NPS/003/024 – Technical Specification for 66kV & 132kV SF_6-free Indoor Gas Insulated Switchgear

1. Purpose

This document provides the technical specification for 66kV and 132kV gas insulated switchgear (GIS), and supersedes the following documents, all copies of which should be removed from circulation.

Document Reference	Document Title	Version	Published Date
NPS/003/024	Technical Specification for 66kV & 132kV Gas Insulated Switchgear	2.0	Feb 2016

2. Scope

This specification covers the technical requirements for 66kV and 132kV SF_6-free indoor Gas Insulated Switchgear (GIS) for use on the Northern Powergrid (NPg) distribution network. It will be necessary to consider and include any project specific requirements as detailed in Appendix 2, Addendum to Supplier Requirements.

2.1. Table of Contents

3. Technical Requirements

3.1. General Requirements

Switchgear and switchgear components shall comply fully with the requirements of the latest version of Electricity Network Association Technical Specification (ENATS) 41-37 Parts 1-4 and the latest versions of the standards and regulations to which ENA TS 41-37 refers.

Switchgear shall preferably have been assessed by the ENA Switchgear Assessment Panel (SAP) and have been awarded an ENA Notice of Conformity (NOC); this shall be confirmed by the Supplier. For products that do not have a NOC, in addition to the self-declaration in Appendix 1, manufactures are required to submit completed self-declarations from ENA TS 41-37 (Parts 1 to 4).

Appendix 1 of this document states Northern Powergrid's specific requirements where options are given within ENATS 41-37, where the requirements of ENATS 41-37 have been supplemented, or where it is felt necessary to reinforce the requirement. Manufactures are requested to complete the self-declaration column within this table.

Appendix 2 contains an Addendum to Supplier Requirements which lists project specific requirements.

3.2. Application

This specification applies to switchgear for indoor applications.

3.3. Rated Voltage

The rated voltage shall be either 72.5kV or 145kV as specified for the specific project.

3.4. Insulation Level

The rated insulation levels shall be as specified in Appendix 1 corresponding to the specified rated voltage.

3.5. Current Rating: 400/132kV & 275/132kV Substations

132kV Switchgear	Normal Rated Current	Bus Bar	Break Rating @ time constant of 45ms	Break Rating @ X/R time constant of 120ms
Transformer CB	2000A	2000A	40kA	31.5kA
Bus Section & Bus Coupler CB	2000A	2000A	40kA	31.5kA
Feeder CB	800A or 1250A	2000A	40kA	31.5kA

3.6. Current Rating: 275/66kV & 132kV/66kV Substations

66kV Switchgear	Normal Rated Current	Bus Bar	Break Rating @ time constant of 45ms	Break Rating @ time constant of 120ms
Transformer CB	2000A	2000A	40kA	31.5kA
Bus Section & Bus Coupler CB	2000A	2000A	40kA	31.5kA
Feeder CB	1250A	2000A	40kA	31.5kA

3.7. Rated Peak and Short Time Withstand Currents

Withstand capability shall be as specified in Appendix 1.

3.8. Transient Recovery Voltages

Transient Recovery Voltages shall be in accordance with BS EN IEC 62271-100 with the first pole to clear factor of 1.3 for all test duties. Transient recovery voltages related to the rated circuit breaking currents shall be as specified in BS EN IEC 62271-100 7.103.5.

3.9. Circuit Breaker Rated Operating Sequence

The rated operating sequence shall be 0 – 0.3s – CO – 3min – CO.

3.10. Circuit Breaker Rated Capacitance Switching Current

The circuit breaker shall be classified as Class C2 as defined in BS EN IEC 62271-100 6.107.4 and shall be rated to switch capacitive current as stated in BS EN IEC 62271-100 5.106.1: Table 1.

3.11. Mechanical Endurance

Circuit breakers shall be rated Class M2.

3.12. Electrical Endurance

Circuit breakers shall be rated Class E2.

3.13. Auxiliary and Control Equipment

Auxiliary and control equipment shall be operated at 110V DC and will generally comply with section 5.4 of ENATS 41-37.

CT secondary terminals shall be of the spring loaded or cage clamp design, or spring washer on stud design.

Secondary terminals for CT bus wiring shall have a shorting/disconnecting facility.

Auxiliary switches used in CT circuits shall be suitable for CT switching duties in accordance with IEC 62271-1 6.4.3.4.5 Table 8: Class 1 (10A).

Secondary terminals for SCADA wiring shall be of the knife disconnecting type and be equipped with 2.3mm test sockets. All other terminals shall be capable of accepting 4mm test plugs.

3.14. Internal Wiring

Local control cubicle (LCC) heaters and lighting shall be supplied by 110V AC. 110V AC/110V DC wiring shall be white in colour. AC supplies within the LCC shall be shrouded.

Terminal types shall be as follows:

Function	Type
AC/DC Terminal Blocks	Weidmuller type WDU6SL or equivalent
CT/VT Terminal Blocks	Weidmuller type WDU10SL or equivalent
Supply Terminal Blocks	Weidmuller type WDU10SL or equivalent

Wiring for CT circuits shall have a cross-sectional area of 2.5mm^2.

Hooked blade crimps shall be used for all internal wiring; the use of bootlace crimps is not preferred and where unavoidable, their use shall be approved with NPg on a case-by-case basis.

Multiple wires connected by a single crimp is not acceptable.

3.15. Voltage Transformers

Voltage transformers shall be in accordance with BS EN 61869-3, as expanded or modified in Appendices 1 and 2 of this document.

Voltage Transformers shall have primary isolation links to facilitate the removal of VTs from the circuit for testing without the need for de-gassing.

VT secondary windings shall be capable of being readily disconnected and isolated from ground for testing purposes. Removable fuse carriers shall be provided in an accessible location (≤1600mm) for an operator standing at floor level. Fuse carriers shall be of the type of Alstom RS20 or equivalent by agreement with NPg and shall meet TS 2.19 for NGET at joint sites. VT fuses shall be fitted with a locking bar to prevent inadvertent removal.

3.16. Current Transformers

Current transformers shall be in accordance with BS EN 61869-2, as expanded or modified in Appendices 1 and 2 of this document.

CTs must be hard wired; wiring via Harting plug and socket is not acceptable.

Busbar zone CT shorting links, of type Alstom CD or equivalent by agreement with NPg, shall be provided in an accessible location.

3.17. CT and VT Terminal Boxes

Current transformer and voltage transformer secondary terminal boxes shall be located outside the high voltage enclosure and shall be easily accessible from the floor level.

Secondary windings shall be wired and connected to the terminal boxes and from there on to the LCC.

Provision shall be made for earthing the CT secondary windings. This will preferably be achieved using an earthing terminal (e.g., Weidmuller STL 5/EN stud terminal or equivalent) within each terminal box.

All terminals on the CT and VT boxes shall be of type Weidmuller WDU10SL or equivalent.

3.18. Test Bushings

Test bushings shall be provided to allow the primary injection of all CTs without requiring internal access to any gas compartment.

Test bushings shall be suitable for AC power frequency or very low frequency (VLF) at the voltages stated in Appendix 1.

3.19. Key Interlocks

Electrical and mechanical interlocking shall be designed to meet the requirements of TS 3.1.1 and TS 3.24.43 for NGET's bays at joint sites. The method of interlocking shall be agreed between the Manufacturer and NGET and the Manufacturer and Northern Powergrid. NGET require mechanical interlocking in addition to electrical interlocking; the Manufacturer shall supply both.

Key interlocks shall be provided to comply with the substation interlock scheme. For NPg's bays, electrical interlocking shall be provided to prevent the following:

- An earth switch being closed when any of its associated circuit breaker or disconnectors are closed
- Any disconnectors making or breaking load current
- A circuit breaker being closed while a disconnector is in the process of operation
- The incorrect sequence of on load bus bar transfer switching operations including cross bay interlocking
- Maintenance being carried out when the switchgear is not earthed against all sources of infeed

Directly driven auxiliary contacts shall be provided where there is electrical interlocking.

3.20. Outage Constraints

The equipment shall be capable of being configured such that installation, extension, operation and maintenance procedures may be carried out with a maximum of one adjacent circuit and one section of busbar out of service simultaneously.

3.21. Earth Switches

Provision shall be made to apply earths to busbars, disconnectors, circuit breakers and power cables to allow maintenance procedures to be undertaken.

High speed earth switches used to discharge overhead line or cable feeders, transformer infeeds and bus couplers shall be of class E1 as defined in BS EN IEC 62271-102.

Earth switches used for earthing feeder circuits shall be rated Class B for induced current switching as defined in BS EN IEC 62271-102.

The positions on the switchgear at which additional earths may be fitted shall be clearly identified.

3.22. Disconnectors

Busbar disconnectors on double busbar arrangement shall comply with the following requirements:

- The rated bus transfer current shall be at least 80% of the rated continuous current of the disconnector up to the maximum of 1600A.
- The rated bus transfer voltage shall be 10V as per BS EN IEC 62271-102: Clause 5.108.2 – Table 7.
- The rated bus charging current shall be 0.1A as per BS EN IEC 62271-102: Clause 5.110 – Table 11.
- Disconnectors shall be suitably interlocked.
- Disconnectors shall have a mechanical endurance of M2.

3.23. Gas Connections

The gas service connection for each gas compartment shall be readily accessible without the use of special access equipment.

Filling points shall be fitted with self-sealing valves.

3.24. Pressure/Density Indication

Further to the requirement of ENATS 41-37 the system shall be capable of detecting a gas loss equivalent to 0.5% of the gas compartment volume per annum or shall provide trend analysis facilities.

3.25. Gas Alarm Scheme

Each gas zone alarm within a bay shall be wired back to the associated LCC and the LCC will indicate any gas zones with low or high pressure. The gas zone alarms for each LCC shall be grouped to provide a signal to Control via the RTU indicating the affected bay.

3.26. Condition Monitoring

On-line condition monitoring (including partial discharge monitoring) should be offered as an option.

3.27. Pressure Relief

Pressure relief devices shall be installed to eject debris away from normally accessible areas. They shall be set to minimise danger to personnel.

3.28. Identification of Gas Compartment Partitions

The position of each gas compartment partition shall be clearly identified. A gas zone shall be provided between each feeder.

Labels shall be fixed to the enclosure at each gas compartment partition showing the identifier of the gas compartment at each side of that position.

3.29. Heaters

To prevent condensation within the local control cubicle, heaters (suitably protected) shall be fitted. The supply voltage for the heater shall be 110V AC unless specified differently in Appendix 2.

3.30. Labels

The equipment shall be labelled such that each bay and each piece of main equipment and associated position indication / viewing port is uniquely identified with bay and equipment designation. Also, each individual piece of switchgear shall be provided with a nameplate bearing information as specified by relevant IEC Publication.

Individual equipment nameplates shall contain the actual type tested current / voltage ratings of the equipment.

In general, all information labels shall be black text on a white background.

All labels shall survive the equipment's anticipated lifespan and shall be clear and indelibly printed in English. Labels shall be held in place with screws rather than glue.

The following is a non-exhaustive list of the labels required:

- Each GIS bay and its LCC shall be identified as bay designation on the SLD.
- The LCC shall have the associated circuit label provided both on the outside and inside of the cubicle.
- Each HV switching device, including earth switch shall be clearly labelled to indicate its function and bay.
- Each phase of the GIS bays and busbar shall be identified with appropriate phase reference at each point where it may be accessed.
- Each partition between gas zones shall be identified.
- Each gas density / pressure monitor shall be identified with a label containing a reference to the gas zone being supervised.
- Each valve shall be labelled identifying its function and the gas identified.

3.31. Auxiliary Contacts

The number and rating of Auxiliary Contacts for the Circuit Breaker, Disconnector and Earth Switch shall be as per table below:

S/N	Equipment	No of Auxiliary Contacts	Rating of the Auxiliary Contacts
1	Circuit Breaker	15 N/O and 15 N/C	Class 1 as per BS EN 62271-1: Table 8
2	Disconnector	20 N/O and 20 N/C	Class 1 as per BS EN 62271-1: Table 8
3	Earth Switch	10 N/O and 10N/C	Class 1 as per BS EN 62271-1: Table 8

The type of Auxiliary contacts required shall be specified at the ordering stage and shall be the combination of various auxiliary contacts types as stated in ENATS 41-37 – Part 4: Clause 5.4.100.

3.32. Local Control Cubicle

Free standing local control cubicles (LCC), meeting the NPg specification NPS/005/003, shall be provided and shall be installed directly opposite or mounted on the corresponding GIS Switchgear.

- All LCCs are required to include all interconnecting cables between the switchgear and the LCC.
- The LCC shall be secured using padlockable door handle.

Small wiring shall be PVC insulated single core cable and wiring circuits shall be as per section 3.14.

3.33. Earthing

The switchgear shall be provided with suitable earthing points for permanently connecting the equipment to the main earth system and high frequency earth.

All new equipment shall be permanently connected to the earth grid, using conductors of a suitable material and cross section for their purpose and joints/connections in accordance with ENA TS 41-24.

The bonding connections of non-current carrying metalwork associated with ancillary equipment shall not be less than 25 x 3mm if tape or strip or 70mm^2 for cable connections.

Provision of removable earth test links within each bay shall be made to facilitate primary injection of CTs.

3.34. Cable Termination

The type of cable termination provided on the switchgear shall adhere to the requirements of BS EN IEC 62271-209.

The switchgear shall be capable of taking both fluid-filled and dry type cable terminations depending on the site specific requirement. This will be confirmed by NPg during the ordering stage.

Unless otherwise specified by the project specific requirements, the terminations shall meet the following requirements:

- The cable termination provided on the feeder breaker shall accommodate single core XLPE cable up to 1300mm^2.

- The cable termination provided on the transformer breaker shall accommodate single core XLPE cable up to 2500mm^2.

The incomers or outgoing feeder cables are generally single cable per phase arrangement but if multiple cables per phase arrangement are required, this will be specified during the enquiry stage.

3.35. Maintenance

Provision of gas handling equipment and any special instruments or tools shall be made to facilitate working with insulation gas and gas mixtures as documented in ENA ER G69.

3.36. Gas Containment Failure

The Manufacturer shall provide guidance on the level of response required in the event of a significant loss of insulating gas from the switchgear, considering the toxicity of the gas and the displacement of oxygen.

4. References

4.1. External Documentation

Reference	Title
BS EN 61869-2	Instrument transformers. Additional requirements for current transformers
BS EN 61869-2	Instrument transformers Part 2: Additional requirements for current transformers
BS EN 61869-3	Instrument transformers Part 3: Additional requirements for inductive voltage transformers
BS EN 62271-1	High-voltage switchgear and controlgear Part 1: Common specifications for alternating current switchgear and controlgear
BS EN 62271-203	High-voltage switchgear and controlgear Part 103: Gas-insulated metal-enclosed switchgear for ratings above 52kV
BS EN IEC 60947-1	Low-voltage switchgear and controlgear. General rules
BS EN IEC 62271-100	High-voltage switchgear and controlgear Part 100: Alternating current circuit breakers
BS EN IEC 62271-102	High-voltage switchgear and controlgear Part 102: Alternating current disconnectors and earthing switches
BS EN IEC 62271-209.	High-voltage switchgear and controlgear. Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52kV.
ENA ER G69	Guidance on working with insulation and interruption gas (IIG) and gas mixtures up to and including 145kV
ENA TS 41-24	Guidelines for the design, installation, testing and maintenance of main earthing systems in substations
ENA TS 41-37 Parts 1-4	Switchgear for use on 66kV to 132kV Distribution Systems
ENA TS 50-18	Design and application of ancillary electrical equipment
NG TS 2.19	National Grid Technical Specifications - Ancillary Light Current Equipment

4.2. Internal Documentation

Reference	Title
IMP/001/913	Code of Practice for the Economic Development of the EHV System
IMP/001/914	Code of Practice for the Economic Development of the 132kV System
NPS/005/003	Technical Specification for Protection and Control Panels

4.3. Amendments from Previous Version

Reference	Title
3.11	Mechanical endurance requirement increased to M2 (132kV & 66kV)
3.12	Electrical Endurance rated Class E2.
3.13	CT switching duties in accordance with IEC 62271-1 6.4.3.4.5 Table 8: Class 1 (10A).
3.14	Terminal function and type tabulated to clarify
3.15	VTs shall be in accordance with BS EN 61869-3. Requirement for isolation links. Height of fuse carriers specified. NGET requirements stated.
3.16	CT wiring must be hard wired. Busbar zone CT shorting links required.
3.19	Reference to SF6 removed
3.19	Interlock functionality included
3.2	Outdoor rated switchgear not required
3.21	Requirement for fast acting earth switches clarified
3.22	Reference to SF6 removed
3.22	Disconnector bus transfer duty clarified
3.25	LCC gas zone alarm grouping

3.29	Included the requirement for heaters
3.30	Included labelling requirements
3.31	Number and rating of auxiliary contacts included
3.32	LCC requirements included
3.33	Earthing requirements included
3.34	Cable termination requirements included
3.35	Provision of maintenance requirements included
3.36	Gas containment failure response included
3.5	Air insulated bushing specification removed.
3.5	Table included summarising normal and fault current ratings for 132kV switchgear installed at 400/132kV and 275/132kV substations
3.6	Table included summarising normal and fault current ratings for 66kV switchgear installed at 132/66kV substations
3.8	First pole to clear factor of 1.3 for all test duties
4.2	Economic development code of practices referenced
Appendix 1	Mechanical endurance requirement increased to M2 (132kV & 66kV)
Appendix 1	Outdoor GIS requirements removed (132kV & 66kV)
Appendix 2	Question relating to recycled SF6 removed
Appendix 2	Question relating to outdoor earth switch requirements removed
Appendix 2	Question relating to mechanism cabinets for outdoor switchgear removed
Appendix 2	Questions relating to outdoor GIIS removed
Scope	Requirement for indoor SF_6-free explicitly stated
Title	Requirement for indoor SF_6-free explicitly stated

5. Definitions

Term	Definition
n/a	

6. Authority for Issue

6.1. CDS Assurance

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

		Date
Liz Beat	Governance Administrator	04/08/2022

6.2. Author

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

Review Period - This document should be reviewed within the following time period;

Standard CDS review of 3 years?	**Non-Standard Review Period & Reason**	
No	**Period: 5 years**	**Reason: To align with procurement cycle**
Should this document be displayed on the Northern Powergrid external website?		Yes
		Date
Joe Helm	Policy & Standards Manager	<<Date>>

6.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Date
Sunil Shrestha	Design & Specification Engineer	<<Date>>

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Paul Black	System Engineering Manager	<<Date>>

Appendix 1: Manufacturer Self-Certification Conformance Declaration

For the switchgear offered (72.5kV or 145kV), the manufacturer shall declare conformance or otherwise using the following level of conformance declaration codes.

Conformance declaration codes:

N/A = Clause is not applicable/appropriate to the product
Cs1 = The test conforms fully with the requirements of this clause
Cs2 = The test conforms partially with the requirements of this clause
Cs3 = The test does not conform to the requirements of this clause
Cs4 = Test not performed, but alternative evidence/ technical case offered

72.5kV Switchgear

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
System Particulars				
Voltage		kV	66	
Frequency		Hz	50	
Number of Phases			3	
Neutral Earthing			Solid	
General Characteristics	**Part 1 / 62271-1**			
Number of poles			3	
Class – indoor/outdoor	4.1.2 / 4.1.3		Indoor	
Rated voltage	5.2	kV	72.5	
Rated insulation level. Lightning impulse level Power frequency withstand	5.3	kV	 325 375 (across isolating gap) 140 160 (across isolator gap)	
Rated frequency	5.4	Hz	50	
Rated normal current	5.5	A	Incomer, bus-section and busbar: 2000A Feeder: 1250A	
Rated short-time withstand current	5.6	kA	40	
Rated peak withstand current	5.7	kA	108	
Rated duration of short circuit	5.8	s	3	
Rated supply voltage of opening and closing devices and auxiliary and control circuits: Closing and tripping Indication Control	5.9	V	 110 110 110	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
Rated supply frequency of closing and auxiliary circuits.	5.10	Hz	DC	
	Part 2 Clause			
Cable testing	5.201		AC tests either VLF or power frequency will need to be applied at 58kV for 15 minutes.	
Circuit breaker characteristics	**Part 3 Clauses**			
Rated short-circuit breaking current. Equal to rated short-time withstand current.	4.101	kA	40 @ time constant of 45ms	
Transient recovery voltage related to the rated short-circuit breaking current.	4.102		Transient recovery voltages related to the rated circuit breaking currents shall be as specified in BS EN IEC 62271-100 7.103.5.	
Rated short-circuit making current	4.103	kA	In compliance with ENA Technical Specification 41-37	
Rated operating sequence.	4.104		0 – 0.3 s – CO – 3min - CO	
Rated capacitive switching currents : Rated Line/Cable-charging current.	4.107	A	10A/125A	
Rated DC time constant.	4.109	ms	Manufacturer to state (see specified fault breaking current)	
Classification of mechanical operations	4.110		Class M2	
Classification of electrical endurance	4.111		Class E2	
Additional key interlocks			Provision for 1 additional key interlock.	
CT secondary terminal			Spring loaded or cage clamp design, or spring washer on stud design	
Bus zone CT secondary terminals.			Shorting/disconnecting facility.	
Auxiliary switches used in CT circuits			CT switching duties in accordance with IEC 62271-1 Table 8: Class 1 (10A).	
Scada terminals			Knife terminal equipped with test 2.3mm sockets	
Internal 110V AC/DC wiring			110V AC/110V DC wiring shall be white in colour.	
Terminals			Terminals shall be spring loaded (as a minimum) e.g. Weidmueller WDU6SL/WDU10SL or	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
			equivalent in accordance with ENA TS 50-18.	
CT wiring			Wiring for CT circuits shall have a cross-sectional area of 2.5mm^2.	
Crimps			Hooked blade crimps shall be used for all internal wiring; the use of bootlace crimps is not preferred.	
Voltage Transformer primary isolation			Isolation links shall facilitate the removal of VTs from the circuit for testing without the need for de-gassing.	
VT secondary windings shall be capable of being readily disconnected and isolated from ground for testing purposes.			Removable fuse carriers shall be provided in an accessible location (≤1600mm) for an operator standing at floor level.	
VT secondary isolation			Fuse carriers shall be of the type of Alstom RS20 or equivalent	
CT wiring			CT wiring hard wired; Harting plugs and sockets not acceptable.	
Busbar zone CT shorting links			Type Alstom CD or equivalent	
Current transformer and voltage transformer secondary terminal boxes			Located outside the high voltage enclosure and shall be easily accessible from the floor level.	
CT secondary winding earthing			Achieved using an earthing terminal (e.g., Weidmuller STL 5/EN stud terminal or equivalent) within each terminal box	
Test bushing requirement			Shall allow the primary injection of all CTs without requiring internal access to any gas compartment.	
Test bushing rating			Test bushings shall be suitable for AC power frequency or very low frequency (VLF) as stated above	
Key interlocks NGET bays			Electrical and mechanical interlocking to meet the requirements of TS 3.1.1	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
			and TS 3.24.43 for NGET bays at joint sites	
Key interlocks NPg bays			Electrical interlocking of NPg bays shall meet the requirements stated in 3.19.	
Outage Constraints			Installation, extension, operation and maintenance procedures may be carried out with a maximum of one adjacent circuit and one section of busbar out of service simultaneously	
Gas service connection			Filling points shall be fitted with self-sealing valves and shall be readily accessible	
Pressure/Density Indication			Detect a gas loss equivalent to 0.5% of the gas compartment volume per annum or provide trend analysis	
Gas Alarm Scheme			Gas alarms wired back to LCC and grouped as described in 3.25	
Condition Monitoring			Option to be considered by NPg	
Pressure Relief			Installed to minimise danger to personnel	
Identification of Gas Compartment Partitions			Labels shall be fixed to the enclosure at each gas compartment partition showing the identifier of the gas compartment at each side of that position.	
Heaters			Heaters (suitably protected) shall be fitted (110V AC)	
Labels			Labelling as specified in 3.30	
Auxiliary Contacts			Circuit Breaker 15 N/O and 15 N/C Disconnector 20 N/O and 20 N/C Earth Switch 10 N/O and 10N/C	
Local Control Cubicle			LCC shall meet the requirements s in 3.32	
Earthing			Bonding connections of non-current carrying metalwork associated with ancillary equipment shall not be less than 25 x 3mm if tape or	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
			strip or 70mm^2 for cable connections	
Cable Termination			Cable termination shall accommodate: Feeder breaker - single core XLPE cable up to 1300mm^2 Transformer breaker - single core XLPE cable up to 2500mm^2.	
Maintenance			Provision of gas handling equipment documented in ENA ER G69.	
Gas containment failure			Guidance on the response required in the event of significant loss of insulating gas.	
Disconnector/earthing switch characteristics	**Part 4 Clauses**			
Current making rating of earth switches used to apply first earth to feeder, incomer or busbar.	(IEC 62271-102) Clause 6.101		E1	
Disconnector bus transfer duty	4.104		10V/0.1A	
Induced current switching earth switch	4.105		Class B	
Rated value of mechanical endurance	4.106		M2	
High speed earth switches			High speed earth switches used to discharge overhead line or cable feeders, transformer infeeds and bus couplers shall be of class E1 as defined in BS EN IEC 62271-102.	
Busbar disconnectors on double busbar arrangement			Rated bus transfer current shall be at least 80% of the rated continuous current of the disconnector up to the maximum of 1600A.	
Interlocking			Disconnectors shall be suitably interlocked	

145kV Switchgear

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
System Particulars				
Voltage		kV	132	
Frequency		Hz	50	
Number of Phases			3	
Neutral Earthing			Solid	
Switchgear General Characteristics	**Part 1 Clauses**			
Number of poles			3	
Class – indoor/outdoor	4.1.2 / 4.1.3		Indoor	
Rated voltage	5.2	kV	145	
Rated insulation level. Lightning impulse level Power frequency withstand	5.3	kV	 650 750 (across isolating gap) 275 315 (across isolator gap)	
Rated frequency	5.4	Hz	50	
Rated normal current	5.5	A	2000	
Rated short-time withstand current	5.6	kA	40	
Rated peak withstand current	5.7	kA	108	
Rated duration of short circuit	5.8	s	3	
Rated supply voltage of opening and closing devices and auxiliary and control circuits: Closing and tripping Indication Control	5.9	V	 110 110 110	
Rated supply frequency of closing and auxiliary circuits.	5.10	Hz	DC	
GIS Switchgear	**Part 2 Clause**			
Cable testing	5.202		AC tests either VLF or power frequency will need to be applied at 115kV for 15 minutes.	
Circuit breaker characteristics	**Part 3 Clauses**			
Rated short-circuit breaking current. Equal to rated short-time withstand current.	4.101	kA	40 @ time constant of 45ms	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
Transient recovery voltage related to the rated short-circuit breaking current.	4.102		Transient recovery voltages related to the rated circuit breaking currents shall be as specified in BS EN IEC 62271-100 7.103.5	
Rated short-circuit making current	4.103	kA	In compliance with ENA Technical Specification 41-37	
Rated operating sequence.	4.104		0 – 0.3 s – CO – 3min - CO	
Rated capacitive switching currents : Rated Line/Cable-charging current.	4.107	A	50A/160A	
Rated DC time constant.	4.109	ms	Manufacturer to state (see specified fault breaking current)	
Classification of mechanical operations M1 or M2	4.110		Class M2	
Classification of electrical endurance	4.111		Class E2	
Additional key interlock			Provision for 1 additional key interlock.	
CT secondary terminal			Spring loaded or cage clamp design, or spring washer on stud design	
Bus zone CT secondary terminals.			Shorting/disconnecting facility.	
Auxiliary switches used in CT circuits			CT switching duties in accordance with IEC 62271-1 Table 8: Class 1 (10A).	
Scada terminals			Knife terminal equipped with test 2.3mm sockets	
Internal 110V AC/DC wiring			110V AC/110V DC wiring shall be white in colour.	
Terminals			Terminals shall be spring loaded, e.g. Weidmueller WDU6SL/WDU10SL or equivalent in accordance with ENATS 50-18.	
CT wiring			Wiring for CT circuits shall have a cross-sectional area of 2.5mm^2.	
Crimps			Hooked blade crimps shall be used for all internal wiring; the use of bootlace crimps is not preferred.	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
Voltage Transformer primary isolation			Isolation links shall facilitate the removal of VTs from the circuit for testing without the need for de-gassing.	
VT secondary windings shall be capable of being readily disconnected and isolated from ground for testing purposes.			Removable fuse carriers shall be provided in an accessible location (≤1600mm) for an operator standing at floor level.	
VT secondary isolation			Fuse carriers shall be of the type Alstom RS20 or equivalent	
CT wiring			CT wiring hard wired; Harting plugs and sockets not acceptable.	
Busbar zone CT shorting links			Type Alstom CD or equivalent	
Current transformer and voltage transformer secondary terminal boxes			located outside the high voltage enclosure and shall be easily accessible from the floor level.	
CT secondary winding earthing			Achieved using an earthing terminal (e.g., Weidmuller STL 5/EN stud terminal or equivalent) within each terminal box	
Test bushing requirement			Shall allow the primary injection of all CTs without requiring internal access to any gas compartment.	
Test bushing rating			Test bushings shall be suitable for AC power frequency or very low frequency (VLF) as stated above	
Key interlocks NGET bays			Electrical and mechanical interlocking to meet the requirements of TS 3.1.1 and TS 3.24.43 for NGET bays at joint sites	
Key interlocks NPg bays			Electrical interlocking of NPg bays shall meet the requirements stated in 3.19.	
Outage Constraints			Installation, extension, operation and	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
			maintenance procedures may be carried out with a maximum of one adjacent circuit and one section of busbar out of service simultaneously	
Gas service connection			Filling points shall be fitted with self-sealing valves and shall be readily accessible	
Pressure/Density Indication			Detect a gas loss equivalent to 0.5% of the gas compartment volume per annum or provide trend analysis	
Gas Alarm Scheme			Gas alarms wired back to LCC and grouped as described in 3.25	
Condition Monitoring			Option to be considered by NPg	
Pressure Relief			Installed to minimise danger to personnel	
Identification of Gas Compartment Partitions			Labels shall be fixed to the enclosure at each gas compartment partition showing the identifier of the gas compartment at each side of that position.	
Heaters			Heaters (suitably protected) shall be fitted (110V AC)	
Labels			Labelling as specified in 3.30	
Auxiliary Contacts			Circuit Breaker 15 N/O and 15 N/C Disconnector 20 N/O and 20 N/C Earth Switch 10 N/O and 10N/C	
Local Control Cubicle			LCC shall meet the requirements s in 3.32	
Earthing			Bonding connections of non-current carrying metalwork associated with ancillary equipment shall not be less than 25 x 3mm if tape or strip or 70mm^2 for cable connections	

Summary of Technical Requirements and Ratings	ENA TS 41-37	UNIT	NPg Requirement	Manufacturer Conformance Code
Cable Termination			Cable termination shall accommodate: Feeder breaker - single core XLPE cable up to 1300mm^2 Transformer breaker - single core XLPE cable up to 2500mm^2.	
Maintenance			Provision of gas handling equipment documented in ENA ER G69.	
Gas containment failure			Guidance on the response required in the event of significant loss of insulating gas.	
Disconnector/earthing switch characteristics	**Part 4 Clauses**			
Current making rating of earth switches used to apply first earth to feeder, incomer or busbar.	(IEC 62271-102) Clause 6.101		E1	
Disconnector bus transfer duty	4.104		10V/0.1A	
Induced current switching earth switch	4.105		Class B	
Rated value of mechanical endurance	4.106		M2	
High speed earth switches			High speed earth switches used to discharge overhead line or cable feeders, transformer infeeds and bus couplers shall be of class E1 as defined in BS EN IEC 62271-102.	
Busbar disconnectors on double busbar arrangement			Rated bus transfer current shall be at least 80% of the rated continuous current of the disconnector up to the maximum of 1600A.	
Interlocking			Disconnectors shall be suitably interlocked	

Appendix 2: Addendum to Supplier Requirements