



DELHI METRO RAIL CORPORATION LIMITED

***DMRC ELECTRICAL STANDARDS &
DESIGN WING (DESDW)***

**SPECIFICATION NO.
DMES – 0006/DMRC-E-TR-GIS-01**

**SPECIFICATIONS FOR 66 KV GAS INSULATED
SWITCHGEAR**

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1. 66KV GAS INSULATED SWITCHGEAR (GIS)

1.1 SCOPE OF WORK

The scope of work comprises of design, manufacture, shop testing, supply, delivery at site, installation, testing and commissioning of 3-phase, 66 kV (Rated voltage 72.5 kV), 2000A, 31.5kA Gas insulated indoor type receiving sub-station. The supply will include all supporting structures, auxiliary equipments, mechanical linkages, hydraulic piping for control devices with pumps, SF6 gas piping, auxiliary circuits wiring, interlocking devices, current and voltage transformers, cable end boxes and SF6 bus ducts. Necessary sub-assemblies must be assembled in the supplier's plan, accounting for the transportation condition. The scope of work includes the following (but not limited to):

1.1.1. Each Incomer Bay (2 Nos.) consisting of;

- Circuit Breaker – 1 No.
- Current Transformer – 1 No.
- Maintenance Earth Switch – 1 No.
- Line Disconnecter – 1 No.
- Line Earth Switch (Fast acting)
- Voltage Transformer with motor operated isolation device of rated insulation
- Indoor lightning arrester
- Bus Disconnecter Switch – 2 Nos.
- Bus end Maintenance earth Switch – 1 No.
- Other items as required for connection to the two bus bars, 66 kV incoming cables through lightning arrester and for completing the intent of work

1.1.2. Each Transformer Feeder Bay (4 Nos.) consisting of;

- Circuit Breaker – 1 No.
- Current Transformer – 1 No.
- Maintenance Earth Switch (Tr. Side)
- Maintenance Earth Switch (Bus Side) – 1 No.
- Bus Disconnectors – 2 Nos.
- Outdoor lightning arrester
- Other items as required for connection to bus bars, cables etc. and for completing the intent of work

1.1.3. Each Bus Coupler Bay (1 No.) consisting of;

- Circuit Breaker – 1 No.
- Current Transformer – 2 Nos.
- Bus Disconnectors & Earth Switch – 2 Nos.
- Other items as required for connection to bus bars, cables etc. and for completing the intent of work

1.1.4. Each Bus VT Module (2 No.) consisting of;

- Voltage Transformer – 1 No.

- Bus Earthing Switch – 1 No.

1.5. Bus bars for double bus arrangement.

1.6. New Gas charging equipment with gas cylinders for each set of the newly constructed GIS substation covered in the scope of work - After commissioning this will become property of Employer. The contractor would be required to hand over them in proper working condition with enough gas for one charging of complete system.

1.7. EOT crane with VVVF drive for continuous operation for GIS equipment handling during installation, commissioning and maintenance etc. Crane lifting capacity shall be adequate to handle the heaviest package of GIS but shall not be less than 5 tonnes.

1.8. Supply, erection, testing and commissioning of all items of work required to make the HV bays (66 kV) fully functional.

1.2 MAIN FEATURES REQUIRED

1.2.1 The 66 kV equipment shall be built according to the SF6 gas insulation technology.

1.2.2 66KV GIS as offered should be fully type tested as per latest IEC standards at the time of submitting the bid. The bidder would be required to submit the detailed type test reports as per latest IEC standards in the event of an order.

1.2.3 The equipment installed shall offer all necessary facilities for equipping and connecting the equipments sections to follow, without entailing any shut down of equipment already in service.

1.2.4 In the event of arching in a compartment, the arches should not extend to the neighboring compartment. Any failure to the enclosure of the compartment shall not lead to damages in the neighboring compartments.

1.2.5 Suitable means of expansions should be provided in the metal enclosure and pipelines to absorb the actual thermal expansion and contraction of the SF6 equipment and to facilitate the alignment of switchgear assembly.

1.2.6 Internal insulation level between live parts and earth when the pressure of the gas goes to the atmospheric pressure should not be less than $1.2 \times 66 / 1.732 \text{ kV}$.

1.2.7 The metal enclosures for the SF6 gas insulated equipment modules shall be made from aluminum alloy.

1.2.8 GIS should be of modular design, and it should be possible to add feeder bays for two additional transformers, if required. The layout of GIS equipments and transformers should show space earmarked for the future provision.

1.2.9 GIS supplier should have minimum 5 years experience in design and manufacturing of similar GIS substations. This shall be explained in tenderer's technical proposal (ref. B8/Annexure 4 to ITT). The tenderer will be required to

explain availability of spares and service from technically trained manpower in terms of B6/Annexure 4 to ITT.

- 1.2.10** The incoming 3 phase 66 kV single core cable feeders shall be of minimum size of 800 mm² (Copper)/1200 mm² (Aluminium). The termination arrangement shall however be designed for two such cables, so that additional cables can be terminated later, if required. The outgoing connections from GIS shall be in gas filled enclosure, designed in such a way that vibration from GIS equipment and transformer are not transmitted to each other. The transformer feeder bays should have termination arrangements suitable for cable cross-section required as per current requirements of transformer. The terminations at transformers shall be of normal outdoor type with suitable cable connection from the GIS.
- 1.2.11** The Disconnectors and earthing switches shall be electrically and mechanically interlocked against mal-operation. Feeder earthing switch shall be fast acting type and isolated from earthed enclosures and shall permit testing of switchgear. It shall also be possible to carryout high voltage testing of cable cores without having to open the breaker assembly or SF6 chamber without disconnecting the cables. Suitable adapter for such testing should be provided. This adapter is to be quoted as a separate BOQ item in Item No. 31, Annexure-B: List of tools. For other routine maintenance also, dismantling of switchgear should be required.
- 1.2.12** The conductors/bus bars shall be of copper/ Aluminium and enclosure shall be made of Aluminium Alloy.
- 1.2.13** The gas barrier insulators shall withstand 1.5 times maximum rated pressure on one side and vacuum on the other side. All fixtures or nuts or instruments whose maintenance / opening would leak the SF6 gas should be clearly ear marked and distinctly identifiable.
- 1.2.14** All gas sampling shall be possible during normal operation and without loss of gas.
- 1.2.15** Loss of gas per annum shall not exceed 1% by weight in each compartment.
- 1.2.16** Adequate burden capacity shall be available in instrument transformers to permit provision of additional test, protection on measuring instruments. The instrument transformer shall have separate metering cores to permit measurement of values of energy, power, current and voltage as per required accuracy, giving due consideration to the fact that load during initial stages may be much lower than designed capacity. The instruments shall also be sized and positioned so that a 5'-5'-6" height operator can read the instrument without additional support.
- 1.2.17** Clear visual indication of isolator and earthing switch, switch blade position, whether open or closed shall be provided.
- 1.2.18** Each component shall be modular and complete with ancillary equipment.

- 1.2.19** Circuit breaker shall be of single pressure interrupter. The moving and fixed contacts shall be housed in the same interrupter chamber without any split so as not to affect the synchronism of three phases. The Operating Mechanism for the circuit breaker shall be Spring/Spring or to give highest reliability to the system, following loss of supply voltage the operating mechanism shall have local storage sufficiency for a duty cycle of O-CO without the need for recharging. The circuit breakers shall be provided with an “anti-hunting” coil for all commands going to the switchgear. All interlock and automatic systems within the actuation system shall be designed so that the circuit breaker executes operations only when it is in a position enabling to do so completely and reliably.
- 1.2.20** The isolators shall be fitted with a suitable actuation system operating simultaneously on all three poles, backed up by an emergency manual actuation in case of malfunction of the former. The isolators shall not change of position under the effect of electro dynamic loads.
- 1.2.21** In case of any internal arc fault – regardless whether it occurs in a bus bar section, a busbar isolator or the circuit breaker-repair works should be possible without shutting down the substation; at least one busbar and the undisturbed feeder should remain in operation. It should be possible to remove and replace a fully assembled circuit breaker without interfering the operation of the adjacent feeder. All circuit breakers should be interchangeable.
- 1.2.22** The GIS equipments shall be arranged in such a manner that in case of maintenance work on any of the equipment, at least one bus bar should be available for operation.
- 1.2.23** Each bay shall be segregated from its neighbor bays by means of gas tight barrier insulators to ensure that in case of an internal arc the fault will be restricted to the concerned bay.
- 1.2.24** The Local Control Cubicles shall be integrated with the GIS and should house IEC 61850 compliant Bay Control Unit (BCU) which should be SCADA compatible. Free standing LCC with conventional system for monitoring and indication shall not be accepted.
- 1.2.25 Following accessories shall be provided for each compartment.**
- a) Pressure relief devices.
 - b) Provision of desiccants.
- 1.2.26 Monitoring of Gas in the enclosure:**
- Each gas compartment should have its own SF6 pressure monitoring facilities as well as static filters. Pressure relief devices shall be designed to limit maximum pressurize below the busting level of the enclosure and

barrier insulation. Instrument shall be provided to continuously monitor the Gas density.

1.2.27 The protection devices for this equipment shall ensure permanent monitoring of gas pressure inside each compartment by means of temperature compensated monitoring devices triggering a dual alarm threshold annunciation system in the event of gas pressure drops:

Stage 1: Performance of the station is unaffected, in particular cut-off capabilities remain intact. Immediate intervention by the specialist is not necessary, but recommended.

Stage 2: The dielectric properties of the station in the presence of occurring over voltage shall be such that all the necessary isolating operations still remain possible without any danger nor any accident taking place. In case of drop of pressure below minimum level, the concerned breaker should trip and then lock.

1.2.28 The inter bay width shall be sufficient to allow access to all drive mechanisms and other termination boxes without the need of dismantling other apparatuses.

1.2.29 The design of the cable termination shall allow plugging and unplugging the HV cable without need of opening the GIS and without any gas work.

1.2.30 Governing Specifications:

The complete GIS equipment shall meet the requirements of latest versions of IEC/International standards/specifications, a few of these are indicated below:

CENELEC EN 62155: Standards for pressure vessel construction

IEC 62271-203: Gas insulated metal enclosed switchgear for rated voltage of 72.5 kV and above.

IEC 62271-1 : Common specifications for high voltage switchgear and control gear standards.

IEC 60137: Insulated bushings for alternating voltage above 1000 volts.

IEC 60044 Instrument transformers.

IEC 62271-100: High voltage alternating current circuit breaker.

IEC 62271-102: AC disconnecter and earth switch

IEC 60480: Guide to checking of SF6

IEC 61634: Use handling of SF6

IEC 60859: Cable connector for GIS

1.2.31 All rating and requirements not covered in this part but furnished earlier in this specification in regard to circuit breakers, isolators, earthing switches and instrument transformers also apply to GIS equipment.

1.2.32 Tests

- a) The modules individually as well as the assembly shall be subject to various test, including type test, as required in terms of provisions of Chapter – 9 of “Employer’s Requirements – General Specifications” prior to shipment.
- b) Site tests shall include leakage tests, moisture contents in dielectric and power frequency test to ensure conducting particles present in the Gas are below permissible limits. These limits shall be furnished by the Contractor.

1.2.33 Earthing

Entire metallic enclosure shall be bonded together and effectively earthed.

1.2.34 Other equipment.

Main intake power transformers, Earthing system, lighting protection, illumination arrangement etc. Shall comply with the relevant stipulations of Outdoor type RSS. The control, monitoring, logging etc shall be identical to the outdoor type RSS.

1.2.35 Transportation, shipment and storage of GIS equipment shall be as per international practice/standards.

1.2.36 The 25 kV side equipments will be outdoor type. The 33 kV equipments will be housed inside AMS building. These will be as per specification indicated elsewhere in the tender.

1.3 TECHNICAL SPECIFICATION

- 1) Enclosure type : Three-phase enclosure
- 2) Rated voltage : 72.5 kV rms
- 3) Rated frequency : 50 Hz
- 4) Rated current of bus bar : 2000 A rms
- 5) Rated insulation
 - a) Power frequency withstand voltage : 140 kV rms
 - b) Lightning impulse withstand voltage : 325 kV rms
- 6) Rated short-time current : 31.5 kA rms, 3 sec
- 7) Peak withstand current : 80 kA peak
- 8) Guaranteed SF₆gaslosses per year : Lessthan 1%

2. DATA SHEET

2.1 66 KV CIRCUIT BREAKER (GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 62271-1 , IEC 62271-100, 62271-203
Type		INDOOR
Substation type		GIS
Phase number		3
Rated frequency	Hz	50
Rated insulation voltage	kV	72,5
Operating voltage	kV	66
Rated short duration power frequency withstand voltage	kV r.m.s.	140
Rated lightning impulse withstand voltage	kV peak	325
Rated short duration power frequency withstand voltage across isolating distance	kV r.m.s.	160
Rated lightning impulse withstand voltage across isolating distance	kV peak	375
Rated current	A	2000
Rated short-time withstand current (3 seconds)	kA r.m.s.	31.5
Rated peak withstand current	kA peak	80
Breaking capacity	kA r.m.s	31.5
Making capacity	kA peak	80
Breaking mode:		SF6
Rated operating cycle		O-CO-CO
Rated auxiliary voltage	Vdc	110
Out of load transformer current breaking capacity	A	
Operating times		
- Opening actuation from current emission on the release coil up to	ms	<60
- Separation of contacts (opening time)	ms	
- Extinguishing of primary arc (breaking time at rated breaking capacity)		

2.2 66 KV ISOLATOR(GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 62271-1, 62271-102, 62271-203
Type		INDOOR
Substation type		GIS
Number of phases		3
Two rotating columns		Yes
Rated frequency	Hz	50
Rated insulation voltage	kV	72,5
Operating voltage	kV	66
Rated short duration power frequency withstand voltage	kV r.m.s.	140
Rated lightning impulse withstand voltage	kV peak	325
Rated short duration power frequency withstand voltage across isolating distance	kV r.m.s.	160
Rated lightning impulse withstand voltage across isolating distance	kV peak	375
Insulation medium		SF6
Rated current	A	2000
Rated short-time withstand current (3 seconds)	kA r.m.s.	31.5
Rated peak withstand current	kA peak	80
Rated auxiliary voltage	Vdc	110
Rated control motor auxiliary voltage	Vdc	110
2) EARTHING ISOLATOR		
Electrical values		As above
Making capacity		Yes

2.3 66 KV CURRENT TRANSFORMER CTIM-X(GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60044-1, 60517
Type		Indoor
Type of substation		GIS
Number of phases		3
- Rated insulation voltage	kV	72,5
- Operating voltage	kV	66
- Rated frequency	Hz	50
Rated short duration power frequency withstand voltage	kV r.m.s.	140
Rated lightning impulse withstand voltage	kV peak	325
Insulation medium		SF ₆
- SF6 rated pressure	MPa	
- SF6 minimum pressure	%	
- SF6 maximum pressure	%	
- Secondary Cores	Core 1 (Protection)	1600-800/1A 20VA, 5P20
	Core 2 (Protection)	1600-800/1A 50VA, 5P20
	Core 3 (Protection)	1600-800/1A 20 VA, 5P20
	Core 4 (Measurement)	1600-800- 400-200/1 A CL 0.2, 15 VA
	Core 5 (Measurement)	1600-800- 400-200/1 A CL 0.2, 15 VA
Actual transformation ratio	A	
Accuracy class		0,5
Rated output	VA	20
Short-circuit current allowable for 3 seconds	kA	31.5
Permanent operation without danger	In	
Overheating	In	
Over-current class		
Total weight	kg	
Overall dimension of one element		
Degree of protection for auxiliary circuit		

2.4 66 KV CURRENT TRANSFORMER CTC(GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60044-1, 60517
Type		Indoor
Type of substation		GIS
Number of phases		3
- Rated insulation voltage	kV	72,5
- Operating voltage	kV	66
- Rated frequency	Hz	50
Rated short duration power frequency withstand voltage	kV r.m.s.	140
Rated lightning impulse withstand voltage	kV peak	325
Insulation medium		SF ₆
- SF6 rated pressure	MPa	
- SF6 minimum pressure	%	
- SF6 maximum pressure	%	
- Secondary Cores	Core 1 (Protection)	1600-800/1A 20VA, 5P20
	Core 2 (Protection)	1600-800/1A 50VA, 5P20
Actual transformation ratio	A	
Accuracy class		5P20
Rated output	VA	50
Short-circuit current allowable for 3 seconds	kA	31.5
Permanent operation without danger	In	
Overheating	In	
Over-current class		
Total weight	kg	
Overall dimension of one element		
Degree of protection for auxiliary circuit		IP55

2.5 66 KV CURRENT TRANSFORMER CTATP-X(GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60044-1, 60517
Type		Indoor
Type of substation		GIS
Number of phases		3
- Rated insulation voltage	kV	72,5
- Operating voltage	kV	66
- Rated frequency	Hz	50
Rated short duration power frequency withstand voltage	kV r.m.s.	140
Rated lightning impulse withstand voltage	kV peak	325
Insulation medium		SF6
- SF6 rated pressure	MPa	
- SF6 minimum pressure	%	
- SF6 maximum pressure	%	
- Secondary Cores	Core 1 (Protection)	600-300/1A 50VA, 5P20
	Core 2 (Protection)	600-300/1A 50VA, 5P20
	Core 3 (Protection)	600-300/1A 50 VA, 5P20
Actual transformation ratio	A	600-300/1
Accuracy class		5P20
Rated output	VA	50
Short-circuit current allowable for 3 seconds	kA	31.5
Permanent operation without danger	In	
Overheating	In	
Overcurrent class		
Total weight	kg	
Overall dimension of one element		
Degree of protection for auxiliary circuit		I

2.6 66 KV CURRENT TRANSFORMER CTTTP-X(GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60044-1, 60517
Type		Indoor
Type of substation		GIS
Number of phases		3
- Rated insulation voltage	kV	72,5
- Operating voltage	kV	66
- Rated frequency	Hz	50
Rated short duration power frequency withstand voltage	kV r.m.s.	140
Rated lightning impulse withstand voltage	kV peak	325
Insulation medium		SF6
- SF6 rated pressure	MPa	
- SF6 minimum pressure	%	
- SF6 maximum pressure	%	
- Secondary Cores	Core 1 (Protection)	1600- 800/1A 50VA, 5P20
	Core 2 (Protection)	1600- 800/1A 50VA, 5P20
	Core 3 (Protection)	1600- 800/1A 50VA, 5P20
Actual transformation ratio	A	800-400/1
Accuracy class		5P20
Rated output	VA	50
Short-circuit current allowable for 3 seconds	kA	31.5
Permanent operation without danger	In	
Overheating	In	
Overcurrent class		
Total weight	kg	
Overall dimension of one element		
Degree of protection for auxiliary circuit		

2.7 66 KV VOLTAGE TRANSFORMER VTI-X AND VTC-X (GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60186, 62271-203
Type of voltage transformer		capacitive
Type		Indoor
Type of substation		GIS
- Primary insulation voltage	kV	72,5
- Operating voltage	kV	66
- Rated frequency	Hz	50
- Rated short-time duration power frequency withstand voltage	kV	140
- Rated lightning impulse withstand voltage	kV	325
Actual transformation ratio		$66/\sqrt{3}$
- Primary winding	kV	
- Secondary winding	V	$110/\sqrt{3}$
Accuracy class		0.2
Rated output at power factor 0,8 lagging	VA	200
Total weight	kg	
Overall dimension of one element		
Degree of protection for auxiliary circuit		

2.8 66 KV SURGE ARRESTER LA (GIS)

INDICATIONS	U	VALUES Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standard		IEC 60099-4
Type of substation		GIS
Type		Indoor
Surge arrester type		
Rated system voltage	kV	66
Rated voltage for surge arrester	kV	60
Permanent voltage	kV	47
Nominal discharge current	kA	20
Discharge class		3
Energy absorbs in 2 shoks	kJ/kV	8

3. TEST SHEET

INDICATIONS	TYPE of TEST			
	Type	Routine	On site	Specials
As per relevant IEC mentioned in specifications	x	x	x	x

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