



PROVINCIAL ELECTRICITY AUTHORITY

TECHNICAL SPECIFICATION DIVISION

115 kV – SF₆ GAS INSULATED SWITCHGEAR

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Invitation to Bid No.:

C Material, equipment, and specifications for 115 kV – SF₆ GAS INSULATED SWITCHGEAR

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed:

1a Scope

This specification cover the minimum technical requirements for the design, manufacture, pre-assembly and testing in the manufacturer's workshop, supply and CIF delivery, transportation to the site(s), erection, installation, field-tests and commissioning of metal-enclosed SF₆-gas insulated switchgears (GIS) for 115 kV substations for indoor installation, complete in every respect with all components and necessary accessories for reliable continuous operation, even if not all details are expressively stated in this specification, remotely or locally operated with a Computer based Substation Control System (CSCS) or Substation Control and Protection System (SCPS).

1b Standards

The 115 kV – SF₆ Gas insulated switchgear and all equipment required within the scope of works shall be manufactured and tested in accordance with the following standards:

IEC 60044-1: 2003	Instrument transformers – Part 1: Current transformers
IEC 60044-2: 2003	Instrument transformers – Part 2: Inductive voltage transformers
IEC 62271-203: 2003	High-voltage switchgear and controlgear – Part 203: Gas-Insulated metal-enclosed switchgear for rated voltages above 52 kV
IEC 62271-100: 2006	High-voltage switchgear and controlgear – Part 100: High-voltage alternating-current circuit-breakers
IEC 62271-102: 2001	High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches

And all other relevant standards, unless otherwise specified in these specification.

PEA will also accept the 115 kV – SF₆ Gas insulated switchgear and all equipment tested in accordance with the later edition of the above standard which may have a difference test items or test procedure comparing with above standard.

PEA will also accept the type test report in accordance with the previous edition of the above standards, if there is no significant change in any test items or no additional test item(s) compared with the above standards. On the other hand, if there is significant change in any test items or there are any additional test items, the previous edition type test report with the additional test report(s) of the significant change test item(s) and/or additional test item(s) will be also accepted.

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1c Principal requirements

1c.1 General

The GIS substation will be either designed to be remote controlled from an Area Distribution Dispatching Center, or locally at substation level from the control room.

Manufacturer must have ISO 9001/14001 certification.

The GIS and all associated equipment shall be of the totally enclosed type for indoor installation. Sulphurhexafluoride (SF₆) gas shall serve as insulating and quenching medium.

The supplier of the GIS and associated equipment shall furnish all materials and necessary hardware, special tools for installation commissioning and maintenance, drawings and instructions for the construction, installation and operation of the complete GIS and their auxiliaries.

The GIS switchgears shall be installed in the building as detailed in the drawings attached in the Tender Documents.

Enclosure of the GIS shall be in aluminium or aluminium alloy and external surface will be painted to give a perfect appearance with at least one primer and one top coat.

The mechanical and electrical components of the switchgear will be suitable material and thickness to withstand the mechanical and thermal stresses due to rated short circuit for 1 second as stated in table at **Appendix 1**.

1c.2 Service conditions and installation

The design of the substations and their facilities shall take into account ambient conditions of areas as listed below.

Therefore, circuit breakers will have to be protected against pollution, heat and corrosion.

The main criteria can be applied globally everywhere in Thailand. Detailed specification will specify the ambient appropriated parameters for the involved area where the substation will be located.

Seismic activity:	0.1g
Maximum wind speed:	≈100 km/h
Maximum recorded rainfall:	250 mm/day
Number of days with thunderstorm:	100 days/year
Average rainfall:	20 mm/day
Mean maximum annual relative humidity:	94%
Mean minimum annual relative humidity:	79%
Minimum daily relative humidity:	17%
Maximum temperature of surfaces exposed to sunbeam:	80°C
Mean minimum daily temperature:	24°C
Maximum ambient temperature:	40°C ⁽¹⁾
Minimum ambient temperature:	11°C

⁽¹⁾ According to IEC 62271-1 over 40°C will be possible under special requirement.



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1c.3 Design requirements

The switchgear bays shall be of standardized, metal-enclosed design and completely factory-assembled.

Components will be of standard manufacture with similar part and assemblies being interchangeable.

Each switchgear bay shall be subdivided into gas-tight high-voltage compartments (Gas compartment), partitioned off from each other through gas-tight insulators as follows:

- Busbar
- Circuit-breaker/Load-break switch
- Cable connection
- Voltage transformers

1c.4 Equipment's characteristics

1c.4.1 Switchgear

1c.4.1.1 Construction

The design and construction of the GIS shall be based on an optimum use of modules for standard bays and shall allow for future extension on both ends without any drilling, cutting or welding on the existing switchgear bays. It shall not be necessary to move or dislocate existing GIS feeder.

Extension must take place without total shut down of the GIS.

The flange connections of the modules shall be equipped with O-ring, or equivalent, with high quality systems for dynamic and static sealing.

In order to save place and have an up to date design, the average distance between 2 normal bays (Line bay – Transformer bay) must not exceed 1,200 mm in case of single-phase encapsulated and not exceed 1,000 mm in case of three-phase.

Internal barrier insulators between enclosures shall be capable of withstanding full pressure from either side with a vacuum pressure on the opposite side. These insulators shall withstand the rated fault-current during internal arcing faults.

The GIS shall be capable of withstanding its rated phase to phase and phase to earth voltage in case gas pressure drops to atmospheric pressure in any compartment.

1c.4.1.2 Maintenance

Removal and replacement of the fully active part of feeder, circuit breaker will be possible without interfering with the operation of the other side feeders.

The arrangement of the offered switchgears shall provide adequate access for testing, operation and maintenance.

For routine inspections and possible repairs, all elements shall be accessible without removing supporting structure. The removal of individual modules, or entire bays, shall be possible without disturbing the enclosures of neighboring bays.

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1c.4.1.3 Pressure relief

Each gas compartment shall be equipped with separate pressure relief device to ensure instant and safe discharge of overpressure in case of an internal arc fault. The relief outlets shall be provided with deflecting devices to ensure that personnel standing close by the GIS are not endangered.

The pressure relief device shall be designed as spring loaded cover or bursting disc suitable for the specific requirements of the GIS.

1c.4.1.4 Gas control

Gas zone control

- (1) Each gas zone shall be independently and continuously monitored by a densimeter or temperature-compensated pressure gauge with two-stage alarm contacts to initiate alarm on loss of gas pressure.
- (2) The first stage adjustable contact shall initiate alarm as an advanced warning that gas density/pressure is below nominal level. The second stage contact shall initiate operation lock-out for the circuit-breaker and give danger alarm or lock-out for other gas compartments.
- (3) Alarms will be transferred to CSCS/SCPS and annunciator.

Gas compartment

- (1) Each gas compartment shall be equipped with a separate gas monitor and filling device.
- (2) The gas compartments shall be equipped with static filters to absorb moisture. The filters located in the circuit-breaker compartment shall be capable to absorb gas decomposition products and moisture.
- (3) All gas pipe connections shall be equipped with non-return valves. Only elastomer sealing shall be used in the gas control system.

The guaranteed leakage rate of each individual SF₆ gas compartment shall be less than 1% per year over the life time of the GIS. Initial filling shall guarantee service period of no less than 10 years.

1c.4.1.5 Mechanical conditions

The complete switchgear will not require more than 2,000 kg/m² of floor loading as stated in civil works drawings.

The erected GIS shall be capable of withstanding electrical, mechanical and thermal ratings of the specified system. All joints and connections shall be able to withstand the forces of expansion, vibration, contraction and specified seismic requirements without malfunction or deformation.

The supplier shall determine the number and position of expansion joints and compensators respectively necessary for balancing expansion stresses caused by temperature differences.

The space for the GIS shall be as shown on the drawings. The layout of the switchgear shall not cause any changes in the building structure such as relocation or modification of beams, foundation, etc. Minor relocation of beams may be made in order to avoid the obstruction of power cable entrance.



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All the exposed parts of GIS shall be treated to prevent corrosion and the process applied shall be described in the bid. The color of the finished coat of paint shall be RAL 7032.

Appropriate gaskets shall be provided where any machined metallic surfaced of different equipment or plant elements containing fluids are to be connected by joints which may be dismantled, either at regular or irregular intervals, or even only exceptionally.

- (1) The gaskets shall fit correctly the corresponding surfaces provided on the metallic parts and shall be easily replaceable. The gaskets shall be of the non-ageing type, able to permanently withstand the highest admissible pressure and the lowest vacuum of the corresponding equipment. They must also be able to withstand the continuous mechanical chemical and physical action of the fluids at the extreme temperatures that can occur in service, without losing their elasticity and tightness.
- (2) The gaskets shall be capable of absorbing the permanent vibrations and the maximum repeated shocks to which the associated equipment and plant are subject, without suffering any permanent deformation or loss of tightness. The material and design of gaskets in contact with hot oil, compressed air or ionized gasses, are subject to the approval of the Authority.

(Possible leaks of hydraulic fluid shall be contained underneath each circuit-breaker and load-break switch. The floors and underbase constructions shall be designed to fulfill this purpose.)

The switchgear room shall be provided with an overhead traveling crane with a carrying capacity sufficient for assembly or disassembly whole GIS.

1c.4.1.6 Electrical conditions

High-voltage conductor connections between adjacent modules shall be made by means of plug-in contacts.

The GIS shall be provided with continuous earthing bus, copper flat bar of 40 x 5 mm cross-sectional area, running through the entire length of the GIS with connecting points for earthing leads. The earthing bus shall be connected to the substation earthing system at least 4 points.

All components of the GIS that are on ground potential shall be connected to this earthing bus.

The switchgear shall be designed for continuous operation under all system operating conditions including sudden change of load and voltage and short circuits within its ratings and under atmospheric condition prevailing at site. The equipment shall withstand at the maximum the rated voltage.

The switchgear shall have proper earthing system to prevent hazardous potential difference within the installation. Earthing terminals shall also be provided as many points as possible to be connected to station earth leads.

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The design shall allow to connect to ground all main circuits without opening gas compartment. All cable connections between the GIS and the local control cabinets shall be made with shielded multi-conductor cables. The cables shall be of the prefabricated plug and socket type, except current transformer.

Ratings and characteristics of the 115 kV - SF₆ Gas Insulated Switchgears

Ratings and characteristics	Unit	Requirement
Nominal voltage	kV r.m.s.	115
Maximum voltage	kV r.m.s.	123
Power frequency	Hz	50
Number of phases	-	3
Power frequency withstand voltage in 1 minute:		
- Phase to earth and between phases	kV r.m.s.	230
- Across open switching device and isolate distance	kV r.m.s.	265
Lightning impulse withstand voltage:		
- Phase to earth and between phases	kV peak	550
- Across open switching device and isolated distance	kV peak	630
Rated normal current		
- Line bays	A r.m.s.	2,000
- Coupler bays	A r.m.s.	2,000
- Transformer bays	A r.m.s.	2,000
Rated short circuit current		
- Switching stations	kA r.m.s.	not less than 40
- Substations	kA r.m.s.	not less than 31.5

1c.4.1.7 Interlocking system

1c.4.1.7.1 Definition

The interlocking system shall positively prevent the operator from unintentionally reaching or creating a dangerous or potentially dangerous condition.

1c.4.1.7.2 Design

The interlocking system shall be constructed in such a way that it cannot be defeated without the use of tools or brute force.

The interlocking system shall be secure and logical and shall fulfill ultimate safety requirements. Any maloperation of related circuit-breakers, load-break switches, disconnectors and earthing switches shall be positively prevented. All mechanical interlocks shall remain active if the auxiliary power supply fails.



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1c.4.1.7.3 Interlocking description

A detailed description of the proposed interlocking system shall be submitted with the bid.

1c.4.2 Circuit-breaker

1c.4.2.1 Requirement

The circuit-breakers will be controlled from its local cabinet or remotely in the control room or from Area Distribution Dispatching.

The circuit-breakers shall be capable of making and breaking the corresponding values of every symmetrical and asymmetrical rating from zero to the rated fault currents, as well as capacitive currents without the occurrence of restrikes and small inductive currents with only minor switching over-voltages.

The circuit breaker shall be puffer type and/or the self blast type.

The 3 poles of the circuit breaker will be group operated by a common drive.

The circuit breakers shall be electrically trip-free and have anti-pumping device.

The operating mechanism shall be provided with two electrically and magnetically independent and redundant tripping coils and circuit.

1c.4.2.2 Rating and features

Rating and features of circuit breaker are specified in **Appendix 1** attached to this specification.

1c.4.2.3 Operating mechanism

The construction and dimensioning of the operating mechanism shall be strictly based on the making and breaking requirements of the circuit-breaker to assure proper opening and closing of the main contacts.

Operating mechanism shall be spring operated or hydraulic spring operated. Recharging of energy storage shall be fully automatic.

a) In case of spring operating mechanism the switching energy shall be stored by a spring assembly charged by an electric motor or emergency manual charging. An indicator shall show the state of energy of the spring assembly, i.e. charged/discharged position.

If the spring assembly is not or insufficiently charged provision shall be made to prevent closing of the breaking.

b) In case of hydraulic spring operating mechanism the switching energy shall be stored by disk spring assembly with an oil hydraulic pump.

An indicator shall show the state of energy of the spring assembly, i.e. charged/discharged position.

If the spring assembly is not or insufficiently charged provision shall be made to prevent closing of the breaker.

Excessive running times of the hydraulic fluid pump shall lead to alarm indication.

All hydraulic piping, valves and fitting shall made from corrosion – resistant material.

The actual hydraulic pressure shall be shown on the local indicators.

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The operating mechanism shall have energy storage ability to perform a O_C_O duty sequence. If energy storage system is not fully recharged within a predetermined time further operation shall be blocked, suitably indicated and alarmed.

Energy stored shall be enough for at least 1 closes at 2 trips from closed position. If the energy storage is not fully recharged with a predetermined time, further operation shall be blocked, suitably indicated and alarmed.

Power supply for all operating devices and control shall be 125 V DC .

A mechanically operated indicator shall be foreseen on each circuit breaker's operating mechanism to clearly show whether the circuit breaker is in an opened or closed position. The indicator shall be orientated towards the Local Control Panel Operation.

Counters shall also be provided.

Each unit shall be furnished with a minimum of six spare auxiliary contacts (3 normally open and 3 normally closed) for PEA's future use. The auxiliary switches for remote switch position indication and busbar replica (for protection) shall be connected directly to the circuit-breaker or isolator drive.

The auxiliary switches shall be wipe type self-cleaning. In case of auxiliary relays are required for auxiliary contacts extension. Only mechanical latching relay type shall be acceptable.

Interlocking shall be provided to prevent from operation of the disconnecting switch when the circuit breaker to closed.

A manual emergency tripping device and closing one for maintenance purpose shall be provided in case the control power source fails.

A manual operating mechanism (handle, rank, wheel etc.) shall be provided to allow operation of circuit breaker in case of electrical supply failure. An interlocking system shall switch off the motor during manual operation.

Anti-condensation heater with hygrostat shall be provided in the operating mechanism housing wherever necessary.

The operating mechanism shall be maintenance-free for a minimum of 5,000 operations guarantee for a period of at least 5 (five) years.

1c.4.3 Disconnecting switch – Maintenance earthing switches

Disconnectors shall be provided at the electrical locations indicated on the single-line diagrams.

1c.4.3.1 General design

The three poles of the disconnector and earthing switches shall be group operated by an electric motor drive with electrical and mechanical interlock.

The actual position switch shall be positively shown by an inspection window or reliable mechanical indicator in compliance with requirement of IEC 62271-102 for checking disconnector or earthing switch position.

1c.4.3.2 Current switching and withstanding

Bus disconnectors shall be capable for loop current switching (on and off) in case of load transfer by means of bus coupler bay without interruption of any bay as per IEC 62271-102.

The disconnector shall be capable of switching small value of current such as charging current for circuit breaker grading capacitors and the capacitance of SF₆ GIS bus without producing excessive transient over-voltage which may cause control circuit over-voltage or transient ground rise on the enclosure etc.

Each earthing switch shall be designed to withstand full short-circuit current in the closed position.

1c.4.3.3 Manual emergency operation

Manual emergency operation of the disconnector or earthing switch shall be possible by means of hand crank or hand wheel. During manual emergency operation it shall not be possible to operate the electric drive motor and vice versa due to self-locking design.

1c.4.3.4 Padlocking

To secure the disconnectors during service work from unintentional operation, provision for mechanical interlock and padlocking shall be furnished.

The provision for blocking and padlocking the earthing switch in both fully open and closed position shall be furnished.

1c.4.3.5 Auxiliary contacts

Each disconnector shall be provided with extra 3 normally open and 3 normally closed spare auxiliary contacts for PEA's future use.

The auxiliary switches shall be wipe type self-cleaning. In case of auxiliary relays are requires for auxiliary contacts extension. Only mechanical latching relay type shall be acceptable.

1c.4.4 Fast acting earthing switch

1c.4.4.1 General design

High-speed earthing switches shall be installed on the line-side of incoming cable and overhead line feeders and on busbars. The high making speed shall be obtained through snap spring operated mechanism. The high-speed earthing switches shall be fault-proof and capable of closing into a short-circuit without causing arc faults in the installation.

The three poles of earthing switch shall be group operated by an electric motor drive with integral mechanically operated auxiliary contacts for required interlocking and position indication.

The actual switching position shall be positively shown by mechanical indicators visible from the operating position.

1c.4.4.2 Current switching and withstanding

High speed earthing switch can switch capacitive current of overhead line.

The switch shall be able to make 2 times full fault current without maintenance.

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1c.4.4.3 Interlocking-padlocking

The earthing switches shall be fully interlocked with every associated main switching device.

In order to secure the earthing switches from unintentional operation, provision for mechanical interlock and padlocking shall be furnished.

1c.4.4.4 Manual emergency operation

Manual emergency operation of the earthing switch shall be possible by means of a hand crank or hand wheel. During manual emergency operation it shall not be possible to operate the electric motor drive and vice versa due to self-locking design.

1c.4.4.5 Auxiliary contacts

Each earthing switch shall be provided with additional 3 normally open and 3 normally closed as spare auxiliary contacts for future use.

The auxiliary switches shall be wipe type self-cleaning. In case of auxiliary relays are required for auxiliary contacts extension. Only mechanical latching relay type shall be acceptable.

1c.4.4.6 Maintenance provision

Provision shall be made to insulate each phase of earthing switch from the metal enclosure enabling the following measurements for commissioning and maintenance:

- Insulation resistance of the main circuits
- Conductivity of current path
- Operating characteristics of circuit-breaker and disconnector such as measuring of operating time
- Primary current injection for instrument transformers

1c.4.5 Current transformer

The Current Transformer (CT) shall be of toroidal core type.

The primary winding (GIS conductor) shall be installed inside a gas compartment. The secondary winding may be installed inside or outside a gas compartment but shall be inside the GIS enclosure.

The current transformer shall be furnished with short circuit device and spark gap at the secondary terminal for open circuit protection and one terminal shall be earthen.

During system fault conditions, the maximum secondary current of the metering core shall not exceed 5 times the rated current.



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1c.4.5.1 Accuracy and burden

- a) The accuracy classes, Accuracy Limit Factor and burdens shall match the switchgear protection system requirements
- b) The accuracy class, ratio and burden of current transformer for metering core shall have sufficient rating to meet the maximum current
- c) The Contractor shall submit the Authority for approval the detailed CT calculation for protective relay settings. The Authority shall then review the calculation, and should any CT data are not met the requirements of the protection functions or are required for sound engineering practice of the protection entail necessary modifications to the calculation, the Authority will return the calculation to the Contractor to carry out the modifications required without extra charge to the Authority.
- d) The magnetizing curves for each current transformer for protection shall be submitted for approval. To guarantee the correct protective relay operation, through-fault stability, calculations showing the correctness of the chosen current transformer core, i.e. rated output, class of accuracy and rated accuracy limit factors, ratio, knee-point e.m.f. and resistance of the secondary windings (corrected to the maximum service temperature), shall be submitted for approval.
- e) Otherwise specified, current transformer will accept continuous flow of 120% of rated current without damage.

1c.4.5.2 Ratings

Ratings are specified in **Appendix 1** attached to this specification.

1c.4.5.3 Labels

All current transformers are to be provided with an identifying label showing manufacturer, type, ratio, class, output and serial number.

Where multi-ratio secondary windings are provided, the above mentioned labels shall clearly indicate the terminal connection for each ratio, and they shall be clearly indicated on appropriate diagrams and drawings.

1c.4.6 Voltage transformer

1c.4.6.1 General design

The voltage transformers shall be inductive type in SF₆ impregnated, foil insulated construction with metal-enclosed housing attached to the high-voltage enclosure of the switchgears as separate gas compartment.

The secondary winding leads shall be brought out through gas-tight bushings to an accessible terminal box mounted on the voltage transformer. The secondary windings shall be protected or supervised with miniature circuit-breakers of adequate characteristics, and provided with transient over-voltage protection.



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1c.4.6.2 Ratings

The thermal rating of the voltage transformer shall allow, at site conditions, a 20% continuous overloading referred to nominal rating of the voltage transformer.

Ratings for voltage transformers shall be as specified in **Appendix 1** attached to this specification.

1c.4.7 Busbar and cable termination

Busbars shall be made of high conductivity hard drawn electrolytic copper or aluminium alloy tubing. Busbar shall be rated for the continuous current of the switchgear as specified at **1c.4.1.6**. Busbar shall have high dynamic and dielectric strength with good heat dissipation, and a favorable ratio of the load carrying capacity to the cross-sectional area.

Busbar conductors and enclosures shall have provisions for absorbing thermal expansion. No mechanical stress shall be allowed to impose on insulation parts.

1c.4.7.1 Busbar design

Busbar design shall allow to open circuit breaker compartment for maintenance or revision without any risk if busbars under electric tensions.

Busbar shall be segregated per bay so that in case of possible flash over, the defect shall be limited to affected busbar only.

1c.4.7.2 115 kV Power cable and cable termination

The Contractor shall perform all necessary studies in order to make sure that the design and dimensions of the cable terminal cope with the cable being supplied for the project.

The 115 kV power cables and their accessories shall be designed, manufactured and tested in accordance with the relevant IEC standards.

1c.4.8 Enclosure

The switchgear shall be treated and protected to withstand at least 5 years of operation under the stated environmental conditions without sustaining corrosion or attacks from fungus or rodents. This period shall start from the issue of the Provisional Acceptance Certificate. This painting guarantee period shall be effective regardless of any other guarantee period for the project or parts of the project or any Final Acceptance Certificate, issued prior to the elapse of the painting guarantee period.

All surfaces to be painted shall be smooth, free from surface defects, corrosion, mill scale and all foreign substances before painting.

Painting shall use RAL 7032 color code. Machined sealing surfaces which are exposed to the atmosphere shall receive protective, removable coatings that can be peeled off during final assembly at site.

Joints of different metals which could lead to electrolytic corrosion must be avoided.



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The number of sealing surfaces and welds shall be kept to a minimum. All welding on pressurized enclosures shall be performed with suitable submerged – arc welding machines. At least 10% of all welds shall be subjected to non-destructive testing by X-rays or ultrasound, and all records thereof be made available upon request. The Contractor shall explain in detail all corrosion protection measures he intends to take, indicate the relevant standards for testing the applied measures, and submit for approval to the Authority.

1c.4.9 Local control board

1c.4.9.1 Switchgear bay

Indicating LEDs shall be furnished to show the status of main switching equipment. All lamps shall be replaceable from the front.

1c.4.9.2 Local control board

Local control board for operation at device level shall be provided for each switchgear bay.

Factory assembled cables with multicore plug and socket connectors shall be used for the control connections between the local control board and GIS equipment, except current transformers.

All Cables and wires shall be fitted with identification ferrule at each termination. Marking shall be machine-lettered.

1c.4.9.3 Local annunciator

Each panel shall be equipped with alarm annunciator to describe all faults which have developed in the related bay.

The display units shall be arranged in matrix form complete with inscription describing the fault condition and visible only while illuminated.

Annunciator shall be equipped with an independent cut off switch to allow annunciator working on local mode only. Position of this switch shall be monitored by CSCS/SCPS.

The operation of the alarm annunciator system shall be as follows:

- When an alarm contact is initiated the audible warning shall sound continuously and the nameplate concerned shall be illuminated by a flashing light.
- An “ACKNOWLEDGE” push-button shall be provided which when pressed, shall silence the audible signal and cause the nameplate to remain illuminated steadily.
- The alarm circuit shall be designed to retain the indication after the reopening of the initiating contact, requiring to press a separate “RESET” push button to cancel the alarm.
- The “TEST” push-button shall be fitted close to “ACKNOWLEDGE” and “RESET” buttons, to illuminate all nameplates on the display unit for as long as the “TEST” button is pressed.
- The operation of the “ACKNOWLEDGE” button shall not preclude the receipt of further indications giving audible alarm and visual indication. Horn and name plate lamps shall be ready to sound and flash respectively for any other point going off normal.



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- f) Operation of an annunciator lamp shall neither interfere with nor cause false operation of any other annunciator lamp whether initiated simultaneously or in sequence.
- g) The audible warning shall be given by the substation alarm horn. Each initiated alarm shall operate this horn.
- h) The number and the inscription of each alarm fascia shall be described in the bid. At least two blank units without any inscription shall be provided for future use.

1c.4.9.4 Local operation mode

A key-switch shall be provided for by-passing the entire interlocking system of the GIS for testing or emergency purposes. Provision shall be made that by-passing with key-switch shall be possible only on local control mode.

Switches of the selective key-switch type for local-remote control transfer shall be provided for all commands. The switches shall have provision to light the signal lamp in the remote control panel when switch is turned to local position.

1c.4.9.5 Control board connection

Each board and all indicating devices shall be sufficiently identified with nameplates and labels. All cable connections between the GIS and the local control board shall be made with shielded multi-conductor cables in order to exclude coupling-in of transient over-voltages in the secondary wiring system. The shield of the cables shall be grounded at both cable ends.

Wiring for power circuits shall be terminated on terminal blocks completely separated and isolated from control terminal blocks.

Terminal blocks shall be provided for termination of external wiring. The local control board shall serve as marshalling box for remote and local control.

All interconnecting wiring shall be suitably protected against physical damage by routing them in protective channels, tubes or pipes.

Space heater with hygrostat control switch shall be installed to prevent condensation.

1c.4.9.6 Remote control

The GIS switchgear will be remote controlled either at substation level in the control room or at the Area Distribution Dispatching Center by CSCS/SCPS system.

1c.4.10 Protective relays

1c.4.10.1 General requirements

- a) The GIS substation will be provided with protection relays according to **Specification no. 11** “Control, Protection and Measures” or **Specification no. RSUB-010** “Substation Control and Protection System (SCPS)”
- b) Relays/IEDs will be of numerical type and connected to the bays control units.



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1c.4.10.2 Wiring System

Wiring will be carried out according to **Specification no.15: Small wiring.**

Except fiber optics cables, all internal wiring shall be carried out with stranded copper conductor, PVC insulated 600 V insulation class. The stripped ends of the stranded conductors shall be tinned or equipped with compression type sleeve.

All cables and wires shall be installed in ducts and plastic conduits, and shall run continuously without spliced or taps.

All switchgear auxiliary contacts, protection control, signaling and measuring devices shall be wired to separate terminal blocks.

Voltage and current circuits shall be wired to test blocks to enable testing of the electrical measuring instruments.

All cables and wires shall be fitted with identification ferrule at each termination. Markings shall be machine-lettered.

Each terminal block shall be provided with at least 15% spare terminals. Two or more wires shall not be connected in one terminal.

1c.4.11 Grounding system

A complete grounding system, to which all dead metallic parts and the neutrals of the electric systems have to be connected, shall be provided in the substation. The grounding system shall meet the requirements of **Specification no. 12: Substation Grounding System and Lightning Protection.**

The grounding system shall be provided in the substation rooms and in the cable ducts.

Measures for suppression of transient over-voltages have to be provided; screen grids of the building shall be integrated in the grounding system.

1c.4.12 Tools, spare parts and maintenance

1c.4.12.1 General requirements

Special tools and accessories required for the installation, commissioning/testing/proper operation, and maintenance of the substation equipment, and equipment for testing and adjusting the protection relays shall be quoted separately with itemized prices.

Where applicable, the equipment shall comply with the IEC standard. All markings, calibrations and relevant instructions marked on the faceplate and other parts of the equipment shall be in English. For all equipment, where applicable, electrical connection cables, spare parts, etc. shall be supplied to ensure proper operation under site conditions.

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1c.4.12.2 Operation tools

All specific tools, needed to operate and maintain the switchgear, shall be provided. The following list is given as example and shall not be limited to listed items.

- Hand crank for In/Out service
- Manual open and close
- Manual charging spring
- SF₆ gas refilling adapter

1c.4.12.3 Equipment for maintenance

The tools and equipment indicated in the following paragraphs shall be used for maintenance, overhaul and repair works on the SF₆-gas insulated equipment in the Authority's electricity system.

The bidder shall quote for the following equipment required for maintenance of the SF₆-gas system.

- SF₆-gas leakage detector, portable, battery-operated with audible and visible alarms, and probe with connection hose of about 2 m length, sensor-check, spare sensor, carrier bag.
- SF₆-gas evacuating and refilling device with cylinder transport cart for topping up, evacuating and refilling of SF₆-gas into gas compartments. The cart shall be equipped with standard cylinder, vacuum pump with suction capacity of approx. 16 cu.m/h, final vacuum less than 1 mbar, and all necessary devices for the specified purpose such as regulators, coupling valves, pressure gauges, pressure reducer for SF₆ gas, connecting hose for standard cylinder min. 10 m long including adequate couplings, etc.
- SF₆-gas moisture measuring device, portable housing, equipped with moisture sensor, needle valve, flow meter, four digit LCD display of measured dew point, flexible power supply cable including plug for 230 V AC, robust 2 m connecting house, transport case.
- Measuring device for decomposition products, portable hosing, measuring capacity min. 2 to 50 ppm, with precision pressure gauge, connection hose min. 2 m long, including adequate couplings and test tubes (min. 10 pcs.), transport case.
- SF₆-gas storage and maintenance unit which comprise gas storage tank, a vacuum pump, built-in filters for cleaning and drying and all necessary devices for draining and storing the gas from the gas compartment during maintenance period and then refill the gas into the compartment again when the maintenance work is completed.
- SF₆-gas density test device, portable design, battery operated with precision pressure gauges, air pump with hose and valve connection, and all further accessories necessary for the proper testing of SF₆ density monitors and temperature compensated contact mano-meters.
- Precision pressure gauge, for SF₆-gas, scales 10 bars, with adequate adapting device(s).
- Steel Cylinder for SF₆-gas, containing 40 kg SF₆-gas



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- i) Vacuum cleaner, industrial type, cyclone type for use in SF₆-workshop.
- j) Steel Cylinder for gas, filled with compressed nitrogen or carbon dioxide gas for cleaning of repaired components and equipment, with reducing valve pressure gauge, hoses and connection, nozzle and trolley for one bottle.

1c.4.12.4 Spare parts

The bidder shall quote separately recommended spare parts for 3 years operation and 10 years operation of the GIS including all auxiliary equipment and operating mechanism system.

All spare parts and tools provided by the Contractor shall be strictly interchangeable with the parts they are intended to replace, and shall be treated and packed for long storage under the prevailing climatic conditions. Each spare part shall be clearly marked or labeled on the outside of its packing with its description and purpose. This shall include detailed directions as how (i.e. for how long under worst climatic conditions) to store the equipment concerned, and pertinent delivery time to be expected in case of orders at a later date.

1d Tests and test reports

1d.1 Type tests

1d.1.1 Switchgear

The switchgear shall be passed type tests in accordance with IEC 62271-203: 2003, or later edition, at least the following items:

- (1) Test to verify the insulation level of the equipment including partial discharge tests and dielectric tests on auxiliary circuit
- (2) Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit
- (3) Tests to prove the rated peak and the rated 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) Tests to prove the strength of enclosures
- (7) Verification of the degree of protection of the enclosure
- (8) Gas tightness tests
- (9) Electromagnetic compatibility tests (EMC)
- (10) Additional tests on auxiliary and control circuits
- (11) Tests on partitions
- (12) Tests to prove the satisfactory operation at limit temperatures
- (13) Tests to prove performance under thermal cycling and gas tightness tests on insulators
- (14) Tests to assess the effects of arcing due to an internal fault.



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1d.1.2 Circuit breaker

Circuit-breaker shall be passed type tests in accordance with IEC 62271-100: 2006, or later edition, at least the following test items:

- (1) Dielectric tests
- (2) Measurement of the resistance of the main circuit
- (3) Temperature-rise tests
- (4) Short-time withstand current and peak withstand current tests
- (5) Tightness tests
- (6) Mechanical operation test at ambient temperature
- (7) Short-circuit current making and breaking tests
- (8) Verification of the degree of protection
- (9) Critical current tests
- (10) Double earth fault tests
- (11) Short-line fault tests
- (12) Capacitive current switching tests
- (13) Line-charging current breaking tests
- (14) Cable-charging current breaking tests
- (15) Single capacitor bank switching tests
- (16) Back-to-back capacitor bank switching tests
- (17) Switching of shunt reactor and motors

1d.1.3 Disconnecting switch – Maintenance earthing switches

Disconnecting switch shall be passed type tests in accordance with IEC 62271-102: 2001, or later edition, at least the following test items:

- (1) Dielectric tests
- (2) Measurement of the resistance of circuit
- (3) Temperature rise tests
- (4) Short-time withstand current and peak withstand current test
- (5) Verification of the protection
- (6) Tightness tests
- (7) Operating and mechanical endurance tests
- (8) Test to verify the proper functioning of the position indicating device
- (9) Bus-transfer current switching tests
- (10) Bus-charging switching tests



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1d.1.4 Fast Acting Earthing Switch

Fast acting earthing switch shall be passed type tests in accordance with IEC 62271-102: 2001, or later edition, at least the following test items:

- (1) Dielectric tests
- (2) Short-time withstand current and peak withstand current test
- (3) Verification of the protection
- (4) Tightness tests
- (5) Test to prove the short-circuit making performance of earthing switches
- (6) Operating and mechanical endurance tests
- (7) Test to verify the proper functioning of the position indicating device
- (8) Inductive current switching tests

1d.1.5 Current transformer

Current transformer shall be passed type tests in accordance with IEC 60044-1: 2003, or later edition, at least the following test items:

- (1) Short-time current test
- (2) Temperature-rise test
- (3) Impulse voltage withstand test on primary terminals
- (4) Verification of the degree of protection by enclosures
- (5) Test of accuracy
- (6) Enclosure tightness test at ambient temperature
- (7) Pressure test for the enclosure

1d.1.6 Voltage transformer

Voltage transformer shall be passed type tests in accordance with IEC 60044-2: 2003, or later edition, at least the following test items:

- (1) Short-circuit withstand capability test
- (2) Temperature rise test
- (3) Impulse voltage withstand test on primary terminals
- (4) Verification of the degree of protection by enclosures
- (5) Test for accuracy
- (6) Enclosure tightness test at ambient temperature
- (7) Pressure test for the enclosure

The type test reports shall be submitted with the bid.



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PEA will also accept other documents instead of the type test reports in the following conditions:

- In case the proposed the GIS has been registered for Product lists for substation turnkey project, the not-expired registration certificate counted to the bid closing date can be submitted instead.

However the document, in above case, shall be proved that the GIS specified in the Product list shall be the same product, type/model and all ratings as the proposed GIS for this bid.

The cost of all type tests and reports shall be borne by the bidders or manufacturers.

1d.2 Routine tests

1d.2.1 Switchgear

The switchgear shall be passed routine tests in accordance with IEC 62271-203: 2003, or later edition, at least the following items:

- (1) Dielectric test on the main circuit
- (2) Tests on auxiliary and control circuits
- (3) Measurement of the resistance of the main circuit
- (4) Tightness test
- (5) Design and visual checks
- (6) Pressure tests of enclosure
- (7) Mechanic operation tests
- (8) Tests on auxiliary circuits, equipment and interlocks in the control mechanism
- (9) Pressure test on partitions

1d.2.2 Circuit breaker

Circuit-breaker shall be passed routine tests in accordance with IEC 62271-100: 2006, or later edition, at least the following test items:

- (1) Dielectric test on the main circuit
- (2) Dielectric test on auxiliary and control circuits
- (3) Measurement of the resistance of the main circuit
- (4) Design and visual checks
- (5) Tightness tests
- (6) Mechanical operating tests

In addition, the following test item shall be carried out:

- (1) Interrupter travelling curve measurement
- (2) Verification of correct wiring and labeling
- (3) Electrical functional tests
- (4) Interlock check test

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1d.2.3 Disconnecting switch – Maintenance earthing switches

Disconnecting switch shall be passed routine tests in accordance with IEC 62271-102: 2001, or later edition, at least the following test items:

- (1) Dielectric tests on the main circuit
- (2) Dielectric tests on auxiliary and control circuits
- (3) Measurement of the resistance of the main circuit
- (4) Tightness test
- (5) Design and visual checks
- (6) Mechanical operating tests
- (7) Electrical functional test
- (8) Verification of the correct wiring

1d.2.4 Fast Acting Earthing Switch

Fast acting earthing switch shall be passed routine tests in accordance with IEC 62271-102: 2001, or later edition, at least the following test items:

- (1) Dielectric tests on the main circuit
- (2) Dielectric tests on auxiliary and control circuits
- (3) Measurement of the resistance of the main circuit
- (4) Tightness test
- (5) Design and visual checks
- (6) Mechanical operating tests
- (7) Electrical functional test
- (8) Verification of the correct wiring

1d.2.5 Current transformer

Current transformer shall be passed routine tests in accordance with IEC 60044-1: 2003, or later edition, at least the following test items:

- (1) Verification of terminal marking
- (2) Power frequency withstand test on primary winding
- (3) Partial discharge measurement
- (4) Power frequency withstand test on secondary windings
- (5) Power frequency withstand test between sections
- (6) Inter-turn overvoltage test
- (7) Test of accuracy
- (8) Enclosure tightness test at ambient temperature
- (9) Pressure test for the enclosure
- (10) Determination of the secondary winding resistance



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- (11) Determination of the secondary loop time constant
- (12) Test for rated knee point e.m.f. and exciting current at rated knee point e.m.f.
- (13) Excitation curve check
- (14) Internal burden measurement

1d.2.6 Voltage transformer

Voltage transformer shall be passed routine tests in accordance with IEC 60044-2: 2003, or later edition, at least the following test items:

- (1) Verification of terminal marking
- (2) Power frequency test on secondary windings
- (3) Power frequency test on primary windings
- (4) Power frequency withstand test between sections
- (5) Measurement of partial discharges
- (6) Test of accuracy
- (7) Enclosure tightness test at ambient temperature
- (8) Pressure test for the enclosure
- (9) Measurement of dissipation factor
- (10) Sealing test

The cost of the routine tests and reports shall be borne by the contractor or manufacturers.



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C2 Material and packing data to be given by bidder

The bidders have to submit the following data and details with the bid

2a Critical document of the proposed GIS (See page 25 of 29)

2b Design data and guarantee of the proposed GIS (See Annex 1)

2c Drawing of the proposed GIS including all accessories with main dimensions and tolerances in mm

2d Detail of the proposed GIS

- Manufacturer's name/country of origin
- Catalogue
- Description of materials used for the component parts
- Surface finishing of component parts
- Detail of sealing and testing

2e Manufacturer's name and technical data of the proposed GIS

2f List of routine tests

2g Packing details

Packing method (shown by drawing(s), and describe packing materials)

Number of sets in each package (one)

Dimensions of each package in cm

Gross weight of each package in kg

Net weight of each package in kg

Number of packages

If several packages are contained in one big case, further details are required:

Dimensions of each case in cm

Volume of each case in m³

Gross weight of each case in kg

Number of packages in each case

Number of cases

Type of storage facility required (indoor/outdoor)



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Note: Conditions for documentation and consideration

The **Contractor** has to supply reports of routine tests **of the proposed GIS** shall be sent to the Authority, before shipment, at the following address:

Substation Construction Division

Provincial Electricity Authority
200 Ngam Wong Wan Road, Chatuchak
Bangkok Metropolis 10900 Thailand



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Critical documents of the proposed GIS

Item	Required documents	Proposed technical document	Reference document (Page/Item)
1	Type test reports, or	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	Product lists certificate	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2	List of routine test	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3	Design data and guarantee of the proposed GIS	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4	Drawing of the proposed GIS including all accessories with main dimensions and tolerances in mm	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5	Detail of the proposed GIS - Manufacturer's name/country of origin - Catalogue - Description of materials used for the component parts - Surface finishing of component parts - Detail of sealing and testing	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No	
7	Manufacturer's name and technical data of the proposed GIS	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8	Packing details	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Note:

The bidders who do not submit all critical documents mentioned in the above table with the bid will be rejected.



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APPENDIX 1

RATINGS OF 115 KV GAS INSULATED SWITCHGEAR EQUIPMENTS

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APPENDIX 1

RATINGS OF 115 KV SF₆ GAS INSULATED SWITCHGEAR EQUIPMENTS

1. Circuit-breakers Ratings (IEC 62271-100)

Type	Unit	SF ₆ gas insulated enclosure
1. Nominal voltage	kV r.m.s.	115
2. Maximum voltage	kV r.m.s.	123
3. Power frequency	Hz	50
4. Number of phases	-	3
5. Power frequency withstand voltage in 1 minute:		
- Phase to earth and between phases	kV r.m.s.	230
- Across open switching device and isolate distance	kV r.m.s.	265
6. Lightning impulse withstand voltage:		
- Phase to earth and between phases	kV peak	550
- Across open switching device and isolated distance	kV peak	630
7. Number of interrupter per pole	-	1
8. Rated normal current		
- Line bays	A r.m.s.	2,000
- Coupler bays	A r.m.s.	2,000
- Transformer bays	A r.m.s.	2,000
9. Rated short circuit current in 1 second at 115 kV		
- Switching stations	kA r.m.s.	not less than 40
- Substations	kA r.m.s.	not less than 31.5
10. Rated total break	ms	Not more than 60
11. Operating mechanism	-	Spring or Hydraulic-Spring
12. Operating sequence	-	O-0.3s-CO-15s-CO
13. Type of tripping	-	Three-pole
14. Rated control circuit voltage	(V - DC)	125
- Tripping circuit, min-max	(%)	70-110
- Closing circuit, min-max	(%)	85-110
15. Applicable standards	-	IEC 62271-100

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2. Current transformers-Ratings (IEC 60044-1)

2.1 For Double bus with coupler

The current transformers shall be of the multi-ratio type as indicated in the following table.

Bay	Ratio	Core number	Accuracy	Burden
115 kV Transformer	2000-1600/1 A	1	5P20	20VA
	400-200/1 A	2	0.5	20VA
	2000-1600/1 A	3	5P20	20 VA
	2000-1600/1 A	4	5P20	20 VA
115 kV Coupler	2000-1600/1 A	1	5P20	20VA
	2000-1600/1 A	2	5P20	20VA
	2000-1600/1 A	3	5P20	20 VA
115 kV Line	2000-1600/1 A	1	5P20	20VA
	2000-1600/1 A	2	0.5	20VA
	2000-1600/1 A	3	5P20	20 VA
	2000-1600/1 A	4	5P20	20 VA

2.2 For H Configuration.

Bay	Ratio	Core number	Accuracy	Burden
115 kV Transformer	400-200/1 A	1	5P20	20 VA
	400-200/1 A	2	0.5	20 VA
	400-200/1 A	3	5P20	20 VA
	400-200/1 A	4	5P20	20 VA
115 kV Line	1200-800/1 A	1	5P20	20 VA
	1200-800/1 A	2	0.5	20 VA
	1200-800/1 A	3	5P20	20 VA
	1200-800/1 A	4	5P20	20 VA

Notes:

- Otherwise specified, CT will be designed to accept continuous flow of 120% of rated current without any damage.
- Burden in following tables are specified for full range at maximum ratio
- The ratings and features of CT shown on the above tables refer to the minimum requirements for metering and relaying equipment. The Bidder shall be responsible for determining the ratings and features of the CT's as indicated on the above tables, should any CT's internal resistance (R_{ct}), burdens, and the class of any relaying cores of each CT as indicated are not met the requirements for use with each of the protective relays for protection of 115 kV line, transformer, buses, meters and etc. The Bidder shall, to the best of his knowledge, determine the proper ratings and features of each CT to meet the requirements of those protections before submitting the proposal at the time of Bidding.
- The following parameter shall be taken into account for determining the ratings and features of CT.



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Short circuit current shall be as follows:

- 40 kA for GIS Switching station
- 25 kA for GIS H configuration substation

Time constant of 115 kV system shall be 45 ms.

The value of CT's secondary winding resistance (R_{ct}) when determining CT calculation shall be in ohms corrected to 75°C temperature.

3. Voltage transformers –Ratings (IEC 60044-2)

Type	115 kV Voltage Transformer
Rated secondary voltage (V)	115/115/ $\sqrt{3}$ // 115/115/ $\sqrt{3}$
Rated output	
- For protection	50VA – Class 3 P
- For measuring	50VA – Class 0.5
Applicable standard	IEC 60044-2

Notes:

- The ratings and features of VT shown on the above table refer to the minimum requirement for metering and relaying equipment. The Bidder shall be responsible for determining the ratings and features of the VT's as indicated on the above table, should any VT's ratio, accuracy and burdens are not met the requirements for use with each of the protective relays for protection of 115 kV line, transformer, buses, meters and etc. the Bidder shall, to the best of his knowledge, determine the proper ratings and features of each VT to meet the requirement of those protections before submitting the proposal at the time of Bidding.
- Separately mounted adjustable resistors with 5 to 10 Watt range shall be provided to connect across the each set (3 phases) at secondary for both metering and relaying cores at VT junction box for use as VT secondary burden.

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.2 High-Voltage Conductor

Description	Unit	Required	Offered
Manufacturer	-		
Country of origin	-		
Manufacturer's type number	-		
Standards	-	IEC/ANSI	
Segregated-phases	YES/NO		
Rated voltage	kV, r.m.s.	123	
Rated frequency	Hz	50	
Number of phases/class	-	3/indoor	
Rated lightning impulse withstand voltage 1.2/50 us peak value	kV, peak	550	
<ul style="list-style-type: none"> - phase to earth - across open gap - phase to earth at SF₆ pressure 1 bar abs. 			
Rated power-frequency withstand voltage (1 min)	kV, r.m.s.	230	
<ul style="list-style-type: none"> - phase to earth - across open gap - phase to earth at SF₆ pressure 1 bar abs. 			
Rated short-time withstand current (1 s), at 115 kV	kV, r.m.s.	40	
Rated peak withstand current	kV, peak	100	

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.2 High-Voltage Conductor

Description	Unit	Required	Offered
Rated normal current, at 40oC ambient temperature			
- busbar and line bays	A	2,000	
- transformer bays	A	630	
Max. permissible ambient temperature	°C	40	
Temperature rise of contacts and terminals at rated continuous current	K		
Material of enclosure	Aluminium	Aluminium	
Min. wall thickness of enclosure	mm		
Burn through time of enclosure due to internal arc at.....kA	ms		
Material of high-voltage conductor	Copper/aluminium		
Material of contacts	-		
Insulation medium	-	SF ₆	
Gas losses per gas compartment and per year	%	< 1.0	
Permanent SF ₆ gas replenishing required	YES/NO	No	
Min. operation period without recharging SF ₆ gas	Years	10	
Max. permissible moisture content of SF ₆ gas	Vol. %		
Max. permissible air content of SF ₆ gas	-		
Type of filter employed for moisture absorbers	-	Static	
Design lifetime of filter	years		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.2 High-Voltage Conductor

Description	Unit	Required	Offered
Rated SF ₆ gas pressure, at 20°C	bar	Spring loaded cover or bursting disc	
Setting of pressure relief device	bar		
Min. operating pressure at 100% rated withstand voltage	bar		
Signal “Loss of SF ₆ gas” at pressure	bar		
Type of pressure monitors	-		
Type of pressure relief device	-		
Material of pressure relief device	-		
Protection method in case of operation of pressure relief device/material	-		
Number of gas compartment per bay	-		
Mechanical strength of enclosures			
- design pressure	bar		
- operating pressure	bar		
- type test pressure	bar		
- routine test pressure (...min)	bar		
- leakage test pressure (...min)	bar		
- safety factor (type test/operating pressure)	-		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.2 High-Voltage Conductor

Description	Unit	Required	Offered
Expansion joints			
- max. slope	Degree		
- max. expansion cycles	-		
- material of joints	-		
- number of joints	-		
- number layers	-		
- layer thickness	mm		
Method to reduce overvoltage due to induced enclosure current	-		
Type of support insulators	-		
Material of support insulators	-	Cast-resin	
Max. electrical field strength at rated voltage phase to earth	kV/mm		
Test voltage	kV		
Gas-tight barrier type insulator			
- average bursting pressure	bar		
- routine test pressure	bar		
- arcing test 1 sec.	kA		
Heaviest part for crane during maintenance	kg		
Type of crane	-		
Lifting capacity of crane	kg		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.2 High-Voltage Conductor

Description/Characteristics	Unit	Busbars	Line bays	Transformer bays
Manufacturer	-			
Type/shape	-			
Standards	-			
Material	-			
Nominal cross-section of conductor	mm ²			
Rated voltage	kV			
Rated lightning impulse withstand voltage	kV, peak			
Rated 1 min power frequency withstand voltage	kV, r.m.s			
Rated normal current	A			
Rated short-time current density				
Rated short-time current	kA			
Rated short-circuit duration	s			

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.3 Circuit-breaker

Description	Unit	Required	Offered
Manufacturer	-		
Manufacturer's type number	-		
Number of phases/class	-	3/GIS	
Standards	-	IEC/ANSI	
Catalog number (to be attached)	-		
Outline drawing number (to be attached)	-		
Rated voltage	kV	123	
Rated frequency	Hz	50	
Rated current, at 40°C ambient temperature	A	2,000	
Rated lightning impulse withstand voltage	kV, peak	550	
Rated 1 min power-frequency withstand voltage	kV, r.m.s	230	
Rated short-circuit breaking current (symmetrical, r.m.s.), at 115 kV	kA	40	
Rated short-circuit breaking current (asymmetrical, r.m.s.), at 115 kV	kA		
Rated short-circuit making current	kA		
Rated duration of short-circuit	s		
Short-time withstand current, 1 s	kA		
Rated cable-charging breaking current	A		
Max. capacitive breaking current	A		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.3 Circuit-breaker

Description	Unit	Required	Offered
First-pole-to-clear factor	-		
Rated operating sequence	-	0-t-C0-t'-C0	
- with t	s	0.3	
- and t'	s	15	
Operating time			
- closing time	ms		
- dead time	ms		
- total break time	ms		
- make time	ms		
Arcing time max.	ms		
Number of breaks in series (per phase)	-	1	
Arc quenching medium	-	SF ₆	
Rated pressure of SF ₆ for arc quenching, at 20°C	bar		
Setting of pressure relief device	bar		
SF ₆ pressure at which alarm operates at 20°C	bar		
SF ₆ pressure at which lockout operates at 20°C	bar		
Signal "Loss of SF ₆ gas" at pressure	bar		
Type of pressure monitors	-		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.3 Circuit-breaker

Description	Unit	Required	Offered
Gas quantity of circuit-breaker module (3-phase)	kg		
Number of refilling required/years	No./years		
Max. time for de-gassing and re-gassing of circuit-breaker compartment	hours		
Mechanical strength of enclosure			
- design pressure	bar		
- operating pressure	bar		
- type test pressure	bar		
- routine test pressure (...min.)	bar		
- leakage test pressure (...min.)	bar		
- safety factor (type test/operating pressure)	bar		
Operating mechanism			
- for closing	-		
- for opening	-		
Stored operating sequence	-		
Number of close coils per breaker	pcs		
Rated power each	W		
Number of trip coils per breaker	pcs		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.3 Circuit-breaker

Description	Unit	Required	Offered
Rated power each	W	125	
Rated voltage of motor	VDC		
Rated power of motor	W		
Number of auxiliary contacts and type, NO/NC	-		
Type of main contacts	-		
Material of main contacts	-		
Surface treatment	-		
Maximum temperature rise, at.....A	K	5,000	
Life duration of contacts at rated short-circuit breaking current	Number of operations		
Min. number of operations before breaker must be removed from service for maintenance inspection:			
- with no-load	-		
- at rated normal current	-		
- at rated short-circuit current interruption	-		
Min. number of mechanical operations	-		
Excepted number of man-hours required for complete maintenance inspection of one circuit-breaker (incl. Gas handling time)	-		
Static weight, complete set	kg		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.3 Circuit-breaker

Description	Unit	Required	Offered
Dynamic weight, complete set	kg		
Packing detailed drawing number (to be attached)	-		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.4 Disconnecter

Description/Characteristics	Unit	Line bays	Bus sectionalizer and isolating circuit-breaker
Manufacturer	-		
Country of origin	-		
Manufacturer's type number	-		
Characteristics	-		
Standards	-		
Catalog number (to be attached)	-		
Outline drawing number (to be attached)	-		
Rated voltage	kV		
Rated frequency	Hz		
Rated normal current, at 40°C ambient temperature	A		
Rated breaking current	kA		
Rated lightning impulse withstand voltage 1.2/50 us			
- to earth	kV, peak		
- across isolating distance	kV, peak		
Rated power-frequency withstand voltage, 1 min			
- to earth	kV, r.m.s.		
- across isolating distance	kV, r.m.s.		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.4 Disconnecter

Description/Characteristics	Unit	Line bays	Bus sectionalizer and isolating circuit-breaker
Rated short-time withstand current, 1 sec.	kA		
Rated duration of short-circuit	s		
Rated peak withstand current	kA, peak		
SF ₆ rated operation pressure	bar		
SF ₆ filling pressure	bar		
Pressure at which alarm operates	bar		
Type of contacts	-		
Base material and specification	-		
Surface treatment	-		
Temperature rise at.....A	K		
Number of switch-off operations between two inspections for changing the main contacts	-		
Operation mechanism			
- for closing	-		
- for opening	-		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.4 Disconnecter

Description/Characteristics	Unit	Line bays	Bus sectionalizer and isolating circuit-breaker
Operating time			
- for closing	s		
- for opening	s		
Number of auxiliary contacts, NO/NC	-		
Rated voltage of motor	VDC		
Rated power of motor	W		
Recommended maintenance period	-		
Manual emergency operation	YES/NO		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.5 Earthing Switch

Description/Characteristics	Unit	High-speed motion	Slow motion
Manufacturer	-		
Country of origin	-		
Manufacturer's type number	-		
Number of poles	-		
Standards	-		
Catalog number (to be attached)	-		
Outline drawing number (to be attached)	-		
Rated voltage	kV		
Rated frequency	Hz		
Rated lightning impulse withstand voltage	kV, peak		
Rated power frequency withstand voltage, 1 min	kV, r.m.s.		
Rated short-circuit making current	kA		
Guaranteed number of short-circuit making operations	-		
Rated short-time withstand current, 1 s	kA		
Rated peak withstand current	kA		
Rated SF ₆ gas pressure	bar		
SF ₆ filling pressure	bar		
SF ₆ pressure at which alarm operates	bar		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.5 Earthing Switch

Description/Characteristics	Unit	High-speed motion	Slow motion
Type of main contacts			
Material	-		
Surface treatment	-		
Temperature rise, at.....A	K		
Operating mechanism			
- for closing	-		
- for opening	-		
Method of interlocking	-		
Operating time			
- for closing	ms		
- for opening	ms		
Charging time	S		
Number of auxiliary contacts, NO/NC	-		
Rated power of motor	W		
Rated voltage of motor	VDC		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.5 Earthing Switch

Description/Characteristics	Unit	High-speed motion	Slow motion
<u>Interrupting capability</u>			
<u>Inductive current</u>			
Interrupting current	A		
Recovery voltage	V		
<u>Capacity current</u>			
Interrupting current	A		
Recovery voltage	V		
Recommended maintenance interval	Years		
Gas quantity of complete earthing switch (3-phase)	kg		
Manual emergency operation facilities	YES/NO		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.6 Current Transformer

Description/Characteristics	Unit	Busbars	Line bays	Transformer bays
Manufacturer	-			
Country of origin	-			
Manufacturer's type number	-			
Number of poles	-			
Standards	-			
Catalog number (to be attached)	-			
Outline drawing number (to be attached)	-			
Type of current transformer	-			
Rated voltage	kV			
Rated frequency	Hz			
Rated lightning impulse withstand voltage (1.2/50 us full wave) of primary winding	kA, peak			
Rated power-frequency withstand voltage, one-minute dry, of primary winding	kA, r.m.s.			
Rated primary current	A			
Rated-short time thermal current (1 s)	kA			
Rated dynamic current	kA, peak			

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.6 Current Transformer

Description/Characteristics	Unit	Busbars	Line bays	Transformer bays
Rated continuous thermal current in percentage of rated primary current	%			
Class of insulation and material	-			
Maximum temperature rise, at.....A	K			
Current ratio	-			
Number of cores	-			
Measuring core				
- rated burden	VA			
- accuracy class	-			
- overcurrent factor	-			
Protection core				
- rated burden	VA			
- accuracy class	-			
- overcurrent factor	-			
Net weight	kg			

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.7 Voltage transformer

Description/Characteristics	Unit	Line bays	Transformer bays
Manufacturer	-		-
Country of origin	-		-
Manufacturer's type number	-		-
Number of phases	-		-
Standards	-		-
Catalog number (to be attached)	-		-
Outline drawing number (to be attached)	-		-
Type of voltage transformer	kV		-
Rated voltage	kV		-
Rated frequency	Hz		-
Rated lightning impulse withstand voltage of primary side	kV, peak		-
Rated power frequency withstand voltage one-minute, of primary side	kV, r.m.s.		-
Rated primary voltage	kV		-
Rated secondary voltage	V		-

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.7 Voltage transformer

Description/Characteristics	Unit	Line bays	Transformer bays
<u>Measuring core</u>			
- rated output	VA		-
- accuracy class	-		-
- rated voltage factor	-		-
<u>Protective core</u>			
- rated output	VA		-
- accuracy class	-		-
- rated voltage factor	-		-
Class of insulation and material	-		-
Maximum temperature rise at.....A	K		-
SF ₆ gas volume			
SF ₆ filling weight	kg		-
Net weight of voltage transformer	kg		-

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.8 Load-break switch, if any

Description	Unit	Required	Offered
Manufacturer	-		
Country of origin	-		
Manufacturer's type number	-		
Standards	-		
Catalogue number	-		
Outline drawing number	-		
Rated voltage	kV	123	
Rated frequency	Hz	50	
Rated normal current	A		
Rated lightning impulse withstand voltage	kV, peak		
- to ground and between poles			
- across isolating distance			
Rated power frequency withstand voltage, one-minutes	kV, r.m.s.		
- to ground and between poles			
- across isolating distance			
Rated capacitive switching current	A		
Rated inductive switching current	A		
Rated making current	kA		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.8 Load-break switch, if any

Description	Unit	Required	Offered
Rated short-time current	kA	SF ₆	
Opening time	ms		
Make time	ms		
Break time	ms		
Stored operating sequence	-		
Arc quenching medium	-		
Setting of pressure relief device	bar		
Rated SF ₆ gas pressure	bar		
SF ₆ filling pressure	bar		
SF ₆ pressure at which alarm operates	bar		
SF ₆ pressure at which lockout operates	bar		
Signal “Loss of SF ₆ gas” at pressure	bar		
Type of pressure monitors	-		
Distance between pole centers	mm		
Bay width	mm		
Gas quantity of load break switch module (3-phase)	kg		
No. of refilling required/years	No./years		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.8 Load-break switch, if any

Description	Unit	Required	Offered
Max. time for de-gassing and re-gassing of load break switch compartment	-		
Mechanical strength of enclosure	-		
- design pressure	bar		
- operating pressure	bar		
- type test pressure	bar		
- routine test pressure (.....min.)	bar		
- leakage test pressure (.....min.)	bar		
- safety factor (type test/operating pressure)	-		
Operating mechanism			
- for closing	-		
- for opening	-		
Stored operating sequence	-		
Rated operating pressure of hydraulic oil	bar		
Setting of safety valve	bar		
Lowest oil pressure at which lockout operates	bar		
Rated power of hydraulic pump (each)	W		
Rated operating pressure of air	bar		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.8 Load-break switch, if any

Description	Unit	Required	Offered
Air consumption for CLOSE	-		
Air consumption for OPEN	-		
Air leakage within load-break switch	-		
Setting of safety valve	bar		
Lowest air pressure at which lockout operates	bar		
Number of making coils per switch	pcs		
Rated power each	W		
Number of trip coils per switch	pcs		
Rated power each	W		
Rated voltage of motor	VDC	125	
Rated power of motor	W		
Number of auxiliary contacts and type, NO/NC	-		
Type of main contacts	-		
Material	-		
Surface treatment	-		
Maximum temperature rise, at.....A	K		
Life duration of contact at rated short-circuit breaking current	Number of operations		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.8 Load-break switch, if any

Description	Unit	Required	Offered
Min. number of operation before load break switch must be removed from service for maintenance inspection:			
- with no load	-		
- at rated normal current	-		
- at rated short-circuit current interruption	-		
Min. number of mechanical operations	-		
Excepted number of man-hours required for complete maintenance inspection of one load break switch (incl. Gas handling time)	Man-hours		
Static weight, complete set	kg		
Dynamic weight, complete set	kg		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.9 Air-to-SF₆-Bushing

Description	Unit	Required	Offered
Manufacturer	-		
Country of origin	-		
Manufacturer's type number	-		
Standards	-		
Insulator material	-		
Rated voltage	kV	123	
Rated current	A		
Rated frequency	Hz	50	
Rated power-frequency withstand voltage, one-minute	kV, r.m.s.		
Rated impulse-withstand voltage	kV, peak		
Rated short-time current	kA		
Rated impulse current	kA		
Creepage distance	cm/kV		
Cantilever strength	N		
Admissible bending load at terminal	N		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.10 SF6 gas monitoring cubicle

Description	Unit	Required	Offered
Material	-		
Thickness of material	mm		
Surface finish thickness	mm		
Number of gas compartments to be supervised	-		
Location of erected cubicle	-		
Weight	kg		
Dimensions (length, width, height)	mm		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.11 Compressed air system

Description	Unit	Required	Offered
Volume of pressure tank	l		
Rated storage pressure	bar		
Number of Compressors	-		
Delivery capacity of one compressor	l/min		
Rated voltage of motor	VAC		
Rated power of motor	W		
Air consumption of dryer	l/min		
Setting of safety valve	bar		
Leakage air per day	l		
Weight of complete unit	kg		
Dimensions (width, depth, height)	mm		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.12 Hydraulic aggregate cubicle

Description	Unit	Required	Offered
Material	-		
Thickness of material	mm		
Surface finish thickness	micron		
Net weight	kg		
Dimensions (length, width, height)	mm		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.13 Surge Arrester

Description	Unit	Required	Offered
Manufacturer	-		
Manufacturer's type number	-		
Standards	-	IEC, ANSI	
Maximum rated voltage	kV		
Rated frequency	Hz	50	
Rated discharge current	kA		
Type of duty	-	Heavy duty	
Discharge class (According to IEC)	-		
Pressure relief class	-	Class A	
Maximum resealing voltage	kV		
High impulse current	kA	100	
Minimum long duration current (rectangular wave)			
- current	A		
- virtual duration of peak	us		
- residual voltage	kV		
Minimum power frequency sparkover voltage at 50 Hz	kV (r.m.s.)		
Maximum front-of-wave impulse sparkover voltage	kV (peak)		
Maximum switching surge sparkover voltage (peak)	kV (peak)		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.13 Surge Arrester

Description	Unit	Required	Offered
Maximum residual voltage (wave 8/20 us)			
- at 5 kA discharge current	kA		
- at 5 kA discharge current	kA		
- at 5 kA discharge current	kA		
Filling medium (air no nitrogen)	-		
Insulation of arrester external assembly			
- BIL (1.2/50 us full wave)	kV (peak)		
- switching surge withstand voltage (250/3,000 us full wave)	kV		
- impulse withstand voltage (1.2/50 us chopped wave)	kV		
- power frequency withstand voltage (10 s wet)	kV (r.m.s.)		
Creepage distance	cm/kV		
Earthquake factor	-		
Overall dimensions of arrester as per Drawing No.....			
- length	mm		
- width	mm		
- height	mm		
Weight of complete arrester	kg		
Number of attached foundation drawings	-		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.13 Surge Arrester

Description	Unit	Required	Offered
Number of attached type test reports	-		
Erection time at site	days		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.14 Travelling crane

Description	Unit	Required	Offered
Manufacturer	-		
Country of origin	-		
Manufacturer's type number	-		
Standards	-		
Working load	tons		
Lifting height	m		
Lifting speed	m/min		
Power supply	-	Single-phase or three-phase 230/400 VAC 50 Hz	

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.15 Local control cubicle

Description	Unit	Required	Offered
Material	-		
Manufacturer	-		
Type	-		
Standards	-		
Protection degree	IP		
Material	-		
Sheet thickness	mm		
Surface finish and thickness	micron	50	
Dimensions			
- length	mm		
- width	mm		
- height	mm		
Net weight	kg		

Annex 1

Invitation to Bid No. :

Manufacturer :

Specification No. : RPRO-051/2562

Bidder :

Performance data and guarantee of

a.16 Remote control cubicle

Description	Unit	Required	Offered
Material	-		
Manufacturer	-		
Type	-		
Standards	-		
Protection degree	IP		
Material	-		
Sheet thickness	mm		
Surface finish and thickness	micron		
Dimensions			
- length	mm		
- width	mm		
- height	mm		
Net weight	kg		