transformers

4.4.1 Minimum Requirements

The voltage transformers shall be supplied in accordance with the general requirements and the latest revisions of NRS 030:2012 and the IEC60044-2 specifications. Voltage transformers shall be of the electromagnetic type and detailed in schedule A. The number of core will be specified in schedule A. of the VT specification

For short circuit protection in the secondary winding circuits, MCB's must be used

4.4.2 Additional Requirements

Voltage Transformers shall have a separated gas compartment and be isolated from the rest of the GIS installation by means of a solid barrier insulator. Voltage transformers shall be attached to the gas insulated system in such a manner that they can be readily disconnected from the system if required for dielectric testing. The metal housing of the voltage transformer shall be connected to the metal enclosure of the GIS with a flanged, bolted and gasket jointed so that the transformer housing thoroughly earths to the GIS enclosure.

Adequate measures shall be provided to prevent any unacceptable impact on the secondary control and protection circuits, which might result from very fast transients (VFT) or Ferro resonance.

4.5 Bus bar Conductors

The components of the GIS shall be connected by either single phase or three phase gas encapsulated bus bars. The bus conductor shall be connected with plug in contacts with silver plated contact surface. The bus system shall be capable of withstanding the mechanical and thermal stresses due to short circuit currents, as well as thermal expansion and contraction created by temperature cycling. Standardized bus bars lengths must be used. The standard bus bar sections shall be of the same length as the bus duct sections and shall be fully interchangeable. All lengths should be stated in schedule B.

It must be possible to carry out contact resistance tests on bus bar sections. When repair work is required on any section of bus bar it must be possible without switching the station off. It should be possible to remove and replace any section of the bus bar or bus duct without dismantling the complete bus bar or bus duct.

The heating due to solar radiation shall be taken into account in determining the current rating of the GIS bus bar conductors which are installed in open trenches or in the open on the surface.

4.5.1 Ratings

The conductors shall be capable of carrying, the continuous currents and short-time fault currents stated in schedule A. The actual current ratings of the conductors to be supplied shall be stated in schedule B. Where the bus ducts are installed in tunnels or covered trenches, the bus ducts shall be designed to achieve the specified current ratings without the need to provide any forced ventilation.

4.6 SF6/Air Bushing and connections on Transformers & Reactors

4.6.1 General

Outdoor SF6 bushings, for the connection between the GIS and overhead lines or conventional air insulated equipment shall be requested where specified in schedule A. Bushings shall comply with the IEC 60137 standard.

Bushing could be used up to 1800 meter above sea level. The creepage distance over the external surface of outdoor bushings shall not be less than 31 mm/kV. The required level will be specified in schedule A. Lightning impulse withstand voltage will be specified in Schedule A

Outdoor bushings must be capable of withstanding a cantilever force applied to the terminal of at least 2500 N

Where specified in schedule A, the GIS shall be connected directly to transformers and reactors.

KIPTS testing is necessary when required in schedule A

Tan delta test point facilities must be provided.

4.6.2 Connections onto Transformer or Reactor Bushings

Transformers and Reactors shall be connected to the GIS via the following and will be specified in schedule A.

- GIS to AIS bushings and tubular conductors
- Complete enclosed adapters
- Cable to GIS connectors.

In the case of a metal enclosure coupling, the design of the transformer bushing housing shall fully comply with the latest IEC standard. The adapter shall have a removable bus link to permit electrically disconnecting the transformer from the bus, testing of the bus or transformer separately and removal of the transformer if required.

The bus enclosure shall be insulated from the transformer or reactor tank to minimize circulating currents. The adapter unit shall also contain a bellow assembly and flexible conductor connections to minimize transfer of vibration from the transformer.

4.6.3 Ratings

The conductors of outdoor termination bushings shall match the rating of the GIS, specified in schedule A.

4.7 HV & EHV Power Cable Circuits

4.7.1 General

The design of the cable end box shall fully comply with the latest IEC 62271-209 standard for dry-type terminations. The final connection of the high voltage or extra high voltage cable circuits in the GIS will be by means of individual single-phase cables, with one cable per phase. All cable end modules shall be suitable for connecting single core, XLPE solid dielectric cable for maximum continuous current.

The cable end unit design shall include a facility for high voltage and insulating testing of the connected power cable on site. The facility must be of a permanent nature and must preferably be designed in such a way that it prevents gas handling or removing of the cable terminations. The facility must be described in detail in schedule B.

The scope of supply shall be as defined in the IEC 62271-209 standard for dry-type terminations.

The fitting of the female GIS termination insulator and insulator collar or adaptor as specified in IEC62271-209 will be performed by the GIS OEM or approved installer as and when required.

4.8 Surge Arresters

4.8.1 Minimum Requirements

The surge arresters shall be supplied in accordance with the general requirements and the latest revisions of the relevant specifications referred to in Doc. No. 240-56062896 "Standard Specification for Outdoor Metal Oxide Surge Arresters without spark gaps for system voltages of 220kV and above" and Doc No. 240-75540566 "Specification for station class metal oxide surge arresters."

4.8.2 Additional Requirements

GIS surge arresters shall be provided when specified and shall be connected directly to the GIS in the positions determined by surge propagation and associated over voltage studies. Where possible surge arrestors must be external to GIS

The ratings shall also be determined by the studies and listed in schedule B. When necessary, AIS surge arresters shall be placed at line exits in close proximity to the line entrance.

The layout of the switchgear and the position of the surge arresters shall be such that the complete surge arrester including the metal enclosure can be removed without having to disturb any other part of the switchgear or associated support steelwork.

4.8.3 SF6 Gas Enclosure and Connection to Switchgear Equipment

GIS surge arresters shall be of the SF6 gas insulated metal oxide type. The metal housing of the arrester shall be connected to the metal enclosure of the GIS with a flanged and bolted gasket joint so that the arrester housing is earthed through the GIS enclosure. The ground connection shall be sized for the fault level of the GIS. The surge arresters shall successfully drain the dynamic currents repeatedly caused by impulse waves. Each single-phase surge arrester shall be provided in a separate SF6 gas enclosure so that its gas compartment is completely isolated from the gas compartments of the other phase surge arresters and the switchgear to which it is connected.

No interconnecting gas pipes shall be provided between the individual phase enclosures and each enclosure shall be fitted with its own SF gas density/pressure monitoring devices.

It shall be possible to evacuate the SF6 gas from the surge arrester enclosure and remove the complete arrester with enclosure from the switchgear without having to evacuate SF6 gas from any other part of the switchgear to which it is connected.

4.8.4 Discharge Counters

Where specified in schedule A discharge counters shall be provided with each single phase surge arrester and shall be located at a position convenient for inspection. The operating counter shall record the number of discharges of the arrester.

Leakage current meters will be fitted if required in schedule A

5. Secondary Electrical Equipment

5.1 Electrical Protection

5.1.1 Minimum Requirements

The minimum requirements for Secondary Electrical Equipment must be IEC 61850 compliant

5.1.2 Additional Requirements

The electrical protection for particular primary circuits, i.e. line and cable feeders, transformers, bus coupler circuits, etc., will be provided by Eskom. This protection will be mounted on panels located in a control room adjacent to the switchgear. The necessary protection circuits between the control and protection panels and the switchgear will be completed by means of cabling in accordance with Clause 5.12. The cables will be terminated in the local control/marshalling kiosks detailed in Clause 5.2. All secondary control, protection and indication circuits from the various individual items of SF6 switchgear are to be cabled to these local control/marshalling kiosks, this cabling being provided as part of the switchgear contract by the manufacturer.

The cabling from the marshalling kiosks to the control and relay panels will be installed separately by Eskom under other contracts.

The protection scheme will be in accordance with Eskom's standards and brief details of the schemes are given in Clause 5.1.1. In addition, the requirements for the control protection and indication circuits to be provided as part of the SF6 switchgear so that these circuits will be compatible with standard schemes as detailed in Clause 5.1.1.

The main bus bar protection scheme will also be provided by Eskom. The protection will be mounted in panels located in the control room. As with the main circuit protection, cables for any bus bar protection circuits will be provided by Eskom between the bus bar protection panels, the circuit protection panels and the local control/marshalling kiosks. Brief details of the bus bar protection scheme are given in Clause 5.1.4. The switchgear supplier must also specify the maximum bus bar fault clearing times that can be tolerated so that Eskom can decide on the best type of bus bar protection to install.

Flash Detection Protection must be included on all bays. Flash detection must be monitored from a single source panel where the cause of detection can be analysed and recorded. The complete bus bar and associated bays must be monitored and recorded individually from this panel. Tripping of the associated bays where flashes have occurred will be possible with the minimal disruption to all healthy bays. All outputs will be controlled and can be isolated from this single source panel. The Flash detection protection scheme must work concurrently with current measurement. The scheme shall be agreed with and be determined by Eskom.

5.1.3 Primary Circuit Protection, Control and Indication

Each particular primary circuit will be provided with one scheme, each scheme being connected to its own individual current transformer protection secondary cores specified in *Clause 5.3*. All metering, e.g. ammeters, remote indication current transducers, kilowatt hour meters, etc., will be connected to the separate metering current transformer core specified.

Two main tripping schemes are to be provided, each tripping scheme being connected to one of the two circuit breaker shunt trip coils. The two tripping schemes are individually fused in the Eskom protection circuitry and all circuits must be such that the two schemes are electrically separate at all points.

The operation of the two tripping schemes will be initiated by the two main protection and the back-up protection schemes of above, the bus bar protection and the bays stripping protection.

The gas protection schemes shall also be connected into the circuit breaker shunt trip circuits. The low gas condition must initiate alarms and a close and trip block. The tripping contacts from the fast protection schemes will be electrically a part of one or both of the two tripping schemes so that these contacts must be electrically separate from the gas protection circuit.

The closing and auto-reclosing scheme will be electrically separate from the tripping scheme. The same applies for the indication and alarm circuits.

All tripping, opening, indication and other auxiliary control schemes will be operated from the DC supply specified in Schedule A.

Closing and opening of the circuit breakers and isolators will be controlled from the remote control and relay panel or over tele-control equipment to be provided by Eskom under other contracts. Facilities shall also be provided for closing and opening the circuit breaker, isolators and earth switches (where these are spring or motor operated) from the local control panels. Selector switches shall be provided on the local control panels for switching these controls between the local and remote positions as well as for switching the controls off and isolating the control circuits as specified in Clause 5.2.

In order that they can be incorporated in the control and protection schemes, all circuit breaker trip and close circuits, auxiliary switches, spring limit switches, interlocks or pressure switches, isolators and earth-switch auxiliary switches and mechanism limit switches and current transformer and voltage transformer secondary cores shall be separately wired and cabled to terminals in the marshalling kiosks to be provided with each primary circuit.

It shall not be necessary to wire every multi-ratio current transformer tapping to a terminal in the marshalling kiosk, selection of the current tap will be made in the current transformer terminal box. In addition, the electrical circuits associated with the gas alarm and indication schemes shall be wired to the terminals in the marshalling kiosks as specified in Clause 5.5.

The final arrangement of the protection and control circuits on the circuit breakers, isolators, earth switches, current transformers, voltage transformers, local control panels and gas alarms and indication schemes shall be agreed with and approved by Eskom.

5.1.4 Bus Bar Protection

All current transformer secondary circuits and isolator auxiliary switches shall be wired and cabled separately to the terminals in the marshalling kiosks to be provided with each primary circuit. No circuits shall be cabled or wired directly between the current transformer terminal box and the isolator mechanism/auxiliary switch box.

The supplier shall state in Schedule B the maximum time from inception of a fault to clearance of the fault that can be tolerated in the case of a bus bar fault on the SF switchgear equipment.

5.2 Local Control Marshalling Kiosks

A local control and marshalling kiosk shall be provided with each of the primary circuits, and other circuits such as separate bus section isolators and bus bar voltage transformers. Adhere to 240-146288697 Specification for the interfacing of the new protection and control equipment to the gas insulated substations bay marshalling kiosk and wiring diagram, 0.52-30571.

Each kiosk shall contain the local control, interlock control and indication devices for the associated SF6 circuit breakers, isolators and earth switches and the DC protection MCB's, links and supervisory relays specified in 5.1.1. The kiosk shall also be a marshalling or junction point for all the protection, control alarm, indication and DC power supply circuits from the associated SF6 circuit breakers, isolators, earth switches and the gas monitoring, alarm and protection system. All cables being provided by Eskom will be terminated in the marshalling kiosks. Cabling access will be specified in schedule A

For the above facilities the local control/marshalling kiosks shall generally be provided with the following features:

- a) A mimic diagram. The discrepancy control/indicating switches, local/off/remote switches and DC isolating switches as well as relays with operation indicators shall be mounted on or adjacent to the mimic diagram. The relays can be mounted inside the marshalling kiosk. Except for on the mimic diagram, other control or selector switches should preferably be mounted below the level of any relays.
- b) All interposing relays associated with the circuit breaker, isolator, etc., control switches shall be incorporated in the marshalling kiosk
- c) The gas alarm, indication and protection equipment shall be indicated on the marshalling kiosk.
- d) MCB's shall be mounted on the rear of the swing frame of the panel on the exterior of the local control/marshalling kiosk, and the width of the panel shall be such as to easily accommodate the fuses and associated wiring. CIRCUIT BREAKER (MCB'S and Isolating links) with aux contacts to be provided for external, visible alarming on the exterior of the Marshalling Kiosk.

The kiosks shall be mounted on the switch house floor or the access decking adjacent to each associated primary circuit or equipment. The kiosks shall preferably be located so that the primary equipment can easily be seen from the local control position at the kiosk, but such that it will not obstruct general access ways along the decking even when the doors are open.

A general arrangement drawing of the kiosk showing the position of all important features and the mounting position shall be submitted at the tendering stage. The final mounting position shall be approved by Eskom

All cables shall enter the kiosk from the bottom, the cables running in cable trenches or trays located in the switch house floor or underneath the access decking.

5.2.1 General Construction

The local control and marshalling kiosks will be installed indoors but care must be taken with the design to ensure that all the kiosks are drip and splash proof. The kiosks shall also be dust; termite, rodent and vermin proof according to IEC 60529 "Degrees of protection provided by enclosures"

The kiosk shall have a rigid base frame fabricated from hot rolled channel sections. The kiosks shall be made up of panels, side sheets and doors mounted on the rigid channel base. These shall be made of folded steel of not less than 2,5 mm (12 gauge) thickness and wherever possible shall be bolted together.

Where panels of kiosks adjoin one another directly, side sheets shall be provided to ensure complete separation between each panel and / or kiosk.

Common wiring shall pass through holes in the side sheets, the edges of which shall be protected by means of grommets to prevent damage to the wire insulation. Chamfered edges will not be acceptable and all sharp edges must be removed.

Doors shall be hinged to open 180° to provide maximum access. Substantial lift-off type hinges shall be used and they shall not be fixed to the door or frame by means of welding. Lockable door handles and catches are to be provided and shall be self-contained and completely flush mounted so as not to hinder the full 180° opening of the doors. The doors shall be provided with seals to ensure that the kiosks are drip and splash proof as well as dust, termite and vermin-proof. Rubber or felt gasket seals will not be acceptable and must be IP 55 compliant.

Where auxiliary equipment such as interposing relays are mounted on the inside of doors this shall be done in such a manner that no screws, studs, connections or panel wires are visible with the door closed. Horizontal straps shall be provided for this purpose for accommodating projection pattern relays, etc., with rear projecting terminal studs. Unistrut members welded to the inside "return" of the rear doors are acceptable.

The LCC must be universally compatible with full functionality for local control and alarming in accordance with the Eskom standard 240-62773019 "Specification for low voltage auxiliary electrical component standard". It shall include the following

- Aux and tripping relays
- Selector switches
- Diodes
- Indication lamps
- MCB
- Push buttons
- Terminals
- Wiring

Doors shall not be wider than 800 mm. Where the width of kiosk requires it, two doors shall then be provided with each door hinged at the side so that doors open from the centre. A substantial centre post shall then be provided in the door frame to provide adequate support and mountings for the door catches.

Suitable ventilation holes shall be provided in the doors to allow free circulation of air within the kiosks to reduce the likelihood of condensation. The holes shall be so shaped as to prevent the ingress of dust or moisture falling at an angle between the vertical and 90° to the vertical and shall have internal brass or copper gauze covering to ensure that the kiosks are termite and vermin proof.

Removable blank gland plates shall be provided for the mounting of PVC SWA type cable mechanical glands. The gland plates shall cover the complete bottom of the kiosk and be such that the kiosk is termite and vermin proof from the bottom. The design of the gland plates shall ensure that any moisture or water that collects on them can easily drain through the section gaps. The gland plates shall be fixed to the top of the base channel frame and any other support frames that are necessary. The gland plates shall be provided in separate sections, each section being approximately 150 mm wide along the length of the kiosk.

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5.2.2 Painting

The local control and marshalling kiosks shall be painted in accordance with “Eskom standard for painting cubicles” TST 41-981.

5.2.3 Mimic Diagram Panel

a) Mimic Diagram

The mimic diagram to be provided shall depict in single line form the main bus bars, circuit breakers, isolators and earth switches associated with the kiosk as well as a symbol to clearly indicate the type of circuit, i.e. generator transformers, transformers, reactor on line.

The size of the mimic and diagram lines and symbols shall be such that they are clearly visible to the naked eye when viewed from a distance of at least 3 m. The supplier will be advised of the colour of the mimic background and lines and symbols after the contract has been awarded.

Discrepancy control switches shall be provided in the mimic diagram for the local control of the circuit breakers, isolators and spring operated or motorised earth switches. Hand dressed discrepancy semaphores shall be provided for any earth switches which are manually operated. The discrepancy control switches and hand dressed semaphores shall comply with the requirements of Clause 5.2.4. The discrepancy switches shall be mounted no higher than 1,75 m and no lower than 1,3 m above the level of the associated operating floor. The indication bar on the switches shall be the same width and colour as the mimic diagram lines.

The mimic diagram shall either be painted directly onto the panel sheet or use printed symbols. The type and construction of a mimic diagram made up shall be approved by Eskom.

b) Other Controls and Indications

The following selector switches shall be provided on each kiosk where applicable:-

- i. Circuit breaker “local/off/remote” switch.
- ii. Bus bar isolator and C.B. earth switch “local/off/remote” switch.
- iii. Feeder circuit isolator and earth switch “local/off/remote” switch (for each individual circuit).

The function and requirements of the selector switches are specified in Clause 5.2.5 and shall comply with the requirements of Clause 5.2.5. If the number of wafers on the control exceeds 14 then a support bracket needs to be used to stabilise the switch.

Any indication and alarm relays associated with the DC supplies shall be mounted on the front panel of the kiosk together with the selector switches detailed above. The relays shall preferably be mounted in a horizontal line above the selector switches which shall also be mounted in a horizontal line.

The relays shall comply with the requirements of Clause 5.8. On each kiosk a lamp test facility with a BLUE pushbutton is to be provided.

5.2.4 Discrepancy Switches and Hand-Dressed Semaphores

The discrepancy control switches and hand-dressed semaphores shall have an indication bar to show whether the particular item of primary equipment controlled and/or represented is open or closed. The bar in line with the associated diagram line shall represent a closed device and the bar at right angles to the associated diagram line shall represent an open device. The discrepancy switches controlling the circuit breakers, isolators and earth switches shall have different escutcheon plates to provide a clear distinction between the different items of equipment being controlled.

The discrepancy control switch and hand dressed semaphores shall be illuminated when the position of the indicating bar does not conform to the position of the primary equipment. The discrepancy control switches shall be such that a control can only be carried out by the action of turning the switch to the desired indication position and then depressing the switch and turning the switch at least a further 30° beyond the normal indication position. The switch shall automatically return to the relevant normal indication position after being released.

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The discrepancy switches shall be suitable for operation at the DC voltage specified in Schedule A. The switches shall preferably be capable of switching the circuit breaker trip and close coil currents and the isolator and earth switch control currents. If the discrepancy switch contact rating is insufficient for this purpose, shunt connected interposing relays may be used. The discrepancy switches must be firmly mounted to prevent movement of the switch when it is operated.

5.2.5 Selector Switches

The selector switches shall comply with the general requirements of Clause 5.1.1. They shall be rated to operate at the DC voltage specified in Schedule A and shall be capable of carrying the circuit breaker trip and close coil currents and the isolator and earth switch control and mechanism motor currents. The use of interposing relays will not be acceptable.

The various selector switches shall perform the following functions:

a) Circuit Breaker "local/off/remote" Switch

Local position: Allow local control of the circuit breaker using the discrepancy switches on the local mimic diagram only and render all protection circuits inoperative.

Off position: Isolate all controls and DC circuits to the circuit breaker mechanism.

Remote position: Allow control of the circuit breaker from the remote control and relay panel only and put the protection circuits into operation.

b) Bus Bar Isolator and Circuit Breaker Earth Switches "local/off/remote" Switch.

Local position: Allow control of the associated isolators and of any spring or motor operated earth switches' using the discrepancy switches on the local mimic diagram only and render all control from the remote control and protection panels inoperative.

Off position: Isolate all control and DC circuits to the isolator and earth switch mechanism.

Remote position: Allow control of the isolators and earth switches from the remote control and protection panels only and render all local control from the discrepancy switches on the mimic diagram inoperative.

c) Feeder Circuit Isolator and Earth Switch "Local/off/remote" Switch.

The functions in the local, off and remote positions shall be as detailed for (b) above. Where two cable circuits are controlled by a single circuit breaker, two separate "local/off/remote" switches shall be provided for each circuit isolator and earth switch

d) Interlocking Switch

Normal and override position:

Switch must be spring returnable and the override position must be 30 deg. from the centre of the switch. It must be lockable in the normal position

"Local/off/remote" Switches above shall be 3 way switches with the number of poles as specified in Schedule A. In the case of isolators and earth switches the number of poles to be provided on the switch shall be dependent on the number of isolators and earth switches to be controlled.

The supplier will be provided with details of the circuits to be wired to the selector switches after the contract has been awarded.

The selector switches shall be labelled in accordance with the requirements of clause 5.1.1.

All the above selector switches shall have unique facilities for locking in any position.

5.2.6 Terminals

The terminals in the marshalling kiosk shall comply with reference to clause 6.1.1.

All cables from the equipment included in this contract and cables from equipment being provided by Eskom shall be terminated in the local control/marshalling kiosk. Terminals shall be provided for making off all the cable cores as specified in Clauses 5.10, 6.11 and 5.12. The terminals shall be mounted away from the rear, front and side sheets of the kiosks so that a clear working space for cabling of at least 100 mm is obtained. The bottom terminal in any row must be at a minimum height of 300 mm above the gland plates and the terminal rows must be spaced at least 200 mm apart.

Where the marshalling kiosk has two doors, a terminal row must not be placed directly behind any centre door pillar.

The terminal block rails shall be securely fixed to special horizontal support members running between the kiosk side sheets. Vertical trunking shall be provided between each row of terminals on each side. A horizontal trunking shall be run across the top of and 50 mm above each set of terminal rows.

5.2.7 Wiring

All wiring between the various items in the local control and marshalling kiosk and the cable terminals shall be provided. This shall include any loops between the terminals on which the cable cores are made off. The wiring shall be in accordance with Clause 5.1.1.

All cores of cables supplied under this contract shall be wired and made off as part of this contract. The wiring of the cable cores shall be neatly done to the satisfaction of Eskom and shall be securely bound to the vertical trunking provided. Any wiring from the terminals on which the cable cores are made off to other items in the kiosk shall be run up the vertical trunking and then to the sides of the kiosk using the horizontal trunking provided. All vertical wiring up the side sheets shall be accommodated in trunking mounted on the side sheets. The trunking shall be as specified in Clause 5.11. with reference to clause 5.1.1

Suitable arrangements shall be made to terminate, support and protect any panel wiring across the hinges of the rear doors. The conductor bundle shall be arranged such that it is substantially vertical where it crosses the hinged joint.

5.2.8 Heaters

Suitably rated heaters must be provided in each marshalling kiosk. The heaters shall be supplied from the single phase AC supply specified in Schedule A. Heaters must not have bare terminals and adequately covered to avoid contact. The heater must be controlled by a thermostat.

The heaters and mounting position(s) shall be in accordance with Clause 5.2.9. Heaters must be positioned lower in the kiosk and in such a way as not to cause damage to adjacent equipment. Interior temperature in Kiosk shall not exceed 55 °C.

5.2.9 Interior Lighting

Each marshalling kiosk shall be provided with adequate interior lighting. The lamps shall be LED energy saving. There will be a lamp control switch for each door. A switch for the lamps shall be provided in each kiosk. The switch shall be provided with a label engraved "interior light".

The A.C. supply for the lamp shall be the same as that for the heaters specified in Clause 5.2.8. The switches will not inadvertently isolate the heater supply

5.2.10 Protection Earthing

For minimum requirements refer to Eskom "Standards for Earthing for Substation Protection Equipment TST 41-1064" and "Substation Design Earthing Standard TST41-877."

Each kiosk is to be provided with a 50 x 3 mm copper earth bar. The earth bar shall be mounted in the bottom of the kiosk. Where panels or kiosks adjoin one another connecting straps shall pass through special apertures in the side sheets provided for this purpose. When installed and connected the earth bar shall run the full length of the suite of panels or kiosks.

All exposed metal non-current carrying parts of meters, relays, control switches, terminal block mounting rails, etc., shall be effectively connected to the earth bar by means of green 2,5 mm PVC covered earthing conductor.

5.3 AC Supplies and Circuits

400 Volt 3 phase 4 wire AC supplies will be provided from AC plug boxes to be provided by Eskom in the switch house.

The normal maximum and minimum voltages that will occur in the supply are as specified in schedule A. All equipment supplied shall be capable of running continuously or switching the AC current within the range of the normal maximum and minimum voltages specified.

5.4 DC Supplies and Circuits

DC supplies as specified in schedule A will be provided by Eskom for all control, protection, interlocking, and alarm, indication and power supply circuits. The normal maximum and minimum voltage levels that will occur on the supply are specified in schedule A.

Each control and protection panel to be provided by Eskom will have its own separately fused supply from the substation DC distribution board. The control and protection circuits will then be suffused in the control and protection panels as specified and referenced to clause 5.1.1.

The design of all circuits must be such that separately fused or sub-fused circuits are always kept electrically separate.

5.4.1 Supply Protection and Rating

In the substation DC distribution board the outlets will be protected by means of DC rated MCB's.

The supplier, where applicable, shall grade his requirements to the various DC circuits made available to him as part of this contract. These circuits shall also be protected by means of DC rated MCB's in the positive and negative circuits.

All separately fused DC circuits associated with the local control and gas protection of the circuit breakers and SF6 switchgear in general and interlocking circuits shall incorporate a voltage supervision relay. The relay shall comply with the clause reference 5.1.1 and wherever possible shall be mounted on the local control/marshalling kiosk as detailed in Clause 5.2.3. The relay shall be provided with an operation indicator as well as two potential free contacts wired to the cable termination blocks in the marshalling kiosk. The contracts shall close on the loss of the monitored DC volts. The operation and reset of the relay shall be time delayed to avoid spurious operations and the indicator shall be self-resetting.

5.5 Terminal Boxes

Terminal boxes shall be arranged in accessible positions and provided with easily removable, hinged or slip-on weather-proof covers with not more than two fixing screws and comply with IP 55.

Where more than one secondary terminal box is provided per (single phase) class of equipment, the terminal boxes shall be interconnected by a weather-proof galvanised conduit having a minimum bore of 25 mm and arranged for bottom entry.

The terminal boxes shall be arranged for bottom entry of cables.

5.6 Interlocking

A comprehensive interlocking scheme shall be provided as part of this contract. The supplier shall recommend the scheme which he will provide, the scheme being fully automatic and in accordance with modern interlocking and logic techniques. An interlocking scheme shall not be dependent on keys. Full details of the scheme to be supplied shall be provided with the tender. To be referred in schedule B.

The final scheme to be provided shall be approved by Eskom.

The interlocking scheme shall be fail safe and be such as to prevent damage to any equipment or the endangering of operating and maintenance personnel under all operating and maintenance conditions.

Interlocking on manually operated devices shall be applied directly to the operating handle to prevent the remainder of the mechanism being subjected to any strain when the interlocking blocks an attempted operation. The interlocking device shall be of sufficient strength to resist any reasonable force that could be applied when attempting a manual operation.

A key operated switch shall be provided at each particular device to permit overriding of the interlocking. The interlocking scheme must allow for testing conditions.

The interlocking scheme shall be such as to ensure that isolators cannot be opened if any pole of the associated series isolator remains closed, e.g. if one pole of a circuit breaker sticks in the closed position. Similarly it shall not be possible to close an earth switch if any pole of an associated isolator with which it is interlocked remains closed.

The interlocking scheme shall be operated off the DC supplies specified in Clause 5.4 and all circuits shall comply with the requirements of this clause. In particular the supply to the scheme shall be separately fused and the circuit shall incorporate voltage supervision relays as specified in Clause 5.4. Override must be controlled by a unique key.

5.7 Relays

All relays to be provided shall be in accordance with the general requirements and the latest revisions of the relevant specifications referred to in Clause 5.1.1

5.7.1 Operation Indicators

Where specified, relays shall be fitted with operation indicators which shall not operate until the relays have closed their contacts.

Indicators may be mechanically operated flags or illuminated. The type of indicator to be supplied shall be stated in Schedule B.

Unless otherwise specified, all reverse type flags, indicators shall be of hand reset type. Resetting shall be accomplished without opening the case.

In electrically reset relays the flag shall follow the contact position and shall be capable of being reset manually without opening the case.

Flag labels shall be left blank unless otherwise specified.

Where series flags are operated by the current from a relay, the flags and particular relays shall be obtained from the same supplier to ensure compatibility.

Electrical operational counters must be supplied for each item of plant that can be operated over and above the mechanical counters supplied for each item of plant.

5.8 Auxiliary Limit and Pressure Switches

Auxiliary, limit and/or pressure switches shall be provided with circuit breakers, isolators and earth switches as specified in Clauses 3.5.

Auxiliary switches shall be approved by Eskom and samples shall be submitted for approval within 6 months after the placing of the contract.

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Auxiliary switch contacts shall provide low electrical contact resistance and high mechanical endurance in high humidity atmospheres. Solid, electroplated or inlaid silver contacts will be acceptable; details of other contact materials shall be submitted to Eskom for approval.

The auxiliary switch contacts shall be wired to a secondary terminal strip complying with the requirements of clause 5.1.1.

All auxiliary limit and pressure switches must be suitably rated to make break and carry the associated circuit breaker close and trip coil currents.

The design of and material used in the construction of auxiliary switch mechanisms shall be such as to provide the utmost reliability.

Sequential motor running facilities must be monitored over a continuous 24 hour period. Excessive operations must be monitored and alarmed within the 24 hour period. The number of excessive operations will be agreed upon in conjunction with Eskom. Any excessive operations will be alarmed accordingly. Referenced to clause 4.1.5

5.9 Electric Motors

Electric motors shall be suitable for operation at the relevant DC supply voltage as specified in schedule A. Referred to IEC 61852

5.10 Wiring

The equipment to be provided as part of this contract shall be fully wired in accordance with the 240-64685228. The supplier shall also be responsible as part of this contract for the making off and terminating of the cores of all cable tails terminated in equipment supplied under this contract.

Eskom may wish the supplier to make off and terminate cable tail cores in equipment supplied under other contracts. A rate price for undertaking this work shall be stated in the optional section of schedule C. All other aspects of wiring and requirements should refer to clause 5.1.1.

5.11 Cabling and Cable Terminations

The provision, laying, installing, making off and terminating of all cables between any item of equipment being supplied as part of this contract shall be the responsibility of the supplier and the contract price shall include for this work.

Eskom may wish the supplier to supply, lay, install make off and terminate other cables not included in those above as an extra to the contract. Rate prices for undertaking this additional work shall be given in the optional section of schedule C.

All cabling shall be carried out in accordance with proper official cable block diagrams complying with the requirement of Clause 5.12.

The cables shall be laid, installed and made off in accordance with the general requirements. Cable core tails shall be terminated as specified in Clause 5.13.

5.12 Electrical Drawings, Cable Diagrams and Schedules

All drawings shall be in accordance with Clause 11.5. Electrical drawings, cable and wiring schedules shall in addition comply with the following particular requirements.

In addition to the electrical schematic or key diagrams for the individual items of equipment which will be supplied under this contract, comprehensive schematic and key diagrams shall be supplied for all the alarm, protection, control and indication schemes to be provided. Separate schematic or key diagrams shall be provided for each group of circuits associated with the local control/marshalling kiosk and shall preferably be subdivided as follows:-

- a) AC electrical protection showing all the circuits from the current transformers and voltage transformers.

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- b) DC electrical protection, control indication and alarm circuits associated with the circuit breakers, isolators and earth switches.
- c) AC/DC power supply circuits for circuit breaker, isolator and earth switch mechanisms.
- d) Gas monitoring, alarm and protection circuits.

The comprehensive schematic or key diagrams shall clearly indicate circuit numbering, where circuits are run in cables, and the cable core terminal blocks up to and including the terminals in the local control/marshalling kiosks.

5.12.1 Circuit Identification Numbers

Circuit identification numbers shall be shown on all schematic diagrams.

The wire ferrule numbers to be provided shall be in accordance with Clause 5.1.1.

5.12.2 Cabling Diagrams

Cabling diagrams shall be provided detailing the wiring of all cable tail cores and other wiring to the cable terminal blocks in the local control/marshalling kiosks and any other panel, cubicle, kiosk or terminal box that will serve as a junction point for cables or circuits which shall be provided as part of this contract.

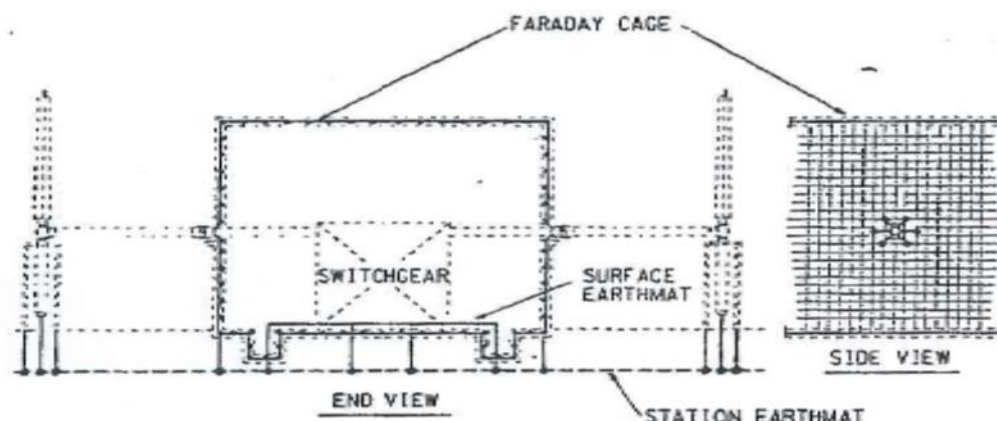
Separate diagrams shall be provided for each junction point.

The diagram shall detail the terminal rows and the position of each terminal block in the row. The cable number, cable (or circuit designation) as well as the internal wiring circuit (wire ferrule) identification numbers shall be detailed on the cabling diagrams.

5.13 Substation Earthing

The GIS building earthing system pertaining to the building and all GIS switchgear installed shall be the design responsibility of the supplier and shall be bonded, preferably at the GIS bushings, to the Eskom designed earth mat for the outdoor equipment which will consist of copper strap buried in a mesh pattern in the soil surrounding the switch house, outdoor HV yard, and in cable trenches where these are provided

The GIS building earthing system shall provide suitable performance under all conditions of operation, and counter measures to minimize the effects of transient ground potential rise (TGPR) e.g. during isolator operation, breakdowns during HV site testing, etc. The GIS building earthing system must ensure overall Electro Magnetic Compatibility (EMC) as illustrated in the drawing below.



Eskom shall require the supplier to provide the above details with the tender documentation.

. This earth mat for outdoor yard is designed according to the Eskom standards "Substation Design Earthing Standard" TST41-877" or "DX Standard - Part 2 Earthing section 3: Substation Earthing DST 34-1245."

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5.14 Flash Detection

The entire GIS infrastructure must be considered for internal flash detection. Each bay must be adequately covered. The devices must be able to monitor from a remote location from a universal panel. The flash detection must allow for tripping the bay where the fault was initiated. The panel must be able to store sufficient data for proper post incident analysis. The system must be allowed to be evaluated by Eskom prior to acceptance and must be described in schedule B.

5.15 UHF Partial Discharge (PD) Monitoring

Provision must be made for online UHF PD monitoring in each gas compartment that can be used as an early fault detection system and for condition assessment. The UHF sensors must be optimally positioned such that full coverage of the GIS installation is achieved. The measuring interface must be compatible with commercially available test equipment for PD detection

6. Structural Support Steelwork and Associated Fittings

6.1 General

Eskom will normally provide a switch house of reinforced concrete or steel frame construction with brick or sheet steel cladding. However Eskom reserves the right to have the GIS installed entirely outdoors. The dimensions and drawings of the building will be provided by Eskom

This contract shall include the supply and installation of all steelwork necessary for fixing and supporting all the GIS to the foundations and walls of the switch house building. Access decking, staircases, ladders, cable trays, etc., shall also be supplied and installed as part of this contract. The general philosophy must be to reach all mechanism drives, inspection windows and gas filling points from ground level with no interference when carrying out maintenance.

6.2 Support Steelwork

The support steelwork shall be so designed that it provides the proper support for all items of the GIS. This shall also include the necessary steelwork for supporting the access decking specified in Clause 7.3, the cable trays specified in Clause 7.4 and any other special cable racks or supports.

In particular, adequate support shall be given to the SF6 ducting connecting with transformers and reactors and outdoor line bushings. The GIS must be self-supporting from ground level except for special conditions e.g. vertical shafts.

The design of the steelwork supporting the SF6 ducting to transformers and reactors shall be such that the ducting is wholly supported and restrained by steelwork fixed to the switch house foundations and walls. No supporting steelwork shall be fixed to transformers or reactors.

6.3 Access Decking, Staircases, Ladders, etc

The contract shall include the supply of decking and gangways wherever this is necessary or desirable to ensure convenient easy access to all operating and inspection locations and points requiring regular maintenance or checks.

The access decking which shall be provided in the switch house shall extend over the length of the installation of circuit breakers to be provided under this contract. Access decking shall not be provided in the positions of future circuits.

The access decking and gangways shall preferably be mounted above the level of the main SF6 bus bars and at a height that will allow:-

- a) Ease of access to all inspection points and mechanism cubicles for maintenance and testing.
- b) Operating and maintenance personnel to readily walk from one pole or three phase circuit breaker set to another without having to climb up and over any part of the SF6 switchgear.

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- c) Operating and maintenance personnel to readily view the position of circuit breakers, isolators and earth switches.
- d) The decking should not interfere with the installation of cable trays.

The access decking and gangways shall be as specified in schedule A. Staircases and vertical ladders shall be provided at regular intervals giving access onto the removable decking from the switch house floor. The position of the staircases and ladders shall be co-ordinated with the points of access into the switchgear area of the switch house and shall be to the approval of Eskom.

6.4 Cable Trays

The supplier shall provide cable trays as part of the contract for carrying and supporting all the cables and gas piping being installed under the contract as well as any cables to the contract equipment which will be installed by Eskom.

Where cable trenches are not provided in the switch house floor, a main cable tray of galvanized unistrut with all fixings necessary shall be supplied and installed. Details of the cable trays to be specified in schedule B.

The cable trays and any steel brackets and other supports shall be of adequate strength to support all the cables envisaged without any deformation of the trays. In particular the main cable trays shall be strong enough to at least carry two layers of cables occupying the full width of the tray.

6.5 Overhead Travelling Cranes

The design specification of the overhead crane will be the responsibility of the GIS supplier.

The mass of the maximum load which the supplier will want to lift during the erection of the SF6 switchgear as well as the mass of the maximum load that may be required to be lifted during maintenance work shall be given in schedule B. The distance over which such a mass will have to be moved during erection or maintenance, shall also be shown on the drawings to be submitted with the tender.

An overhead remotely operated electrical travelling crane will be provided in the switch house, the crane being able to run the full length of the switch house, including any loading bay areas.

The crane will be used for erection purposes as well as for the maintenance of the GIS plant during its design life.

The provider of the overhead crane will be responsible to liaise with the civil contractor and provide all technical details necessary for the building design and erection to house the overhead crane.

The overhead crane must comply with the "Driven Machinery regulations of the OHS Act

6.6 Corrosion Protection

For minimum requirements refer to Eskom specification 240-75655504. The minimum degree of surface preparation shall be as stipulated in the Detailed Plant/Item Corrosion Protection Specifications (DS).

All supporting steelwork, access decking, handrails, ladders, etc., shall be hot dip galvanised.

Unless approval in writing is received from Eskom, all welding, cutting and drilling of holes in any item which is to be galvanised shall be completed before being galvanised.

Where it is necessary to cut or drill on site, any steelwork which has been galvanised, the damaged galvanising shall then be repaired to Eskom's satisfaction.

Details of measures taken to prevent flange corrosion shall be given by the supplier in schedule B. These details shall include drawings of the flange arrangements, treatments and service experience.

7. Inspection and Testing

The type, production and site commissioning tests which the supplier shall carry out on all the equipment which he is supplying, shall be in accordance with IEC 62271-203 and IEC 62271-1. All type testing shall be carried out in accordance with the relevant IEC product standards. All testing shall be done at accredited local test facilities (SANAS accredited – e.g. SABs) or accredited international testing authorities (e.g. KEMA/CESI/IPH);

All the tests required for circuit breakers, isolators, earth switches, surge arrestors, current and voltage transformers, bushings, shall be performed wherever they are applicable to SF6 switchgear, and the cost shall be included in the tender price for the equipment, with the exception of the type tests. The cost of type tests shall be given separately in the relevant section of schedule C.

Eskom reserves the right to inspect any piece of equipment being supplied at any stage of manufacturing and to be present at any of the type or routine tests or to appoint a representative to do so. The supplier must inform Eskom at least 8 weeks before the start of any type or routine tests.

7.1 Type Tests

All equipment proposed according to this specification shall be type tested as typical units in accordance and comply with the newest relevant IEC Standards. An evidence of type testing, in the form of type test reports and/or type test certificates together with each complete summary of type test (in English) shall be submitted with the tender documentation. The type test reports and/ or type test certificates and the summary of type tests shall be in both printed copy and in electronic Portable Document Format (PDF). The type test reports shall be in electronic Portable Document Format (PDF).

- i. The type test certificate which is the proof of official accreditation shall have the official signatures of the accredited test laboratory where the type-tests were performed which is responsible for its validity and contents. The type test certificate shall contain a record of series of type-tests carried out strictly in accordance with the IEC standard. It shall contain essential drawings and the equipment tested.
 - ii. Where the Supplier and OEM are using the type test certificate and type test report beyond that particular equipment that was type tested, to indicate that the other equipment types with their different ratings are covered by the type test certificate and type test report, a separate official signed off letter on the company's letterhead shall be supplied by the Supplier with the tender documentation. This letter shall clearly state all particular tests and the tested parameters that are extrapolated from the type test certificate and type test report.
 - iii. The summary list of type-tests indicating the following:-
 - o The type test performed,
 - o The IEC standard it was type tested on,
 - o The type test report document number;
 - o The date of type test performed
 - o The Test Facility where the type test was performed, the Test facility accreditation authority.
- a) Witnessing of testing:-

The supplier shall ascertain whether inspection or witnessing of tests is required. The supplier shall then give Eskom or Eskom's appointed representatives not less than 8 weeks' notice of when equipment will be ready for the inspection or witnessing of tests as requested.

If evidence is available of type tests on equipment identical in all respects, this may be accepted in lieu of these tests, at Eskom's discretion.

In order to assist Eskom in making provision for inspection and witnessing of tests, the name of manufacturer, place of manufacture, where equipment can be inspected and the place where equipment will be tested shall be given in Addendum B2 to schedule B. Should the supplier wish to change to another manufacturer he shall advise Eskom in writing and in due time of the new details as listed above.

The supplier shall advise all sub-contractors at the time of placing orders or sub-orders that all equipment may be subject to inspection and witnessing of tests by Eskom or their appointed representatives.

b) The type tests to be performed on GIS equipment:-

The following type tests shall be performed, in exception of specific equipment with the list of required type tests:-

- 1) Tests to verify the insulation level of the equipment;
 - a) Power frequency withstand voltage
 - b) Impulse withstand voltage
 - c) Switching impulse withstand voltage (if applicable)
- 2) Test to prove temperature rise of any part of the equipment and the measurement of the resistance main circuit
- 3) Tests to prove the rated peak and the short time withstand current
- 4) Tests to verify the making and breaking capacity of the included switching devices
- 5) Tests to prove the satisfactory operation of the included switching devices
- 6) Dielectric tests on auxiliary circuits
- 7) Pressure tests and Tests to prove the strength of the enclosures
- 8) Gas tightness tests
- 9) Tests on partitions
- 10) X-ray tests on insulators
- 11) Dielectric tests on auxiliary circuits
- 12) Partial discharge test

Requirements for SF6 gas to air bushings type tests:-

Equipment shall be type tested in accordance with the requirements of SANS 60137. The following type tests shall be carried out:

- a) Measurement of the dielectric losses (dissipation factor, tan delta) and capacitance at ambient temperature
- b) Partial discharge measurement at 150% rated max. Phase voltage/min. at minimum rated SF6 pressure.
- c) Dry lightning impulse withstand voltage test (BIL or LIWL) (SANS 60137 8.3) (for bushings on GIS);
- d) Dry power frequency withstand level voltage tests (SANS 60137 8; 9.3 & 8.1) (for bushings on GIS);
- e) Wet power frequency voltage withstand level (PFWL) test (SANS 60137 8; 9.3 & 8.1) for all bushing < 300kV (for bushings on GIS);
- f) Wet switching impulse withstand test (SIL) for bushings rated for $U_r \geq 300\text{kV}$ (SANS 60137 8.4) (for bushings on GIS);
- g) Temperature rise test (SANS 60137 8.7) (for bushings on GIS);

- h) Verification of thermal short-time withstand current (SANS 60137 8.8) (for bushings on GIS);
- Internal pressure test on gas-filled, gas-insulated and gas-impregnated bushings (SANS 60137 8.11) (for bushings on GIS);
- i) Cantilever load withstand test (SANS 60137 8.9) (for bushings on GIS);
- j) EMC tests (SANS 60137 8.6) - where applicable; (for bushings on GIS);

Requirements for disconnectors and earthing switches type tests:-

Equipment shall be type tested in accordance with the requirements of SANS 62271-102. The following type tests shall be carried out:

- a) Dielectric tests (refer to 6.2 of SANS 62271-102);
- Power frequency withstand voltage tests
 - Lightning impulse dry withstand voltage tests
 - Switching impulse voltage tests of switches rated 300 kV and above
- b) Radio interference (RIV) test (refer to 6.3 of SANS 62271-102);
- c) Measurement of the resistance of circuits (refer to 6.4 of SANS 62271-102);
- d) Temperature rise tests (refer to 6.5 of SANS 62271-102);
- e) Verification of the protection (refer to 6.6 of SANS 62271-102);
- f) Electromagnetic compatibility tests (EMC) (refer to 6.9 of SANS 62271-102);
- g) Test to prove the short-circuit making performance of earthing switches (refer to 6.101 of SANS 62271-102);
- h) Operating and mechanical endurance tests (classification M1 and M2) (refer to 6.102 of SANS 62271-102);
- i) Test to prove the short-circuit making performance of earthing switches (classification E1 and E2) (refer to 6.101 of SANS 62271-102);
- j) Operation at temperature limits (refer to 6.104 of SANS 62271-102);
- k) Test to verify the proper functioning of the position indicating device (refer to 6.105 and Annex A of SANS 62271-102);
- l) Bus-transfer current switching tests (refer to 6.106 and Annex B of SANS 62271-102);
- m) Induced current switching tests of earthing switches (refer to 6.107 and Annex C of SANS 62271-102);
- n) Bus-charging current switching tests of disconnectors (for very fast transient overvoltage (VFT) phenomena) (refer to 6.108 and Annex F of SANS 62271-102);
- o) Where applicable, type test for specific requirements for resistor-fitted-disconnector in GIS (refer to Annex H of SANS 62271-102);
- p) Proof tests for enclosures (compartment/ metallic tank for GIS) (SANS 62271-203 6.103);
- q) Test under conditions of arcing due to an internal fault (for GIS) (SANS 62271-203 6.105);
- r) Insulator tests (for GIS) (SANS 62271-203 6.106);
- s) Corrosion test on earthing connections (for GIS) (SANS 62271-203 6.107); and
- t) All type-tests applicable to GIS disconnectors and earthing switches.

Requirements for circuit-breaker type tests:-

- a) The manufacturer shall perform a complete set of type tests for each circuit-breaker design offered. The type test certificates and reports shall be submitted for review during the tender or product evaluation stage. The type test reports shall be according to IEC 62271-100 for all standard requirements and the breakers required for reactors shall comply with IEC 62271-110. All type test done on IEC60056 shall not be accepted. If any type testing is carried out during a contract period, Eskom shall be invited as a witness.

NOTE: If, in the opinion of Eskom, repeat or new type-tests are necessary, the cost of these tests will be taken into account in the evaluation of tenders. In such a case, Eskom may request the supplier to submit details of the cost of carrying out each applicable type test.

- b) The circuit-breaker shall be type tested in accordance with SANS 62271-100 and shall include the following tests:
- Equipment insulation level (SANS 62271-100 6.2); dry lightning impulse withstand voltage test (BIL or LIWL);
 - Dry power frequency withstand level voltage tests (PFWL) (SANS 62271-100);
 - Wet power frequency voltage withstand level (PFWL) test (SANS 62271-100);
 - Dry switching impulse withstand level voltage test (SIWL) (SANS 62271-100);
 - Temperature rise and measurement of resistance of circuits (SANS 62271-100 6.5 & 6.4);
 - Short-time withstand current and peak withstand current tests - main circuit (SANS 62271-100 6.6);
 - Circuit-breaker short-circuit making and breaking capacities (SANS 62271-100 6.102 to 6.106);
 - Critical current tests (where applicable) (SANS 62271-100 6.107);
 - Single-phase tests (for $U_n \geq 66$ kV) (SANS 62271-100 6.108);
 - Double earth fault tests (for $U_n \leq 132$ kV non-effectively earthed system) (SANS 62271-100 6.108);
 - Short-line fault tests (for class S2 circuit-breakers and $U_n \geq 66$ kV) (SANS 62271-100 6.109);
 - Out-of-phase making and breaking tests (applicable if an out-of-phase rating is assigned) (SANS 62271-100 6.110);
 - Capacitive current switching tests (SANS 62271-100 6.111);
 - Switching of shunt reactors (for $U_n \geq 66$ kV) (SANS 62271-110);
 - Electrical endurance tests (for class E2 circuit-breakers) (SANS 62271-100 6.112);
 - Circuit-breaker mechanical operation (SANS 62271-100 6.101.2.1 - 6.101.2.3);
 - Circuit-breaker extended mechanical endurance tests (for class M2 circuit-breakers) (SANS 62271-100 6.101.2.4);
 - Radio interference voltage tests (for $U_n \geq 132$ kV) (SANS 62271-100 6.3);
 - Verification of the protection (IP coding) (SANS 62271-100 6.7) and, in the case of dead-tank circuit-breaker designs, verification of the protection (IP coding and mechanical impact test) (SANS 62271-203 6.7);
 - Tightness test (SANS 62271-100 6.8 / SANS 62271-203 6.8 (for GIS));
 - EMC tests (SANS 62271-100 6.9) - where applicable;
 - X-radiation test procedures for vacuum interrupters (SANS 62271-100) - where applicable;

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- Additional tests on auxiliary and control circuits (SANS 62271-100 6.10);
- Proof tests for enclosures (compartment/ metallic tank for GIS) (SANS 62271-203 6.103);
- Test under conditions of arcing due to an internal fault (for GIS) (SANS 62271-203 6.105);
- Insulator tests (for GIS) (SANS 62271-203 6.106);
- Corrosion test on earthing connections (for GIS) (SANS 62271-203 6.107); and
- All type-tests applicable to GIS circuit-breakers.

7.2 Production Tests (Routine tests)

- a) Production tests (Routine tests) shall be made either in the course of component assembly, and/or on the complete shipping unit assembly.

Generic routine test certificates/reports shall be supplied with the tender documentation in electronic format (pdf). The test certificate shall indicate (make provision for) the tests performed, results, identification of the equipment tested, etc. The format of the test certificate/report shall make provision for approval by an authorised Eskom representative.

The following routine tests shall be performed at the factory on every unit following its manufacture:

- 1) Pressure test performed on all individual enclosures
- 2) Circuit breaker tests shall be performed in accordance with SANS 62271-100 and SANS 62271-203;
- 3) Tests of disconnectors and earth switches shall be performed in accordance with SANS 62271-102 and SANS 62271-203;
- 4) Current transformer tests as per **IEC 61869-1**
- 5) Voltage transformer tests as per **IEC 61869-1**
- 6) Gas to air bushings shall be tested in accordance with SANS 60137 and SANS 62271-203, and the following are minimum requirements:-
 - a) Measurement of the dielectric losses (dissipation factor, tan delta) and capacitance at ambient temperature
 - b) Dry power-frequency voltage withstand test (1 min. at minimum rated SF6 pressure)
 - c) Partial discharge measurement at 150% rated max. Phase voltage/min. at minimum rated SF6 pressure.
 - d) Resistance measurement
- 7) Tests on transport units
 - a) GIS modules or components shall be assembled in the factory to transport units. The size of the transport units shall be as large as practical for transportation to site and handling during installation. On assembly units without support or barrier insulators dielectric tests are not necessary. The following tests are to be carried out on each transport unit and the detail stated in schedule B
 - i. Dielectric voltage withstand test in accordance with the latest IEC standards 62271-1 (or 60694), 62271-203 and 60060
 - ii. Partial discharge test
 - iii. Measurement of the resistance of the main circuit
 - iv. Gas leakage test

b) One hardcopy of the routine test certificates/reports shall be supplied with each circuit-breaker and stored in the documentation pocket inside the operating mechanism enclosure. In addition to the hardcopy, the routine test certificates/reports shall be made available in electronic format and submitted to Eskom.

7.3 Site Commissioning Tests

All tests must be witnessed by Eskom or its representative.

7.3.1 Minimum Site Commission Tests

All circuit breaker and isolator tests must be carried out with equipment specified in schedule A

- a) Circuit Breakers
 - Timing tests on main contacts and auxiliary switches of main 1 and main 2 circuits.
 - Speed tests including contact stroke
 - Dynamic resistance tests
 - Coil current tests
 - Coil resistance tests
 - Static contact resistance test
 - Starting, mean and end motor currents
 - Measure motor running time
 - All control, alarm switches to be tested and verified
- b) Isolators and Earth Switches
 - Static contact resistance test
 - Starting, mean and end motor currents
 - Measure motor running time
 - All control, alarm switches to be tested and verified
- c) Current Transformers
 - Ratio test
 - Magnetising test
 - Insulation test
 - Polarity test
- d) Voltage Transformer
 - Ratio test
 - Insulation test
- e) Bus Bar/Duct
 - Contact resistance test
- f) Protection Tests (interlocks, alarms, e.g.)
 - Refer to clause 6.1.1
- g) SF6 Gas Test
 - SF6 gas percentage test

- SF6 gas dew point test
 - SF6 gas pressure
 - SF6 gas density monitor settings
- h) GIS High Voltage Test
- After the switchgear has been completely installed on site and filled to rated pressure with SF6 gas, the complete assembly shall be subjected to high voltage testing.
 - Test voltages shall be agreed with Eskom. The supplier shall be responsible for undertaking these HV site tests including the provision of suitable test equipment. Inspection and test plans (ITP) to be specified in schedule B, Records and documentation shall be provided.
- i) Earthing
- Ensure all earths are correctly installed and tested with no circulating current loops.

7.4 Test Certificates and Reports

All tests shall be witnessed by an Eskom representative. A final set of all test reports shall be supplied to Eskom within 4 weeks after the tests have been completed.

7.4.1 Type Tests

Three copies of type test reports for every item of equipment to be supplied are required. **One** of the three copies shall be in electronic PDF or Word format. Each set of the type test certificates applicable to any particular item of equipment shall be bound together into individual volumes.

7.4.2 Production Tests

Three copies of the production test certificates shall be submitted to Eskom. **One** of the three copies shall be in electronic PDF or Word format. The manufacturer shall also retain a complete set of routine test certificates for Eskom's reference for a period of at least ten years after the contract has been placed. The relevant manufacturer's serial number, Eskom's contract or order number and the item number shall be stated on each routine test certificate.

7.4.3 Site Commissioning Tests

Three hard copies and electronic copy (pdf/word) of the site commissioning test certificates shall be submitted to Eskom. The supplier shall also retain a complete set of site commissioning test certificates for Eskom's reference for a period of at least seven years after the contract has been placed. The relevant manufacturer's serial number, Eskom's contract or order number and the item number shall be stated on each site commissioning test certificate. All test results must also be supplied as stipulated in schedule A

7.5 Sulphur Hexafluoride Gas

For minimum requirements refer to Eskom Standard 240-101383919. Test results must be supplied.

7.5.1 Additional Requirements

Moisture content testing should be done not less than 7 days after completion of gas filling.

a) Type Tests

Tests shall be in accordance with IEC 60376.

b) Site Commissioning Tests

Whenever any gas section of the switchgear has been filled, either from cylinders or other vessels in which the SF6 gas has been transported or stored or after the SF6 gas has been subjected to a purification process on site, a sample of SF6 gas shall be taken and tested to prove compliance with Eskom Standard TST 41-694. The results of each test shall be properly recorded and documented.

The sample of SF6 gas shall only be taken from the switchgear SF6 gas compartment after sufficient time has elapsed from filling for any impurities in the SF6 gas enclosure to have contaminated the SF6 gas.

7.6 Monitoring and Indication Devices

Monitoring or indications shall include the gas density or pressure monitoring devices.

The type, production and site tests shall be agreed between Eskom and the supplier after the contract has been placed and the type and mode of operation of each device is known.

However, where applicable the tests on each device shall basically be on the following:

7.6.1 Type Tests

According to IEC 62271.

7.6.2 Production Tests

According to IEC 62271.

7.7 Pressure Vessels and Portable Containers

Since metallic gas containment enclosures are classified as pressure vessels, concessions granted by the Chief Inspector of Factories to users of GIS in this country are conditional. In other words, such enclosures must be designed, manufactured, tested and inspected in accordance with recognised standards and inspection authorities and must comply with all local authorities e.g. OHS Act. Relevant standard must be specified in schedule B.

7.8 Pressure Relief Devices

All different types of pressure relief device shall be type and production tested to prove their correct operation and stability.

7.9 Density Gauges

All different density/pressure gauges shall be type and production tested to prove their correct operation and stability.

7.10 Gas Seals and Leaks

Leakage shall be according with IEC 62271

7.11 Solid Insulation Material

All solid insulation shall be type and production (sample) tested to prove their correct operation and stability.

7.12 Local Control, Alarm and Protection Equipment, Auxiliary Supply Equipment, Cabling and Wiring

The supplier test engineer shall carry out complete operation tests to check the correct operation of all protection, alarm, indication and control circuits before overall tests including the remote control and protection equipment are conducted with Eskom.

7.13 Interlocking

The scheme for interlocking circuit breakers, isolators, etc., shall be checked and tested in a thorough, logical and complete manner in accordance with a predetermined logic plan after all the cables and wiring have been installed and tested in accordance with Clause 6.6.

The supplier shall complete all the checks and tests to his own satisfaction before repeating the tests completely with Eskom to the same predetermined logic plan.

7.14 Corrosion Protection

All steelwork supplied under this contract shall be inspected during fabrication by Eskom or their appointed representative. Eskom's requirements according to clause 6.6 shall be complied by the supplier.

8. Performance Verification for 765 kV and above

8.1 Scope

A performance verification programme shall be undertaken in conjunction with Eskom having the prime objective of examining, establishing and certifying the design criteria for ≥ 765 kV GIS, for installation in Eskom's a.c. power system

8.2 Programme

The programme shall embrace the following subjects;

8.2.1 Insulation coordination

8.2.1.1 Studies shall be carried out by means of computational aids modelling the exact substation layout and system envisaged.

8.2.1.2 Full scale tests shall be carried out on representative prototypes to determine the necessary high voltage test levels and procedures for type testing and where applicable, routine testing of the GIS to be installed.

8.2.1.3 Clearance in air for external insulation systems.

8.2.2 Dielectric behavior

8.2.2.1 Long-term reliability of insulation systems e.g. accelerated life tests, partial discharge criteria and resistance to breakdown caused by metal particle contamination.

8.2.2.2 Audible noise generated by the GIS, Corona and RIV produced at the gas/ air bushing location and altitude correction factors.

8.2.2.3 Theoretical studies to optimise electric field stress patterns, shielding's, etc.

8.2.2.4 On site high voltage testing methods to detect imperfections (e.g. assembly errors, transport damage, pollution, etc.) and establish correct behaviour with respect to transient voltages created by isolator operations and discharge of external capacitances.

8.2.3 Switching behavior

8.2.3.1 Circuit breakers

- Proving tests: Short-circuit switching, making capability, low reactive current switching, transmission line switching.
- Development of switching resistors

8.2.3.2 Isolators (disconnectors)

- Proving test, e.g. one minute spark over test, switching of bus bar charging currents under synchronous, asynchronous and trapped charge conditions.
- Switching of loop currents modelled on actual installations

8.2.3.3 Earthing Switches

- Proving tests: Switching of induced currents from transmission lines.
- Fault making performance (high speed earthing switches only)

8.2.4 Mechanical Behavior

- Mechanical endurance of circuit breakers, isolators and earthing switches.
- Pressure relief in case of internal fault.
- Impulsive forces occurring during operation of circuit breakers and other devices, vibrations, etc.
- Gas seals
- Anti-corrosion measures.

8.2.5 Thermal behavior

- Temperature rise (steady state conditions).
- Losses due to induced currents.

8.2.6 Voltage transformers

- Electromagnetic VT – Ferro resonance elimination. On site tests to establish dielectric integrity.
- Electronic potential divider type - development.

8.2.7 Current transformers

- Development of secondary cores with requisite characteristics e.g. linear transfer characteristics.

8.2.8 Earthing and electromagnetic compatibility

- Counter measures to minimize transient ground rise potentials e.g. during isolator operation, breakdowns during HV site testing, etc.
- Control wiring philosophies to eliminate propagation of transients.
- Earth mat design and appropriate earthing procedures.

9. Maintenance and Repair Work

9.1 Maintenance during the Guarantee Period

The supplier shall be responsible for all maintenance and repair work during the guarantee period as specified in the General Conditions of Contract NEC family of contracts.

The supplier shall supply all maintenance personnel, tools, equipment and material (including any SF6 gas required) at his own expense necessary to complete any maintenance or repair work during the guarantee period.

9.2 Special Tools and Devices

A complete set of special tools and devices used for the erection, repairs, testing and maintenance (first line & major intrusive) of the GIS shall be supplied in a serviceable condition as part of this contract.

These hand and special tools and devices shall be correctly packed and housed in suitable cabinets fitted with locks. A complete tool and device list must be supplied in schedule B.

A complete set of SF6 gas filling and SF6 gas handling equipment used for the erection, repairs and maintenance of the GIS shall be supplied in a serviceable condition as part of this contract. This SF6 gas filling and SF6 gas handling equipment shall be correctly packed and housed in suitable cabinets fitted with locks. A complete list must be supplied.

One set of transducers including brackets and including cables to be supplied. The electrical cables must be compatible with **Programma and Elcon** test equipment.

Should any custom-made handling equipment, e.g. trolleys and cranes, be used by the supplier for installing SF6 duct sections in tunnels or trenches, this equipment shall become the property of Eskom at the completion of the site installation work and the cost shall be included in the overall contract price. This equipment shall be handed over in serviceable condition.

Similarly where the design and layout of the SF6 bus bar / ducts is such that it is necessary to use custom made handling equipment to be able to remove or install individual bus bar / duct sections in compliance with the requirements, this equipment shall be provided as part of the contract.

Details of the custom made handling equipment as well as the manner in which it shall be used to enable the installation, testing, repair and maintenance work, shall be provided at the time of tendering.

9.3 SF6 Gas topping up of gas compartments

Live topping up of SF6 gas compartments must be possible. The supplier shall provide Eskom with a procedure to do gas topping up of gas compartments under live conditions.

10. Spares

The supplier shall include in his submission the recommended spare parts and stock levels to be kept for operation and maintenance during the design life of the equipment. A comprehensive list stating descriptions and prices of every different part spare shall be submitted with the tender. These prices must include the long term (life time of equipment) packaging of these parts with pressure gauges fitted to storage containers.

Unit prices shall be submitted for at least the following critical spares:-

- | | | |
|----|---|---------|
| a) | Complete combined disconnect/maintenance earthing switch including the drive | 1 unit |
| b) | Complete fast acting earthing switch, including the drive | 1 unit |
| c) | Complete circuit breaker including the drive | 1 unit |
| d) | Support insulators | 4 units |
| e) | Barrier insulators | 4 units |
| f) | Gaskets of all different sizes use on the installation, packed for long term storage. | 4 sets |
| g) | Density monitor for circuit breaker. | 1 unit |
| h) | Density monitor for other compartments. | 1 unit |
| i) | Each type of outdoor bushing to be supplied. | 1 unit |

Documented maintenance and storage procedure for the above spares must be supplied in schedule B

The spares which Eskom will wish to purchase for the SF6 switchgear equipment supplied under this contract will be based on this list of parts and corresponding prices.

The prices shall include for the manufacture, testing, long term packing and delivery to site. The prices stated shall be valid for a period of three (3) years after the placing of the contract, and shall not be subject to any conditions as to the time of ordering of any parts as spares nor the number of each part that Eskom may eventually decide to purchase.

Spares shall be packed in separate cases, clearly labelled and consigned either to the substation site or to the Eskom store specified in Schedule A. The supplier shall ascertain from Eskom to which of these destinations each or all items of spares must be delivered prior to shipping the spares.

Each item of the spares in a case shall be suitably identified by means of a metal label and a parts list complete with diagrams showing the application of all parts supplied shall be provided with the spares. Eskom's order or contract number shall appear on the cases containing spares. Each major item (CB, Ct, VT, bushing eg), shall be equipped with an impact monitor.

The Supplier shall undertake to supply to Eskom all the necessary replacement parts for the GIS throughout its expected service life. If the manufacture of the specific make and type of GIS (or any of its replacement parts) is discontinued, Eskom shall be advised in writing.

Written advice (relating to discontinuation) shall also be provided for parts of the equipment that the Supplier obtains from a third party (sub-supplier). In this situation, the Supplier shall supply the following information to Eskom:

- all design data;
- all material characteristics and parameters;
- all testing information (parameters, equipment, methods, criteria, etc.);
- all manufacturing information; and
- all relevant working drawings and information.

This information shall be supplied to Eskom in a legible and acceptable format in English when notice of discontinuation of the GIS or any of its replacement parts is given. In this case, Eskom will be able to make alternative arrangements to obtain the necessary replacement parts. Another option is to pool spare parts: the Supplier shall state his/her spares availability philosophy with the tender documentation.

11. General

11.1 Deviations from the Specification

Should no indication be given at the tendering stage where the equipment offered does not comply with the specification, the equipment will be deemed to comply with the specification in all respects. The contract works shall then also comply with the requirements, whether or not this was intended at the time of tendering.

11.2 Design Collaboration

The supplier shall assist Eskom with the design of equipment associated with the GIS but which will be supplied under other contracts. This will principally include the civil engineering layout and details for the switch house and major pieces of structural support steelwork.

Details of where design assistance is required are given in schedule A.

11.3 Packing, Storage and Unpacking

All the equipment shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and the variations in such conditions that will be encountered on route from the manufacturer's works to the site. All equipment delivered to site must be suitably packed for the duration of the works/project.

The SF6 metal enclosed equipment shall be shipped in the largest factory assembled units that the transport and loading limitations and handling facilities on site will allow, to reduce the erection and installation work on site to a minimum. Mechanism drive heaters connections must be extended for storage purposes.

Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Should the units be considered too large for packing in crates, they shall be suitably lagged and protected to prevent damage to any part, particularly of small projections, during transport and handling. Special lugs or protective supports shall be provided for lifting to prevent slings and other lifting equipment from causing damage. Each crate, container or shipping unit shall be marked clearly on the outside to show where the weight is bearing and the correct position for the slings.

Each individual piece to be shipped, whether crate, container or large unit, shall be marked with a notation of the part or parts contained therein as well as the identification marks detailed under the General Conditions of Contract.

Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the metal enclosed equipment of which each gas section shall be sealed and pressurised prior to shipping. Either dry nitrogen or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and atmospheric pressure encountered during the journey to site. The supplier shall be responsible for determining the maximum temperature and atmospheric variations to be encountered during shipment to site and calculating the pressure to which the section shall be filled to ensure positive pressure at all times during shipment. The type of gas, the maximum pressure to which sections will be filled prior to the minimum allowable pressure during shipment shall be advised prior to despatch.

All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided as part of the contract and shall remain the property of Eskom. If considered necessary, blanking plates or other sealing devices shall be provided with facilities for measuring the gas pressure and recharging at any time during the transport period. Any seals, gaskets, 'O' rings, etc. that may be used as part of the arrangement for sealing off gas sections for shipment to site, shall not be used in the final installation of the equipment on site.

The equipment shall only be unpacked or removed from the containers immediately prior to being installed. They shall not be left lying unnecessarily in open crates or containers. Special precautions shall be taken when gas sections which have been sealed and pressurised for shipping are opened up to reduce the ingress of dirt and atmospheric moisture to a minimum. Whenever possible this shall only be done immediately prior to installation and if any section is to be left outside for any length of time after being opened, it shall be resealed and pressurised with either dry nitrogen or SF6 gas until required.

11.4 Cranes and Lifting Equipment

An overhead crane will be supplied for indoor use as stipulated in clause 7.5. The supplier will be able to make use of this facility at his own risk. For outdoor installations the supplier must supply his own cranes and lifting equipment.

The supplier shall make his own arrangements for any other cranes that may be required for installing and erecting the equipment. The cost of such cranes shall be included in the contract price.

All special lifting devices that are needed for installing and later for maintaining the SF6 switchgear and associated equipment being supplied under this contract shall be included in the contract. Such devices shall remain the property of Eskom and shall be handed over to Eskom at the completion of the contract erection work in good working order. All such lifting devices and controls shall comply with the OHS Act.

11.5 Drawings and Documents Requirements (Include Protection Drawings)

The supplier shall provide the following documentation as indicated in brackets:

- a) Complete technical schedule B (no blank spaces). (with tender)
- b) Failure curves for material and components. (with tender)

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- c) Maintenance strategy and intervals. (with tender)
- d) Full set of drawings that shows the following minimum information:
- Manufacturer's drawing number and revision number. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number – for population after awarding of the contract. (after awarding of contract)
 - critical dimensions such as overall dimensions, structure dimensions, phase to phase spacing, height of lowest part above ground, height of highest part above ground, height of mechanism drives, height of inspection windows above ground, operating mechanism enclosure dimensions, etc.; (with tender)
 - properly annotated drawings with a complete list of major components (bill of materials); (with tender)
 - details of main terminals including dimensions of the fixing holes, terminal hole spacing, plate thickness and maximum permissible forces (loads) on main terminals (with directions) expressed in Newton (N); (with tender)
 - details of the main earthing terminal and operating mechanism enclosure earthing terminal; (with tender)
 - mass of GIS components in kilograms (kg), which shall include the empty mass, mass and description of heaviest component, ready for service and mass of SF6 gas. (with tender)
 - any special trenches or steelwork required;(with tender)
 - the steel support structure dimensioned outline and general arrangement (3D); (with tender)
 - the steel support structure label mounting holes; (with tender)
 - the steel support structure earthing terminal connections; (with tender)
 - the concrete foundation dimensioned outline, design detail and general arrangement; (with tender)
 - mounting and fastening arrangement for the GIS onto the foundation including the minimum required length and diameter of foundation holding down bolts as well as the relative position of levelling nuts, spacers, washers, etc. in relation to the base plate;(after awarding of contract)
 - maximum torque required for the foundation holding down bolt nuts used to secure the support structure base plate (Nm); (after awarding of contract)
 - static and dynamic forces (loads), centre of gravity (after awarding of contract)
 - location of all enclosure doors and handles; (with tender)
 - location and annotation of control facilities (gas filling/evacuation points, SF6 density monitoring device with its environmental protection shelter/cover, etc.); (with tender)
 - location and layout of LV control cable gland plates; (with tender)
 - SF6 pressure and quantity requirements; and (with tender)
 - location of nameplate on equipment; (with tender)
- e) generic auxiliary and control circuit schematic wiring diagrams for each bay. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number – for population after awarding of the contract. (with tender)
- f) full list of spares required for maintenance (refer to clause 10) (with tender)
- g) full list of operating tools (refer to clause 9.2) (after awarding of contract)

-
- h) detailed list of standard tools required for minor maintenance (refer to clause 9.2) (with tender)
- i) detailed list of additional specialised tools for major (specialised) maintenance (refer to clause 9.2) (with tender)
- j) full list as well as copies of type test certificates and reports generic routine test certificates for the circuit-breaker (with tender)
- k) transport, storage, installation, operating and maintenance manuals and (with tender)
- l) the submission, where applicable, of the following additional information:
- premature failures experienced in service of similar design GIS supplied elsewhere by the manufacturer, together with the recommended modifications (with tender)
 - details of corrosion protection and lubricants (with tender)
 - measures taken to prevent flange corrosion (with tender)
 - information required for controlled switching (refer to 240-56063756, SPECIFICATION FOR OUTDOOR CIRCUIT-BREAKERS FOR SYSTEMS WITH NOMINAL VOLTAGES FROM 6,6 kV UP TO AND INCLUDING 765 kV (with tender)
 - a written commitment from the supplier regarding the submission of the maintenance DVD, training (clause 11.15) and (with tender)
 - spares availability philosophy (with tender)

11.6 Manuals

11.6.1 General

Transport, storage, installation (erection), operation and maintenance information shall be submitted in the form of manuals. These manuals shall be in English and provided in the following formats:

- a) hard copy A4 form; and
- b) electronic copy (pdf) form copied onto an appropriate medium.

The manual and contents shall be approved by Eskom. The approval process shall be initiated immediately upon contract award and completed within three months. The onus shall be upon the supplier to meet this programme. If further material is required, then this shall be subject to negotiation.

11.6.2 Content

The instruction manual(s) shall cover as a minimum all requirements as stipulated in the specific equipment specifications

- it shall be specifically compiled for the equipment with which it has been supplied;
- torque wrench settings, clearances, settings and other important information shall be listed, e.g. the typical operating times, speed curves (including reference points A&B) and tolerances in synchronism;
- it shall give a clear description of the operation, and the diagrams, photos and description shall be easily read together;
- routine inspection, minor and major maintenance procedures shall be given together with a list of lubricants, recommended spares and/or special tools etc., required for these activities;
- it shall contain high-quality diagrams and photos showing details of operating components of the equipment, which also identify and list separately each component making up the diagram;
- seals and gaskets requiring replacement during overhaul shall be detailed and the suppliers of these components, together with the part number(s), shall be listed; and

- the names and addresses of suppliers of lubricants, oils, gases, compounds etc., shall be listed.
- full maintenance analysis FMECA as per Annexure D

One set of operating and maintenance manuals shall be supplied to Eskom with the tender documentation for approval. After approval, the requisite number of manuals shall be supplied.

Qualified personnel will install, operate, maintain and repair the equipment with the aid of the manufacturer's instruction manuals and DVD aids.

11.7 Measurement Units

All pressures quoted in schedule B of this specification and on all documents, drawings and communications appertaining to the contract works shall be in metric units.

11.8 Nameplates

Every item of primary electrical equipment shall be provided with a rating and diagram plate. These labels shall be manufactured in accordance with 240-75660336 and shall be attached using inherently corrosion-resistant rivets or self-tapping screws. The labels will indicate actual and not contract ratings. No stick-on labels, double sided tape or glue is acceptable, unless otherwise approved by Eskom. These labels shall be placed in a position where they can be easily read when the equipment is installed.

11.9 Label Identification and Allocation

Labels shall be provided for clearly identifying each three-phase circuit, each individual item of primary equipment, each individual gas section, marshalling kiosk, mechanism cubicles, junction boxes, battery charging plant, etc. In addition all relays, alarm facia, control switches; feeders, moulded case circuit breakers, either control, protection and alarm elements, and all elements and controls for the gas system shall be identified by means of a suitable label, according to 240-75660336 "Manufacturing Specification for Distribution Equipment Labels Standard"

The labels shall be in English.

Labels shall be mounted horizontally and parallel to each other and to the equipment to which they are associated.

11.9.1 Primary Equipment and Gas Section Identification Labels

For minimum requirements please refer to "Standard for the labelling of Substation and Networks" DISASAANO. Every individual item of metal enclosed primary equipment and gas sections shall be identified by means of an alpha numeric code. The code shall be agreed with Eskom and shall be such as to clearly differentiate between the different types of equipment.

The alpha numeric code shall be painted or attached on to the associated piece of equipment in such a position that it is clearly visible from the access decking. The height and width of the lettering shall be at least 150 mm and 20 mm respectively.

The identification code numbers for each item of primary electrical equipment and gas section shall be clearly shown on the general arrangement drawings.

11.9.2 Main Circuit Identification Labels-

Each main circuit and set of bus bars shall be identified by means of a label, the inscription of which shall be agreed with Eskom.

The labels shall be fixed to the equipment by means of a strong, galvanised steel frame.

11.9.3 Warning Labels

Warning labels shall be provided at all points where no operation interlocking is provided or when operation is possible could damage the equipment or endanger operating and Maintenance personnel.

Warning labels shall be of vitreous enamel on a steel-plate base and shall be mounted in such a manner that they cannot be easily damaged or distorted.

11.10 Preparation and Coating

Corrosion protection shall be in accordance with DX doc. 240-75655504

The final colour of the equipment shall be as specified in schedule A. Any deviations from standard light grey must be submitted to Eskom for approval.

All kiosks, cubicles, panel and terminal box interiors must have at least one priming and one finishing coat of gloss white paint or enamel.

The supplier shall submit to Eskom for approval the paint specifications to which he will be painting all the equipment.

11.11 Holding down Bolts

The supplier will provide all foundation bolts, including nuts and washers, which will be cast into concrete floors and foundations to be constructed by Eskom under other contracts.

All bolts, nuts and washers shall be provided as part of this contract for fixing the equipment to any other structures and equipment being supplied under this and other contracts.

The general design of the foundation holding-down bolts shall be agreed with Eskom and/or their civil engineers.

The supplier shall supply drawings detailing position and size of all bolts, holes or fixing pockets to be provided in the structures or equipment or foundations. Any special clearance requirements for fitting the bolts and fixing nuts and washers shall be detailed on the drawings.

11.12 Extension of the existing GIS with equipment from a manufacturer other than the original manufacturer.

If the existing GIS is extended with equipment different than the original equipment then the following shall apply:

- The new supplier shall ensure and demonstrate that the new equipment is fully compatible with the existing equipment.
- The new supplier shall demonstrate extensive previous experience in designing, implementing and commissioning of an interface bay similar to the one offered.
- The extended equipment shall have total separate gas compartments. It shall not have a common gas compartment with the existing equipment
- Detailed interfacing methodology of the adaptor bay compartment and its electrical connectivity shall be supplied with tender documents. These drawings shall clearly indicate how the adapter connects to the existing equipment and show how the gas sealing is done. The drawing shall also indicate the details of the electrical connection and the support structures if there are differences in the height from the floor level.
- It will be an implicit requirement for the new supplier to obtain all dimensions, connectivity and other relevant information required for the detail design of the interface compartment. Also, no manufacturing and/or implementation of the interface compartment shall commence until such time ESKOM reviewed and approved all of the detail interface design documentation.

- In the event of the new supplier requiring access to the compartment prior to detail design, for whatever reason, the Supplier shall provide all labor, spares, equipment, consumables, etc, for this purpose.
- Prior to any opening of the existing equipment, the manufacturer will be required to provide ESKOM with a detailed work instruction and methodology of the work to be performed. No work will commence until ESKOM approved the relevant submittals.

11.13 Interchangeability of Parts

Where possible the design of all the SF6 switchgear, primary electrical elements or gas sections, shall be such that similar parts can be interchanged. The length and construction details of single or three phase bus bars and ducting shall be such as to provide the greatest degree of interchangeability of the sections between any position in the complete installation. Flange, seal and bolt hole arrangement of all joints in the normal metal enclosures shall be identical.

All parts which may require renewal or replacement shall be made to template, gauge or jig, so that original and spare parts will be interchangeable. The supplier shall provide and maintain in storage for the design life span of the equipment, free of cost to Eskom, templates, gauges, patterns, drawings and records for future repairs or replacement parts. The supplier shall supply all special tools and templates necessary for site erection / repairs and they shall become the property of Eskom. When the manufacturer can no longer support the maintenance and repair of this equipment, all manufacturer's drawings, templates, records and special tools shall be handed to Eskom.

11.14 Pressure Vessels and Portable Gas Containers

11.14.1 General

Pressure Vessels and portable gas containers shall comply with the regulations of the Occupation Health and Safety Act, No.85 of 1993 as amended, of the Republic of South Africa.

11.15 Training Requirements

The supplier shall provide training of an international standard on the supplied equipment by OEM accredited instructors. The training shall be in accordance with the Eskom training standard 240-124520996, and organised on the following levels:

- Orientation and basic functioning
- Operational and first line maintenance
- Installation, testing and commissioning of the GIS and circuits (controls)
- Specialized maintenance on all aspects of the GIS which must include major intrusive work, repair and testing

11.16 Reliability, Availability and Maintainability (RAM Programme)

11.16.1 General

The *Supplier* shall provide a RAM Programme Manual.

11.16.2 Reliability

The reliability programme shall include:

- a) An evaluation of the GIS equipment throughout the design, the production and the test procedures used;
- b) An estimate of the failure rates expected for the various system devices during their useful life based on component history of factory failure rates, in service failure rates and references.

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- c) An assurance that the material and the components selected for this application enable the GIS installation to perform in compliance with the specified requirements;
- d) De-rating and safety factors used in the design of each item to enhance the reliability of the entire system; and
- e) Test data that support the performance capability as well as the quality of parts and materials supplied.

11.16.3 Availability

The GIS installation shall be designed to meet the following guaranteed values of availability:

- a) Scheduled outages, which involves planned inspection and maintenance, not be more than once per year; and
- b) Forced outage also not to be more than once per year.
- c) The overall GIS availability to be 99,8 % per year per feeder bay. This availability to be calculated on a yearly basis.

The maximum outage time to be limited to 8 hours with the understanding that only one feeder bay to be switched out at a time for scheduled maintenance activities. The outage time allowed for scheduled maintenance might only be during weekends.

11.16.4 Maintainability

The GIS installation shall be designed to meet the following maintainability requirements:

- a) The Supplier shall design the equipment to minimise both repair and maintenance effort and the need for special skills and tools;
- b) The Supplier shall include as a minimum the following factors in the maintainability design plan:
 - analysis and allocation of scheduled maintenance effort required to keep the equipment in proper working order;
 - for each repair or maintenance work, quantitative estimates shall be made of repair frequency, duration, man-hour's and parts requirements;
 - spare parts provision and logistic support;
 - personnel safety requirements;
 - recommendation on the quantities of spare parts or units required. Technical information concerning spare parts shall include reasons for selection, information on storage and supply of parts for the repair and maintenance of equipment during the nominal operating life; and
 - provide installation, operation, repair and maintenance manuals in compliance with the *Employer's* requirements. The manuals shall include details of special skills, training, or tools needed for maintenance operations.

12. Authorization

This document has been seen and accepted by:

Name and surname	Designation
P Moyo	Power Delivery Engineering GM
B Ntshangase	Senior Manager SED

Name and surname	Designation
J. Machinjike	General Manager Grids (TX)
B Ntshangase	SCOT Chairman
P Tlhalhetji	Substations Study Committee Chairman
V Singh	Design Base Design Manager
K Munsamy	Transmission Western Grid Manager
V Shikoana	Senior Manager Asset Management
N Ramparshad	Transmission Eastern Grid Manager
L Mohata	Transmission Southern Grid Manager
J Malinga	Transmission North East Grid Manager
M Mapaila	Transmission North East HV plant Manager (HV Plant representative on GIS & Mixed technology Care group)

13. Revisions

Date	Rev	Compiler	Remarks
Nov 2016	6	A Marais	Documentation Verification
Nov 2016	5	A Marais	Final approved version
Sept 2015	4	A Marais	Final Document for Publication
Aug – Sept 2015	3.1 and 3.2	A Marais	Reviewed the following clauses:- 1 – added technical evaluation; 2.1 – added technical evaluation; 2.2 – updated the reference documents; 2.3 – updated the reference documents; 3.7 – updated the buffer compartments subsection; 3.12 – revised the last paragraph for GIS building earthing system; 3.13 – paragraph revised to separate the scope for GIS building earthing system from outdoor yard earthing; 5.13 – revised paragraph to separate the scope for GIS building earthing system from outdoor yard earthing; 7.1 – aligned type-test requirements with technical evaluation criteria; 7.2 – updated production (routine test) requirements; Annex A – replaced with Supplier's and Eskom responsibility clauses; Annex E – added the schematic showing the proposed position of buffer compartments;
Feb 2015	3	A Marais	2.3.1 definition for buffer compartment was added 3.7. Inline filters was specified (2 nd & 3 rd paragraph's) 3.7 4 th last paragraph last sentence was added 3.11 Last paragraph was deleted 4.1 2 nd paragraph was modified 4.6.1 Section was modified 7. Added a paragraph on accreditation of Type test facilities 10. last 2 paragraphs in connection of discontinuation of spares was added 11.5 Whole section was changed 11.6.2 Last bullet was added 11.12 Extension of existing GIS with equipment other than the original manufacturer was added. Annex E on proposals of buffer compartment positions was added.

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Date	Rev	Compiler	Remarks
Feb 2014	2	A Marais	SF6 in the title was taken out to cater for alternative gasses. 4.4.1 Capacitor type voltage transformers was taken out 4.6.2 Connections to transformers and reactors 8. Performance verification (new section added)
Aug 2013	1	A Marais	First issue

14. Development team

- A B Marais Group Technology – PDE HV Plant
- G Drake Transmission Solutions Research, Test and Development
- R Dolly Transmission (East Grid)
- Q Nepgen Transmission (North East Grid)
- S Pretorius Transmission (Central Grid)
- P Vermeulen Transmission (Free State Grid)
- A Kotze Asset Management
- L Kotze Group Technology – PDE PTM&C
- T Muchna Group Commercial
- T Du Plessis Group Technology – SED
- S Nkosi Group Technology – SED
- F Schoeman Group Technology – SED

15. Acknowledgements

Inputs from Chris van der Merwe (Power System Consultant | Trans-Africa Projects (Pty) Ltd)

Annex A – Supplier and Eskom responsibilities

The responsibilities of Eskom and the Supplier of the switchgear and associated equipment shall be as defined below.

A.1 Supplier's responsibilities

The Supplier shall be responsible for, but not limited to, the following:

- a) upon submission of a tender, the submission of a complete set of technical documents as required by this standard (refer to clause 11.5 for drawings and documentation requirements), this shall be in paper print, Adobe PDF copy and all the technical schedules A and B shall also be submitted in a copy of the Microsoft Excel format. The tender shall state clearly all deviations (if any) in the Deviation Schedule and in schedule B (if applicable). Deviations will be evaluated by Eskom and the outcome will be communicated, in writing, to the Tenderer;
 - 1) The Supplier shall also read the Technical Evaluation Criteria standard 240-87340147 with this document and supply all the information with the technical submission in order for the technical documentation to be evaluated by Eskom. Failing to provide information called by this standard and the Technical Evaluation Criteria standard 240-87340147 shall render the technical submission disqualified for technical evaluation.
- b) The GIS building and the GIS building earthing system, providing the details with the tender documentation;
- c) all testing and recording of results required by this specification as well as the OEM's own protocols using accredited personnel including the use of approved and calibrated test equipment. Type testing shall be carried out in accordance with the relevant IEC product standards. All testing shall be done at accredited local test facilities (SANAS accredited – e.g. SABs) or accredited international testing authorities (e.g. KEMA/CESI/IPH);
- d) in the case of evaluation at the factory of the GIS substation equipment, the erection of a completely functional prototype at the Supplier's own premises under direct supervision of the OEM for a comprehensive evaluation by Eskom before erecting on Eskom site. Unless otherwise agreed by Eskom;
- e) ensuring equipment is in an acceptable and safe working condition during all phases of transportation from factory to site, storage until the point of official handing over;
- f) all necessary arrangements for factory acceptance, transporting and off-loading at the most convenient point (if applicable), as well as for transporting and off-loading at the ultimate destination. Eskom will only accept delivery to the destination specified at the time of placing the order – unless otherwise negotiated. Shafts, bearings and machined surfaces exposed during transport and storage shall be treated with a temporary anti-corrosive coating;
- g) provision of OEM accredited installation and pre-commissioning services for all on-site work;
- h) the supply of all documentation relevant to the circuit-breaker including routine factory test results. Records shall be available during the pre-commissioning (on-site) testing phase;
- i) the supply of a fully complete GIS substation equipment module delivered, assembled, installed, pre-commission (on-site) tested, HV power frequency tested and ready for handover (including, where applicable, controlled switching systems);
- j) where necessary (i.e. in the absence of an on-site a.c. power supply), the supply of an a.c. power supply (e.g. generator) for the installation and pre-commissioning of GIS substation equipment;
- k) the supply of all conductor clamp main terminals on the supply and load side;
- l) the supply of all necessary auxiliary equipment, including operating mechanisms, control, monitoring and protective devices, installed in suitable operating mechanism enclosures;

-
- m) the supply of all auxiliary and control wiring and terminations for the GIS substation equipment, including inter-pole cabling and cabling to the central control enclosure(s) of the equipment. For single-pole operated circuit-breakers the wiring shall be done in the factory. No additional inter-pole wiring on site is allowed;
 - n) the supply of all electrical and mechanical interconnections between the elements of the GIS substation equipment – made to Eskom's satisfaction;
 - o) the supply of all fixing bolts, fasteners and adapter plates – excluding the bolts required for fixing support structures to concrete foundations;
 - p) the supply of the steel support structures for the GIS substation equipment;
 - q) the first filling of the SF6 to the OEM's rated value;
 - r) testing and recording of results required by this standard as well as the OEM's own protocols using accredited personnel including the use of approved and calibrated tools and test equipment;
 - s) the onsite HV power frequency testing in accordance with the SANS/ IEC 6221-203 standard. This shall include instance when onsite intrusive work was performed on the SF6 insulated gas compartments;
 - t) provision of all training in accordance with 240-124520996 by OEM accredited trainers;
 - u) any modifications required during the GIS substation equipment service life; and
 - v) any other responsibilities as specified in this document.

A.2 Eskom's responsibilities

Eskom shall be responsible for the following:

- a) the supply of the relevant standard(s) or specification(s) and completed schedule A's with the enquiry;
- b) the evaluation of all equipment offered and documentation supplied with a tender. This includes the compilation of an internal Eskom technical evaluation report summarising the outcomes of the evaluation;
- c) when required, the assessment and evaluation of the relevant manufacturing facilities;
- d) when required, the assessment and evaluation of the relevant transport, installation and pre-commissioning facilities;
- e) the approval of all drawings submitted by the Supplier (e.g. general arrangement, nameplate, schematic wiring, etc.);
- f) the approval of all other documentation provided by the Supplier (e.g. drawings, buffer compartment, manuals, training material, inspection and testing plans after installation, etc.);
- g) the supply of a heater connection point for long term storage;
- h) the provision of the outdoor yard earth mat;
- i) the stringing and clamping of main conductors;
- j) the supply and installation of all control, metering, relaying and annunciation equipment remote from the control cubicle enclosures;
- k) provide suitable storage facilities where GIS substation equipment is to be stored for extended durations prior to installation due to unplanned delays or as spares; and
- l) the witnessing and approval of the first complete GIS factor acceptance testing (FAT)
- m) the witnessing and approval of the GIS substation equipment installation, pre-commissioning and HV power frequency testing.

Annex B – Technical Schedules

(Normative)

B.1 Schedules

NOTE: The schedules attached in this document are **ONLY AN EXAMPLE** of the minimum requirement and Project specific schedules will be provided when a commercial enquiry is issued.

B.2.1 Schedule A

Schedule A lists Eskom's minimum requirements in enquiries and orders. These requirements may include references to the relevant subsections in this specification.

B.2.2 Schedule B

The tenderer will fill in this schedule **(all blank spaces)**. By doing this, the tenderer will state compliance with this specification and provide the information the purchaser has requested.

B.2.3 Deviation Schedule

The tenderer will complete a deviation schedule.

Notes:

- 1) Where this specification allows the purchaser to make a choice, the example of schedule A (in the model form) lists the preferred items/values/quantities. In the interests of standardisation, purchasers are encouraged not to deviate from these preferences.
- 2) These schedules, when completed, become normative annexes to the enquiry specification.

TECHNICAL SCHEDULES A & B FOR THE SPECIFIED kV GIS SWITCHGEAR

SAP: _____ Select item from list . . .

Schedule A: Purchasers specific requirements

Schedule B: Guarantees and

technical particulars of equipment offered

1	2	3	4	5
Clause	Referring Doc 240-50807380	Description	Schedule A	Schedule B
G General substation details				
G1 Substation design details				
G1.1 Substation Name:				
G1.1.1		Location		
G1.1.2		Buildings required	Yes	
G1.1.3		Earthing and earth mat layout required	Yes	
G1.1.4		Number of bays required as per Station Electric Diagram	Yes	
G1.1.5		Layout design: As per specified Station Electric Diagram	Eg.Breaker & half	
G1.2 General: Technical documentation provided (Latest Revision)			Action	Acceptance
G1.2.1		240-50807380 – Specification for SF6 Gas Insulated Switchgear (GIS) and associated equipment	Yes	
G1.2.2		Technical Schedules A & B for the GIS Switchgear	Yes	
G1.2.3		Technical Specification for the Civil and Building Design of a GIS station – Design Criteria	Yes	
G1.2.4		Technical Schedules A & B for the 44kV to 765kV HV GIS Indoor Circuit-breakers	Yes	
G1.2.5		Technical Schedules A & B for the 44kV to 765kV HV GIS Indoor disconnectors/ Earthing switches	Yes	
G1.2.6		Schedules A & B Summary of Requirements for Current Transformer with Class TPY Cores	Yes	
G1.2.7		Inductive Voltage Transformer Schedules A & B	Yes	
G1.2.8		Eskom standard drawings: Standard terminal numbering/ Terminal arrangement	Yes	
G1.2.9		GIS Surge Arrestor Schedules A & B	Yes	
G1.2.10		Digital secondary plant interface requirements	Yes	
G1.2.11		Digital secondary plant interface Technical A & B schedules	Yes	

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G1.2.12		Geotechnical study report	Yes	
3 Requirements For Sulphur Hexafluoride				
Metal enclosed clad Equipment				
3.1		SF6 gas density and pressure		
		<input type="checkbox"/> Max. Operating pressure	bar	Yes
		<input type="checkbox"/> Min. Operating pressure	bar	Yes
		<input type="checkbox"/> Vapor pressure graph		Yes
3.2		SF6 gas temperature		
		<input type="checkbox"/> Max. safe operating temperature	°C	Yes
		<input type="checkbox"/> Minimum safe operating temperature	°C	Yes
		<input type="checkbox"/> Variation in max. safe operating temperature	°C	Yes
		Max. ambient temperature of area of installation	°C	50
		Minimum ambient temperature of area of installation	°C	-10
		Altitude of the installation	mm	<1800
3.3		SF6 gas purity		
		SF6 Content	%	>98
		Moisture content	ppmv	<400
3.4		Gas Filling Connections		
		State gas filling connections (DILO)	DN20	
3.5		Gas- Monitoring Devices & Alarms		
		Over pressure alarm (visual and audio)	Y/N	Yes
		Low gas alarm contacts	Y/N	Yes
		- N/O		0
		- N/C		2
		Low gas block contacts	Y/N	
		- N/O		0
		- N/C		2
		- Number of spare terminals provided		≥ 2
		Circuit Breaker Open	Y/N	Yes
		Spring discharge	Y/N	Yes
		Relay coils de-energize	Y/N	Yes
		Pressure indication requirement	Y/N	Yes
3.6		Gas treatment Devices in Gas Compartments		
		Details of filters and filter material	Y/N	Yes
3.7		Gas Compartments		
		Install inline particle filter in series with balancing pipes • an exchangeable filter element • Withstand a minimum pressure of	Y/N	Yes

		20 Bar.		
		<ul style="list-style-type: none"> Able to filter out particles bigger than 8 µm and withstand a sudden pressure impulse of 50 bar. The flow rate should not be lower than 100 litres per minute with air as reference. 		
		DILO non return valve (DN 8 or DN 20)	DN20	
		The arrangement of gas sections or compartments shall be such that it is possible to extend and replace existing bus bars or circuits, replace faulted items and perform maintenance without having to take out of service more than one bus bar or adjacent circuits at any one time.	Y/N Yes	
		Buffer compartments installed to reduce outage time and details indicated in gas schematic diagram	Y/N Yes	
		Gas schematic diagram indicating the amount of gas in each compartment per phase in kilogram	Y/N Yes	
3.8		Support Insulators and Support barriers		
		Colour of compartment barrier/ partitioning insulators	- Orange	
		Colour of intermediate supporting insulators	- Silver	
		Details of the permissible gas leakage rate across barriers / partitioning	% Yes	
		Electrical properties of supporting and barrier/ partitioning insulators	Y/N Yes	
		Tests to ensure that all insulators are free of partial discharges	Y/N Yes	
		Mechanical properties of supporting and barrier/ partitioning insulators	Y/N Yes	
3.9		Gas seals		
		Sealing material and techniques used must be submitted with tender documents	Y/N Yes	
		The relative leakage rate to the SF6 gas compartment must not exceed 0.5% per annum. The frequency value for the time between replenishment shall be at least 10 years	Y/N Yes	

		The frequency value for the time between replenishment shall be at least 10 years	Y/N	Yes	
		Proof of leak tightness tests	Y/N	Yes	
		Facilities to detect and locate a gas leak through any section seals, if applicable	Y/N	Yes	
3.10		Expansion and flexible connections			
		Expansion joint tolerances	Y/N	Yes	
		Method of compensating for expansion	Y/N	Yes	
3.11		Metal Enclosure			
		Maximum fault level for 1 sec 765kV kA		50	
		Switching impulse withstand voltage (250/2500µs) referred to sea level			
		• To earth and across open switching device position	kV	1550	
		•			
		•			
		• Between phases in the open position	kV	2060	
3.12		Support and Mounting Brackets			
		Drawings of all supports, brackets and guides necessary for supporting, fixing and/or locating the bus/ bar/ bus ducts in position	Y/N	Yes	
		Insulation level of supports and brackets where applicable	Y/N	Yes	
3.13		Earthing and common Bonding of metal Enclosure			
		Earthing requirements by the supplier	Y/N	Yes	
3.14		Finish of internal Surfaces and Cleaning			
		The finish of the interior surfaces	Y/N		
		Details and recommendations of paint/ coating of internal surfaces		Yes	
		Details and recommendations of flange protection options		Yes	
3.15		Indication and Verification of Switch positions			
		State methods to providing external indication and direct visual examination of switchgear contact positions	Y/N	Yes	

3.16		Pressure Relief Devices		
		Advise in which compartments pressure relief devices are necessary. If deemed not necessary, calculations or proof must be provided	Y/N	Yes
3.17	NRS 087	Supply of SF6 Gas		
		Detail of the SF6 gas handling and management procedure	Y/N	Yes
3.18		External SF6 Gas Detecting Instruments		
		Instruments to automatically and continuously monitoring the presence of SF6 gas in the atmosphere	Y/N	Yes
		Technical details and sensitivity of SF6 gas detectors (including cable and connection facilities)	Y/N	Yes
3.20		Condition Monitoring Devices		
		Partial discharge detecting devices	Y/N	Yes
3.21		Seismic Activity		
		Seismic Activity	Y/N	0.3g
4.		Primary Electrical Equipment		
4.1	240-56063756	Circuit Breakers:		
4.1.5		Please refer to schedules A & B of " Specification for outdoor circuit breakers for systems with nominal voltages from 44 kV up to and including 765 kV		
		Safety device for over pressure on the hydraulic :	Y/N	
		(a) Stop/ Start pump motor		Yes
		(b) Block open / close if pressure insufficient to complete an open / close operation		Yes
		(c) Block closing if pressure insufficient to complete an open / close operation		Yes
		(d) Block open (Main 1 and 2) if pressure insufficient to complete an open operation		Yes
		(e) Excessive motor running time		Yes
4.2	240-560-63815	Isolators and Earth Switches		

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4.2.2.1		Please refer to schedules A & B of "Specification for outdoor Isolators for systems with nominal voltages from 44 kV up to and including 765 kV"		
		Number of inspection windows	2	
4.3	IEC 60044-1	Current Transformers:		
		Please refer schedules A & B of NRS 029:2012 for Current Transformers		
4.4	IEC 60044-2	Voltage Transformers		
		Please refer schedules A & B of NRS 030:2012 for Voltage Transformers		
4.4.1		Electromagnetic, inductive type voltage transformer	Y/N	Yes
4.5		Bus Bar Conductors		
		Specify all lengths	Y/N	Yes
4.5.1		Ratings:		
		Continuous circuit current	A	4000
		Continuous short circuit fault current for 1 sec 400 kV	kA	63
		Continuous short circuit fault current for 1 sec 765 kV	kA	50
4.6		SF6/ Air Bushing		
		Interlock Scheme	Yes	
4.6.1		Creepage distance equivalent	mm/kV	31
		GIS connection to transformer and reactor bushings	Y/N	Yes
		Lightning impulse withstand voltage • 765 kV	kV	2400
		Cantilever withstand force	N	>2500
4.6.2		KIPTS requirement	Y/N	N/A
		Connections onto Transformers and Reactor bushings • GIS to AIS bushings and tubular conductor • Complete enclosed adapters • Cable to GIS connectors	Y/N	Yes No No
4.6.3		Ratings: Continuous circuit current	kA	4
		Continuous short circuit fault current for 1 sec 765 kV	kA	50

5.2.4		Cabling access for control cables	Y/N	From below floor	
5.2.5		Discretionary switches <ul style="list-style-type: none"> Voltage dependency selector Switches DC rating Local off remote switches Number of independent poles 		Yes Yes Yes	
5.4		DC Supplies and Circuits			
		<ul style="list-style-type: none"> Normal Maximum / Minimum 	V V	220 +/-30 %	
5.6		Interlocking			
		<ul style="list-style-type: none"> Describe proposed system 	Y/N	Yes	
5.7		Relays			
5.7.1		Operation Indicators <ul style="list-style-type: none"> Mechanically operated or Illuminated 	Y/N	Yes	
5.9		Electrical Motors			
		<ul style="list-style-type: none"> DC Supply 	V	220	
5.13		Building Earthing Requirement			
		<ul style="list-style-type: none"> Electro Magnetic Compatibility (EMC) 		Yes	
5.14		Flash Detection			
		<ul style="list-style-type: none"> Describe proposed system 	Y/N	Yes	
5.15		UHF Partial Discharge (PD) Monitoring			
		Describe the system	Y/N	Yes	
6		Structural Support Steelwork and Associated Fittings			
6.1		General			
		Indoor installation	Y/N	Yes	
6.3		Access decking, Staircases, ladders, etc.			
		Width of gangways	mm	> 600mm	
6.4		Cable trays			
		Details of the cable trays	Y/N	Yes	

6.5	OHS Act	Overhead Traveling cranes		
		<ul style="list-style-type: none"> Specify and supply overhead crane Max load to be lifted by overhead crane during maintenance and erection 	Y/N kg	Yes
6.6	240-75655504	Corrosion protection		
		Corrosion specification Corrosively rating of environment	Y/N	Yes "high"
		<input type="checkbox"/> Details of flange arrangements, treatments to prevent flange corrosion must be provided with tender	Y/N	Yes
7				
Inspection and Testing				
7.1		Type Tests		
		-Place where equipment will be type tested - All tests must be done according to the relevant section of IEC 62771-203 - All deviations must be recorded in the deviation schedule	Y/N	Yes Yes Yes
7.2		Production Test		
		Required tests will be executed during production as stipulated	Y/N	
		1) Pressure test performed on all individual enclosures		Yes
		2) Circuit breaker tests		Yes
		3) Tests of disconnectors and earthing switches		Yes
		4) Current transformer tests		Yes
		5) Voltage transformer tests		Yes
		6) SF6 gas-to-air bushings		Yes
		7) Tests on transport units		Yes

7.3		SITE Commissioning Tests		
7.3.1		Required tests will be executed after installation as stipulated.	Y/N	Yes
		Elcon SA10 or Programma TM1600/TM 1800 must be used for Circuit breaker and Isolator tests	Y/N	Yes
		Circuit Breakers Isolators and Earth Switches Current Transformers Voltage Transformer Bus bar/ duct Protection tests (interlocks, alarms, e.g.) SF6 Gas Test GIS Test	Y/N	Yes Yes Yes Yes Yes Yes Yes Yes
7.4		Test Certificates and Reports		
7.4.1		Test reports shall be supplied to Eskom within 4 weeks after the tests have been completed.	Y/N	Yes
7.4.3		Site Commissioning tests All site test results supplied in electronic format ((Elcon (BTS 11) or Programma)	Y/N	Yes CABAWIN
7.5	240-101383919	Sulphur Hexafluoride Gas SF6		
		Gas test results according to Eskom standard.	Y/N	Yes
7.6	IEC 62271-203	Monitoring and Indication devices		
7.6.1		Type Tests in accordance with IEC 62271-203	Y/N	Yes
7.6.2		Production Tests in accordance with IEC 62271-203		Yes
7.7	OHS Act	Pressure Vessels and Portable Containers		
		Complies with South African Legislation OHS Act	Y/N	Yes
7.8		Pressure Relief Devices		
		Type and pressure tested	Y/N	Yes
7.9		Density Gauges		
		Type and pressure tested	Y/N	Yes

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7.10	IEC 62271	Gas Seals and Leaks		
		According to IEC 62271	Y/N	Yes
7.11		Solid Insulation Material		
		Required tests will be executed.	Y/N	Yes
7.12		Local Control, Alarm and Protection Equipment, Auxiliary Supply Equipment, Cabling and Wiring		
		Required tests will be executed	Y/N	Yes
7.13		Interlocking		
		Required tests will be executed	Y/N	Yes
7.14	240-75655504	Corrosion protection and lubrication		
		Compliance to Eskom's requirements	Y/N	Yes
9 Maintenance and Repair work				
9.1		Maintenance during the Guarantee Period		
		Adhere to contract documents with regard to maintenance and repair work	Y/N	Yes
9.2		Special Tools and Devices		
		Supply separate tool and device list for: - Erection - Repairs - Maintenance (e.g. gas fittings, transducers intrusive, specialized tools and jigs, etc.) Compatibility of test devices to Programma and Elcon	Y/N	Yes Yes Yes Yes
9.3		SF6 Gas topping up of gas compartments		
		Must be possible. Supplier to provide Eskom with correct procedure to do live top-up	Y/N	Yes
10 Spares				
		List of recommended spare parts and stock levels including prices	Y/N	Yes

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		List of critical spares including prices	Y/N	Yes	
		Packaging and identification according to Eskom requirements	Y/N	Yes	
		Maintenance and long term storage procedures for spare parts	Y/N	Yes	
		<ul style="list-style-type: none"> Eskom store / site where equipment must be supplied to After dissociation of GIS production, Eskom must be provided with the spares manufacturing drawings 	Y/N	Yes	
11		General			
11.1		Deviation from Specification			
		Any deviations offered to this specification shall be listed in schedule C with reasons for the deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by Eskom.	Y/N	Yes	
		No deviations from or modifications to this specification will be recognized unless noted in schedule C.		Yes	
11.2		Design Collaboration			
		Supplier shall assist Eskom where support is needed with additional design interface like civil construction.	Y/N	Yes	
11.3		Packaging, storage and unpacking			
		According to Eskom requirements	Y/N	Yes	
11.4		Cranes and lifting equipment			
		According to Eskom's requirements	Y/N	Yes	
11.5		Drawings and documents as required by Eskom			
		<ul style="list-style-type: none"> Complete technical schedule B with no blank unfilled spaces (with tender) Failure curve for material and components (with tender) Maintenance strategy and intervals (with tender) Full set of drawings that shows the following minimum information: <ul style="list-style-type: none"> Manufacturer's drawing number and 		Yes Yes Yes Yes	

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		<p>revision number. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number – for population after awarding of the contract; (after awarding of contract)</p> <ul style="list-style-type: none"> • a descriptive title of the drawing (after awarding of contract) • critical dimensions such as overall dimensions, structure dimensions, phase to phase spacing, height of lowest part above ground, height of heights' part above ground, height of mechanism drives, height of inspection windows above ground, operating mechanism enclosure dimensions, etc.; (with tender) • properly annotated drawings with a complete list of major components (bill of materials); (with tender) • details of main terminals including dimensions of the fixing holes, terminal hole spacing, plate thickness and maximum permissible forces (loads) on main terminals (with directions) expressed in Newton's (N); (with tender) • details of the main earthing terminal and operating mechanism enclosure earthing terminal; (with tender) • mass of GIS components in kilograms (kg), which shall include the empty mass, mass and description of heaviest component, ready for service and mass of SF6 gas (with tender) • any special trenches or steelwork required between phases; (with tender) • the steel support structure dimensioned outline and general arrangement; (with tender) • the steel support structure label mounting holes; (with tender) • in the case where the steel support structure is designed by the manufacturer, the steel support structure earthing terminal; (with tender) • the concrete foundation dimensioned outline, design detail and general arrangement; (with tender) • mounting and fastening arrangement for the GIS onto the foundation including the minimum required length and diameter of foundation holding down bolts as well as the relative 		
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		<ul style="list-style-type: none"> position of leveling nuts, spacers, washers, etc. in relation to the base plate; (after awarding of contract) maximum torque required for the foundation holding down bolt nuts used to secure the support structure base plate (Nm); (after awarding of contract) static and dynamic forces (loads), center of gravity (after awarding of contract) location of all enclosure doors and handles; (with tender) location and annotation of control facilities (gas filling/evacuation points, SF6 density monitoring device with its environmental protection shelter/cover, etc.); (with tender) location and layout of LV control cable gland plates; (with tender) SF6 pressure and quantity requirements; and (with tender) location of nameplate on equipment; (with tender) 		
		<ul style="list-style-type: none"> generic auxiliary and control circuit schematic wiring diagrams for the circuit-breaker. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number – for population after awarding of the contract 	Yes	
		<ul style="list-style-type: none"> full list of spares 	Yes	
		<ul style="list-style-type: none"> required for maintenance (refer to clause 9) 	Yes	
		<ul style="list-style-type: none"> full list of operating tools (refer to clause 8.3) 	Yes	
		<ul style="list-style-type: none"> detailed list of standard tools required for minor maintenance (refer to clause 8.3) 		
		<ul style="list-style-type: none"> detailed list of additional specialized tools for major (specialized) maintenance (refer to clause 8.3) 	Yes	
		<ul style="list-style-type: none"> full list as well as copies of type test certificates and reports (refer to Error! Reference source not found.); 	Yes	
		<ul style="list-style-type: none"> transport, storage, installation, operating and 	Yes	

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		<p>maintenance manuals (refer to clause Error! Reference source not found.);</p> <ul style="list-style-type: none"> training material (refer to section Error! Reference source not found.); and the submission, where applicable, of the following additional information: <ul style="list-style-type: none"> premature failures experienced in service of similar design GIS supplied elsewhere by the manufacturer, together with the recommended modifications details of corrosion protection and lubricants measures taken to prevent flange corrosion Information required for controlled switching (refer to Error! R <p>eference source not found.); SPECIFICATION FOR OUTDOOR CIRCUIT-BREAKERS FOR SYSTEMS WITH NOMINAL VOLTAGES FROM 6,6 kV UP TO AND INCLUDING 765 kV ESP 32-1166 clause 5.1.1</p> <ul style="list-style-type: none"> a written commitment from the supplier regarding the submission of the maintenance DVD; and spares availability philosophy 	<p>Yes</p> <p>Yes</p>	
11.6		Manuals		
11.6.1		Manuals supplied as per Eskom requirements	Y/N	Yes
11.6.2		Full maintenance analysis FMECA as per Annexure D	Y/N	Yes
11.7		Measuring units supplied as per Eskom requirements		
		Metric	Y/N	Yes
11.8	SANS 62271-203/ 60044-1/ NRS 029 240-75660336	Nameplates		
		Nameplates provided for all equipment shall comply to the following SANS 62271-203 and DSP 34-1513, for CT's according to SANS 60044-1 / NRS 029	Y/N	Yes
		Method used to attach nameplates		Yes
		Nameplate material offered in relation to DSP 34-1514		Yes

11.9	DISASAA N0 and 240- 75660336	Label Indication and Allocation		
		Labels comply to Eskom Standard	Y/N	Yes
11.10	240- 75655504	Preparation and Coating		
		Preparation and Coating according to Eskom standard		Light grey (G29)
11.11		Holding down bolts		
		Holding down bolts and position drawings as per requirement	Y/N	Yes
11.12		Extension of the existing GIS with equipment from a manufacturer other than the original manufacturer		
		The new supplier shall ensure and demonstrate that the new equipment is fully compatible with the existing equipment.	Y/N	N/A
		The new supplier shall demonstrate extensive previous experience in designing, implementing and commissioning of an interface bay similar to the one offered.		N/A
		The extended equipment shall have total separate gas compartments. It shall not have a common gas compartment with the existing equipment		N/A
		Detailed interfacing methodology of the adaptor bay compartment and its electrical connectivity shall be supplied with tender documents. These drawings shall clearly indicate how the adapter connects to the existing equipment and show how the gas sealing is done. The drawing shall also indicate the details of the electrical connection and the support structures if there are differences in the height from the floor level.		N/A
		It will be an implicit requirement for the		

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		<p>new supplier to obtain all dimensions, connectivity and other relevant information required for the detail design of the interface compartment. Also, no manufacturing and/or implementation of the interface compartment shall commence until such time ESKOM reviewed and approved all of the detail interface design documentation.</p> <p>In the event of the new supplier requiring access to the compartment prior to detail design, for whatever reason, the Supplier shall provide all labour, spares, equipment, consumables, etc, for this purpose.</p> <p>Prior to any opening of the existing equipment, the manufacturer will be required to provide ESKOM with a detailed work instruction and methodology of the work to be performed. No work will commence until ESKOM approved the relevant submittals.</p>	N/A	Xxxxxxxx
			N/A	Xxxxxxxx
			N/A	Xxxxxxxx
11.13		Interchangeability of parts		
		As per Eskom Standard	Y/N	Yes
11.14	OHS Act	Pressure Vessels and Portable Gas Containers		
		All Pressure Vessels and Portable Gas Containers to comply with National legislation OHS Act	Y/N	Yes
11.15		Training Requirements		
		Supplier to provide training of an international standard on the supplied equipment by OEM accredited instructors on the following:	Y/N	
		<ul style="list-style-type: none"> Orientation and basic functioning Operational and first line maintenance Installation, testing and commissioning of the GIS and circuits (controls) Specialize maintenance on all aspects of the GIS which must include major intrusive work and testing 		Yes
				Yes
				Yes
				Yes

11.16		Reliability, Availability and Maintainability (RAM Program)		
		The Supplier to provide a RAM Programme Manual within 2 months after Notification of Acceptance.	Y/N	Yes

On Behalf of Eskom

Frik Schoeman
Senior Technologist
Asset Management SED

Date: _____

On Behalf of Supplier

Name of Supplier: _____

Supplier Representative: _____

Signature: _____

Date: _____

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Annex C – Maintenance Analysis

Below is the table with the FMECA required details that shall be completed and submitted with the tender documentation by the supplier. This shall have the headings of each column as shown below.

The supplier shall provide the details of the maintenance analysis (Table 1A: FMECA sheet) to indicate the reasoning as to the identified maintenance activities and logistics requirements. Note that a criticality assessment may have to be included for each Functional Importance, Health, Usage or Environment row that is included in Table: Maintenance Requirements Definition, if the Consequence or Probability is dependent on these. The supplier shall complete the shaded areas.

The supplier shall also complete the shaded areas of the maintenance requirements definition (Table 1B). The maintenance requirements are defined based on the activities identified from the FMECA and RCM (if included) and taking criteria, associated with the actual functional location, into consideration. This results in several possible maintenance requirement permutations, one of which will be selected by the maintenance function for any item of plant, and from which a consolidated maintenance plan can then be developed.

Annex D – FMECA Worksheet

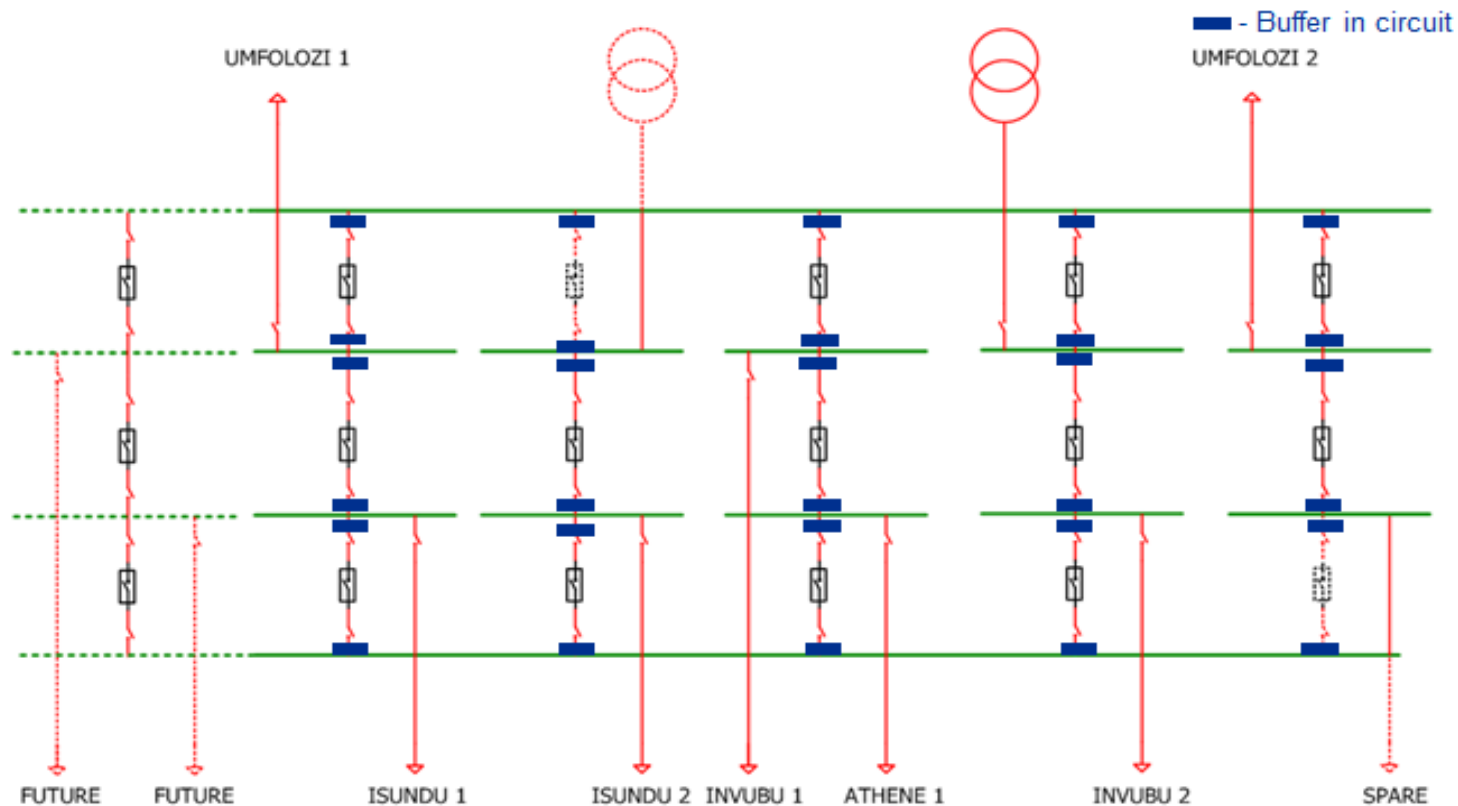
Table D.1: FMECA Worksheet

Equipment Class:		Breaker																																				
Equipment Sub Class:		SF6																																				
Equipment Sub Class Family:		ABC																																				
Trigger Modifiers	Functional Importance	Options	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32		Key		
		Critical																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	1M		Once monthly		
		Significant																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	6M		Once every six months		
		Economic																																		1Y	Once every year	
	Usage / Duty Cycle	Run to fail	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X																		2Y	Once every two years	
	High			X	X				X	X			X	X			X	X			X	X			X	X			X	X			X	X		3Y	Once every three years	
	Low	X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X		X	4Y	Once every four years
	Environment	Harsh		X		X		X		X		X		X	X			X		X		X	X			X		X		X	X			X				
	Mild	X		X		X		X			X		X		X			X		X		X	X			X		X		X	X			X				
	Health	Very Good / Good	X	X	X	X						X	X	X	X				X	X	X	X			X	X		X	X	X	X			X		X		
Fair / Poor / Very Poor					X	X	X	X						X	X	X	X					X	X	X	X					X	X	X	X					

Maintenance Tasks	FMECA Ref No	Trigger ¹ (Time and/or Condition)																														Outage Y/N	Manual Y/N	Maintenance Activities			
Condition Monitoring																																					
Inspection or Test Task 1...n																																					
Preventive Maintenance based on Time																																					
Maintenance Task 1...n																																					
Preventive Maintenance based on Condition																																					
Maintenance Task 1...n																																					
Corrective Maintenance:																																					
Maintenance Task 1...n																																					
Statutory Maintenance																																					
Maintenance Task 1...n																																					

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Annex E– Proposed buffer compartment positions for breaker-and-a-half configuration



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