NATIONAL GRID ELECTRICITY DISTRIBUTION

Take Charge

Compact Connection Solution – Specification

Rev. V1 – 31 May 2023

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1 Abbreviations

Abbreviation	Definition
AC	Alternating Current
AR	Auxiliary Relay
AVC	Automatic Voltage Control
BS EN	British Standard European Norm
CB	Circuit Breaker
CCS	Compact Connection Solution
CMR	Continuous Maximum Rating
CoG	Centre of Gravity
CT	Current Transformer
DC	Direct Current
DEIT	Directional Inverse Definite Minimum Time Earth Fault
EE	Engineering Equipment
EIT	Inverse Definite Minimum Time Earth Fault
EMC	Electromagnetic Compatibility
ENA	Energy Networks Association
EV	Electric Vehicle
HV	High Voltage
IEC	International Electrotechnical Commission
IP	Ingress Protection
KNAN	Ester Fluid Air Natural
LV	Low Voltage
LVAC	Low Voltage Alternating Current
MSA	Motorway Service Area
NGED	National Grid Electricity Distribution
NER	Neutral Earthing Resistor
OLTC	On-Load Tap Changer
PX	Special Accuracy Class
REF	Restricted Earth Fault
RTB	Relay Test Block
RTU	Remote Terminal Unit
SAT	Site Acceptance Test

Abbreviation	Definition
SBEF	Standby Earth Fault
SCADA	Supervisory Control and Data Acquisition
ST	Standard Technique
TCC	Tap Change Control
TDS	Trip Relay with 2.5s Time Delay Reset Contact and Hand Reset Flag
TPI	Tap Position Indicator
TS	Technical Specifications
UPS	Universal Power Supply
3OCIT	3 Element Inverse Definite Minimum Time Overcurrent
3HSOC	3 Element High Set Overcurrent

2 Introduction

The Take Charge project has successfully specified, designed, tested and trialled a brand-new Compact Connection Solution (CCS) for delivering large capacity Electric Vehicle (EV) charging to Motorway Service Areas (MSAs). This document builds upon the functional specification prepared in the initial design stage and captures the as-built specification for dissemination and sharing across the wider industry. It should be noted that the specification detailed herein describes the 12 MVA installation that was built for Take Charge. The proposed solution is also able to be uprated to 20 MVA by changing the rating of the transformer.

This specification document has been written to be agnostic to equipment supplier, “The Supplier”, who would be responsible for the design and manufacture of the new package solution in line with the requirements. Similarly, the purchasing entity, “The Purchaser”, could be a Distribution Network Operator (DNO), Independent DNO (IDNO) or other network owner/operator.

3 Scope of Works

3.1 Overview

The Supplier shall be responsible for the design, manufacturing, procurement, assembly, testing, transportation, offloading, installation, commissioning and warranty of the overall CCS defined in this specification. The specific demarcation of responsibilities is provided in Section 3.2.

The CCS will include the following main items of equipment:

a) CCS enclosure/housing
b) 33/11.5 kV transformer
c) 36 kV switchgear
d) 12kV switchgear
e) Transformer protection and control panel
f) Neutral Earthing Resistor
g) Low Voltage AC (LVAC) supplies
h) DC power supplies
i) Protection CTs and VTs
j) Remote Terminal Unit (RTU)
k) Heating and cooling system
l) Fire and security alarm system

The diagram provided in Figure 3.1 shows the demarcation of the scope of work with respect to The Purchaser and The Supplier.

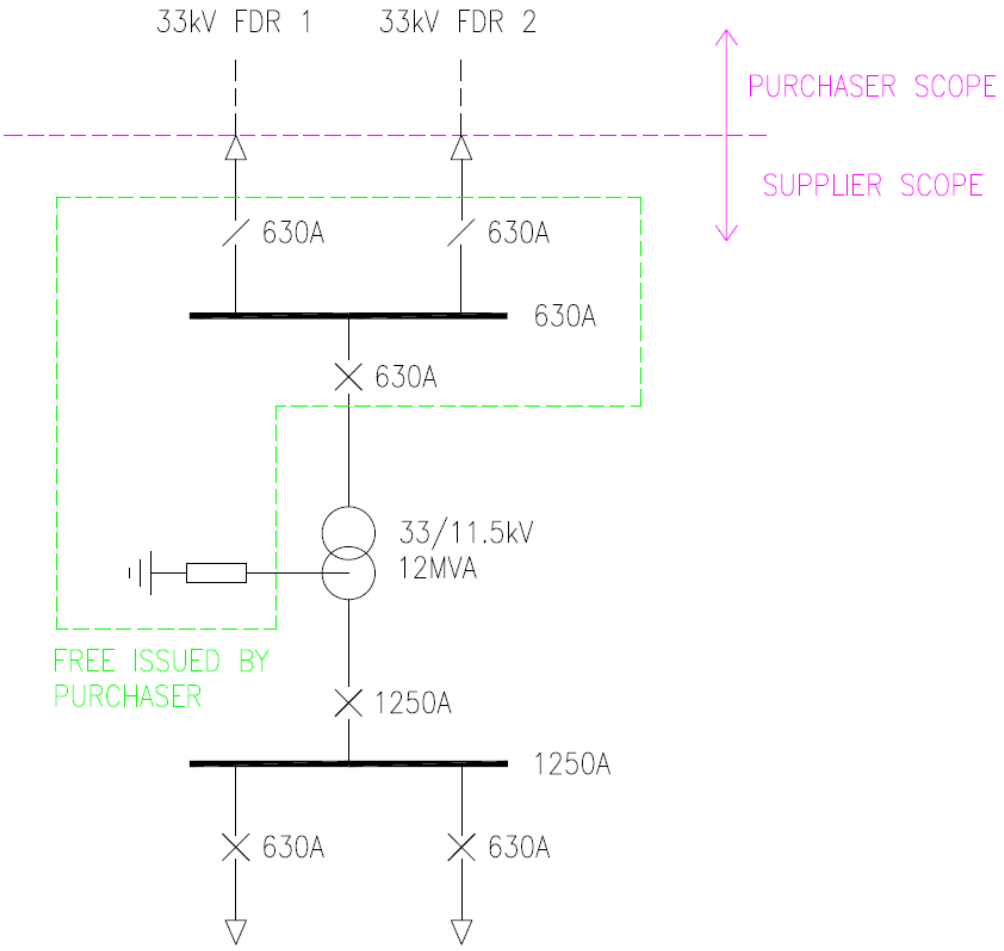

Figure 3.1 Demarcation between Purchaser and Supplier SoW

The Purchaser will free-issue certain items of equipment to The Supplier to allow them to integrate these items into the overall CCS. These items are as follows:

a) 36 kV switchgear
b) Transformer protection and control panel
c) NER
d) RTU
e) 110 V DC battery charger and distribution board
f) 48 V DC battery charger

The Supplier shall be responsible for the production, supply and update of all documentation associated with the supply of the CCS and in line with the Schedule of Responsibility detailed in Section 3.2.

3.2 Schedule of Responsibility

Table 3.1 details the responsibility for the supply, design, installation and commissioning works for the CCS.

Table 3.1 Schedule of responsibility

Item	Description	Supplier	Purchaser
	Hardware		
1	Design, supply and installation of the CCS enclosure	●	
2	Design, supply and installation of the 33/11.5 kV transformer	●	
3	Specification and supply of the 36 kV switchgear		●
4	Installation and integration of the 36 kV switchgear into the CCS enclosure	●	
5	Specification and supply of the transformer protection and control panel		●
6	Installation and integration of the transformer protection and control panel into the CCS enclosure	●	
7	Specification, supply and installation of the 12 kV switchgear	●	
8	Specification and supply of the NER		●
9	Supply and installation of NER mounting brackets	●	
10	Specification and supply of the 110V DC battery charger and distribution board		●
11	Specification and supply of the 48V DC battery charger		●
12	Installation and integration of the battery chargers into the CCS enclosure	●	
13	Specification and supply of the RTU		●
14	Installation and integration of the RTU into the CCS enclosure	●	
15	Design, supply and installation of all marshalling kiosks in the CCS enclosure	●	
16	Design, supply, routing and installation of all small wiring (including LVAC/DC power, control, indication and measurement signal wiring) in the CCS enclosure	●	
17	Civil design (inc. any temporary works to facilitate the offloading and installation of the CCS at its final location)		●
18	Supply and installation of the civil sub-structures and temporary works		●
19	Design, supply and installation of any supporting steelwork (i.e. supporting steelwork, access platforms and HV cable supports) for the CCS	●	
20	Supply, installation and termination of all 33 kV cabling to the 36 kV switchgear and from the switchgear to the 33/11.5 kV transformer		●
21	Supply, installation and termination of 11kV cabling from LV side of the 33/11.5 kV transformer to the 12 kV switchgear incoming feeder cable box (including neutral connection)		●
22	Supply and installation of the LVAC and DC distribution boards into the CCS enclosure	●	
23	Supply, installation and termination of the main LVAC cable between the auxiliary transformer and LVAC distribution board		●
24	Supply, installation and termination of the secondary LVAC supply cable from the local LV network (if applicable)		●
25	Supply and installation of signal wiring from the marshalling kiosk to the RTU	●	
26	Supply and installation of the CCS enclosure heating and cooling system	●	

Item	Description	Supplier	Purchaser
27	Supply and installation of an intruder security system for the package substation	●	
28	Supply and installation of a fire detection system within the substation enclosure	●	
Testing, Delivery, Installation and Commissioning			
29	All factory testing of the CCS	●	
30	All factory and type testing of the 33/11.5kV transformer	●	
31	Transportation of equipment to Purchaser's site	●	
32	Off-loading of equipment to final position	●	
33	Supply and installation of all CT wiring from the transformer to the marshalling kiosk	●	
34	Cold commissioning activities	●	
35	Hot commissioning activities		●
36	Connections to main earth grid		●
37	A set of spares and special tools necessary for maintenance, operation and control during warranty period of Supplier equipment	●	
Engineering, Project Management, Training			
38	Production of Project Gantt chart and regular progress updates	●	
39	Production of Outline Design and Detailed Design documentation	●	
40	Review, comment and approval of Detailed Design documentation		●
41	Supply of detailed testing specification for the CCS and 33/11.5 kV transformer	●	
42	Review of detailed testing specification for the CCS and 33/11.5 kV transformer		●
43	Supply of all installation, operation and maintenance manuals (one hardcopy of the final documentation to be stored in the CCS enclosure)	●	

4 References

Table 4.1 provides a list of references that shall be adhered to in relation to this Functional Specification. Within this specification, references to supporting specifications and standards have been quoted where necessary to highlight particular requirements.

Table 4.1 References

Reference	Description
NGED EE 1	Relating to Continuous Maximum Rated (CMR) System Transformers for use on systems up to 132kV
NGED EE 5	Relating to 11kV Distribution Transformers
NGED EE 8	Emergency Rated System Transformers – 66/11.5kV and 33/11.5kV Delta/Star and Star/Star connected
NGED EE 16	LV Distribution Fuseboards

Reference	Description
NGED EE 23	110V and 220V Batteries, Chargers, Controllers, Distribution Boards & Associated Auxiliary Cabling for Primary Network Substations Other Than Metering Circuit Breaker Type
NGED EE 52	HV and LV Fuse Links
NGED EE 78	Multipair Cables
NGED EE 79	Specification for SCADA Multipair Light Current Control Cables
NGED EE 80	Multicore Cables
NGED EE 84	Surge Arresters
NGED EE 86	Tap Change Control Cubicles associated with 132kV, 66kV and 33kV Transformers
NGED EE 87	Protection, Alarm and Control Panels associated with 36kV and 72kV Outdoor Switchgear, 33kV and 66kV Transformers and Control Panels associated with Arc Suppression Coils
NGED EE 89	Fixed Earthing Systems for Major Substations
NGED EE 98	Approved Protection, Voltage Control and Alarm Relays and Test Access Blocks
NGED EE 104	Substation 24V and 48V Batteries, Chargers, Distribution Boards & Associated Auxiliary Cabling
NGED EE 107	Specification for Low Voltage Connectors
NGED EE 122	NGED Assessed Switchgear and Associated Plant for Use on the Distribution Network
NGED EE 123	Dry Type Neutral Earthing Resistors
NGED EE 140	Steel Substation Buildings
NGED EE 185	12kV Primary Type Indoor Circuit Breakers
ENA TS 12-11	Dry cable terminations in HV switchgear for service at rated voltages 12, 24 and 36kV
ENA TS 35-1	Distribution Transformers (from 16kVA to 2000kVA)
ENA TS 35-3	Continuous Maximum Rated (CMR) system transformers (for use on systems up to and including 132 kV)
ENA TS 48-5	Environmental test requirements for protection and control equipment and systems
ENA TS 50-18	Application of ancillary electrical equipment
ENA TS 50-19	Standard numbering for small wiring (for switchgear and transformers together with their associated relay panels)
BS EN 60071-1	Insulation co-ordination. Definitions, principles and rules
BS EN 60071-2	Insulation co-ordination Part 2: Application guidelines
BS EN 60076-1	Power Transformers – Part 1: General
BS EN 60076-2	Power Transformers – Part 2: Temperature rise for liquid-immersed transformers
BS EN 60076-3	Power Transformers – Part 3: Insulation levels, dielectric testes and external clearances in air
BS EN 60076-4	Power Transformers – Part 4: Guide to the lighting impulse and switching impulse testing – Power Transformers and Reactors
BS EN 60076-5	Power Transformers – Part 5: Ability to withstand short circuit
BS EN 60076-6	Power Transformers – Part 6: Reactors

Reference	Description
BS EN 60076-7	Power Transformers – Part 7: Loading guide for mineral-oil-immersed power transformer
BS EN 60076-10	Power Transformers – Part 10: Determination of sound level
BS EN 60076-18	Power Transformers – Part 18: Measurement of frequency response
BS EN 60076-22-1	Power Transformers – Part 22-1: Power Transformer and reactor fittings – Protective devices
BS EN 60137	Insulated bushings for alternating voltages above 1000 V
BS EN 60214-1	Tap-changers Performance requirements and test methods
BS EN 60296	Fluids for electrotechnical applications. Unused mineral insulating oils for transformers and switchgear
BS EN 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60616	Terminal and Tapping Markings for Power Transformers
BS EN 61000-6-2	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments
BS EN 61000-6-4	Electromagnetic compatibility (EMC). Generic standards - Emission standard for industrial environments.
BS EN 61099	Insulating liquids - Specifications for unused synthetic organic esters for electrical purposes
BS EN 61869-1	Instrument transformers. General requirements
BS EN 61869-2	Instrument transformers. Additional requirements for current transformers
BS EN 61869-3	Instrument transformers. Additional requirements for inductive voltage transformers
BS EN 61936-1	Power installations exceeding 1 kV AC Common rules
BS EN 62271-1	High-voltage switchgear and controlgear Part 1: Common specifications for alternating current switchgear and controlgear
BS EN 62271-200	High-voltage switchgear and controlgear Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
BS EN 62271-100	High-voltage switchgear and controlgear Part 100: High-voltage alternating-current circuit-breakers
BS EN 62271-102	High-voltage switchgear and controlgear. Alternating current disconnectors and earthing switches
BS EN 62271-103	High-voltage switchgear and controlgear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV

5 General Requirements

5.1 Safety

The equipment will be located at an MSA and therefore will be in close proximity to members of the public. The Supplier shall ensure that the works associated with the design, build, installation and testing of all equipment is compliant with the following standards and regulations:

a) Distribution Safety Rules
b) Health and Safety at Work Act 1974
c) Electricity Safety, Quality and Continuity Regulations 2002
d) Construction (Design and Management) Regulations 2015
e) Electricity at Work Regulations 1989
f) Manual Handling Operations Regulations 1992
g) Work at Height Regulations 2005
h) Workplace (Health, Safety and Welfare) Regulations 1992

5.2 Normal Service Conditions

Outdoor equipment shall be designed for operation under "-25 outdoor" climatic and environmental service conditions as detailed in BS EN 61936-1. Indoor equipment shall be designed for operation under "-5 indoor" climatic and environmental service conditions as detailed in BS EN 61936-1.

5.3 Insulation Level

The required insulation levels for all equipment are listed in Table 5.1 in accordance with BS EN 60071-1:

Table 5.1 Insulation levels

Nominal System Voltage (kV)	Highest Voltage for Equipment (kV)	Power-frequency Withstand Voltage (kV)	Lightning Impulse Withstand Voltage (kV)
0.415	1	3	-
11	12	28	95
33	36	70	170

5.4 System Fault Level

Table 5.2 details the system faults that the equipment shall be designed to as a minimum.

Table 5.2 System fault levels

Nominal System Voltage (kV)	Three Phase Short Circuit (kA) (3 secs)	Single Phase Short Circuit (kA) (2 secs)
0.415	25	25
11	25	25
33	20◊	20◊

◊Purchaser to confirm minimum fault levels for specific site

5.5 Signage and Labels

The 33/11.5 kV transformer shall be fitted with appropriate rating plates in accordance with BS EN 60076-1 respectively. The entries on the plates shall be indelibly marked. All equipment designations shall be clearly labelled using weatherproof material, fitted in a visible position.

The equipment shall be fitted with appropriate health and safety signs including:

a) Prohibition signs

b) Warning signs

c) Mandatory signs

d) Emergency escape signs

Safety warning signs shall conform to BS 5499.

The Purchaser shall supply the mandatory signs including danger of death sign(s). The Supplier shall design and provide the remaining signs. The location/position of the mandatory signs shall also be agreed with The Purchaser and meet the requirements of the relevant Standard Techniques (ST).

All signs shall be suitable for the environment conditions described in Clause 5.2 and shall last for the lifetime of the equipment.

5.6 Earthing

The Supplier shall ensure that all equipment is suitably earthed to maintain safe and reliable operation. The CCS enclosure, transformer main tank, transformer cooling bank and any other free-standing item of equipment shall have at least two suitable earthing lugs, diagonally opposite each other, to allow connection to the main substation earthing grid.

All equipment housings, kiosks, cubicles, motors, driving mechanisms etc. shall be bonded to their supporting structure.

It shall be noted that parts of NGED's network employ arc suppression coil earthing and Suppliers are advised to consider carefully the implications of this, with particular emphasis on the phase voltages during earth fault conditions.

5.7 Auxiliary Systems

5.7.1 AC Supply

The Supplier shall state the requirements for LVAC supplies to the CCS and transformer. The requirements shall include the number of circuits, number of phases and load requirement.

The standard LVAC voltage is maintained between 400/230 V (rms) +10%/-6% and has a frequency of 50Hz +/-1%.

The Supplier shall declare the sensitivity of the equipment to loss of voltage.

5.7.2 DC Supply

The Purchaser shall free issue DC batteries and chargers associated with the 110 V and 48 V supplies required for the switchgear and RTU. The Supplier shall work with the Purchaser to ensure that the sizes of the supplies are sufficient for the equipment to be installed in the substation. DC voltages shall conform to the requirements detailed in Clause 7.1 of ENA Technical Specification 48-5.

Battery systems shall be designed with adequate ventilation and the facility to easily replace units if required. The DC installation shall be equipped with a self-monitoring system with an alarm contact for SCADA purposes.

5.7.3 Other

The Supplier shall ensure that all small wiring, terminations and terminal blocks comply with ENA Technical Specification 50-18. Labelling and numbering of small wiring shall also comply with ENA Technical Specification 50-19.

The Supplier shall use Harting connector solutions for measurement and signal wiring in the CCS. The segregation of circuits shall comply with Clause 6.6.1 of ENA Technical Specification 50-18.

5.8 Noise Levels

The sound power level of each component must not exceed 70 dBA. The Supplier shall perform sound power measurements in accordance with BS EN 60076-10 at a distance of 1m from the principal radiating surface.

5.9 Design Life

All equipment and the installation shall be designed for continuous operation. The Supplier shall design components to operate for the following timescales as a minimum:

a) CCS primary equipment – 40 years design life

b) 33/11.5 kV Transformer – 40 years design life

The Supplier shall state how the design life shall be achieved within their Offer. Any extraordinary measures, such as enhanced maintenance, must be clearly stated and accompanied by supporting documentation.

5.10 Electromagnetic Capability

All equipment shall be tested to be immune to mains borne and/or radiated disturbances and shall not be a source of such disturbances. Equipment shall be tested and comply with BS EN 61000-6 for industrial environments.

5.11 Magnetic Field

The Supplier shall ensure that the magnetic field emitted from all equipment is less than 500μT measured at a distance of 1.5m from the surface of the equipment during operation at full rated power. The Supplier shall produce a model showing the proposed magnetic field strength during the design stage. The magnetic field shall be measured during the Factory Acceptance Testing and after final installation to demonstrate compliance with the requirement.

5.12 Spares and Tools

The Supplier shall provide a spare parts list detailing the costs of any recommended items and their storage requirements. The spares strategy may form part of the overall Maintenance and Service Agreement as detailed in Clause 5.20.

The Supplier shall also provide details of any special tools and/or equipment that are required for the installation, operation and maintenance of the equipment.

5.13 Availability

The Supplier shall ensure that the equipment and installation is available at 100% of its capacity for at least 98.6% of the year, i.e. there shall be no more than 5 whole days of planned maintenance outages per year. The Supplier shall state the expected availability within their Offer.

5.14 Reliability

The Supplier shall design the equipment and installation to meet the requirements of Clause 5.13 for at least 99.9% of the time. External events attributed to the Purchaser (network events) shall be excluded from any reliability calculations.

5.15 Redundancy

The extent to which equipment/system redundancy is included in the CCS design shall be stated in the Offer and the Supplier shall demonstrate that this is consistent with the specified levels of availability/reliability.

5.16 Transportation

The Supplier shall be responsible for the transportation and off-loading of all equipment detailed in their scope of supply to the final installation location at the site address stated in APPENDIX 1. The Supplier shall also be responsible for undertaking any surveys with respect to identifying potential transportation restrictions and developing appropriate transportation plans. The Supplier shall be liable for ensuring compliance with the required statutory regulations in relation to the transportation of the equipment by road.

The Supplier shall provide the Purchaser with details of the number and types of vehicles, lengths, axle loads, transportation heights and further information as required to assist in the design and installation of any temporary works required for the transportation and off-loading of equipment.

5.17 Commissioning

The Supplier shall be responsible for all cold commissioning activities associated with the complete system. This will include all the Site Acceptance Testing (SAT) for all aspects of the CCS and transformer.

The Supplier shall submit detailed testing and commissioning schedules as part of the design approval to allow the Purchaser to review and agree on the works to be carried out in this regard.

5.18 Documentation

5.18.1 General

The Supplier shall produce and submit for approval by the Purchaser; project programme, document list, design packages, testing documentation and manuals to an acceptable industry standard.

The Supplier shall ensure that all documentation is provided in English.

All drawings and documents shall be supplied in Adobe Acrobat (*.pdf) format. In addition, technical drawings including single line diagrams and layouts shall be provided in AutoCAD 2013 (*.dwg) format. Reports or calculations may also be provided in Word (*.docx) or Excel (*xlsx) for review purposes.

5.18.2 Design Packages

The Supplier shall provide a detailed design package for the complete system (CCS, transformer and other auxiliary equipment) for review and approval by the Purchaser. The Supplier shall provide a document reference list with the detailed design package to allow the Purchaser to identify any omissions and to keep track of document submissions.

The Supplier shall allow the Purchaser at least 10 working days for the review of any design document and submission of associated comments. The Supplier shall ensure that the submissions are phased appropriately to avoid large volumes of documentation being submitted at any one time.

5.18.3 Testing

The Supplier shall provide detailed test schedules, specifications and programmes for review and approval by the Purchaser. The testing information shall cover the Factory Acceptance Tests, Site Acceptance Tests and commissioning activities. All testing documentation must be approved before testing can commence and shall be submitted for review no later than two months before the test is due to be performed.

The Supplier shall ensure that three hard copies of testing documentation are made available to the Purchaser at the time of witnessing the tests.

5.18.4 User Manuals

The Supplier shall produce a User Manual for the complete system. A draft version of the User Manual must be available at least one month before the first Factory Acceptance Test. The approved User Manual must be submitted at least three months before the complete system is energised.

The Supplier shall provide a hard copy of the draft User Manual during testing and three hard copies of the final User Manual upon commissioning. The final User Manual shall incorporate any changes as described in Clause 5.18.5.

5.18.5 As Built Information

The Supplier shall be responsible for providing updated “as built” design documentation following the final commissioning and energisation of the complete system. The Supplier shall provide three hard copies of the final “as-built” design and soft copies as detailed in Clause 5.18.1. All updated designs shall be completed no later than two months after the complete system has been energised.

5.19 Training

The equipment installed in the CCS is likely to differ from the equipment that is installed across the majority of sites within the Purchaser’s network. As such, the Supplier shall be responsible for the provision of basic training for the up to five people from the Purchaser. The training shall incorporate the following items:

a) Site based training for operational staff

The Supplier shall provide a programme of training for review by the Purchaser including content, timing and location of the training.

5.20 Maintenance and Service Agreement

5.20.1 General

The Supplier shall provide details of any maintenance plans and/or service agreements that could be procured by the Purchaser to manage the ongoing requirements of the equipment within the Offer. The Supplier shall provide details such as remote support capabilities, corrective and preventative maintenance options, spare parts and cost breakdowns for the various options. The Supplier shall also detail the standard warranty period and any options to extend the warranty.

5.20.2 Maintenance Requirements

The Supplier shall provide a list of all items which require regular inspection and/or maintenance, along with the recommended intervals, to achieve the specified design life.

Consideration shall be given to minimise the outage requirements for any operation and maintenance activities through provision of redundancy/duplication of critical systems and components. Appropriate positioning of components to which access may be required shall also be considered and demonstrated by the Supplier. The complete system shall be designed such that routine inspections and maintenance do not require an outage to be taken.

The Supplier, with assistance from the Purchaser, shall monitor the availability of the complete system following handing over. One year prior to the end of the warranty period a report shall be presented to the Purchaser demonstrating the actual availability and reliability of the complete system. If the actual availability or reliability is measured to be less than specified, remedial action shall be agreed and taken to rectify the shortfall in performance.

6 33/11.5 kV Transformer

6.1 General

The 33/11.5 kV transformer shall be designed, constructed, tested and installed in accordance with the requirements of NGED EE Spec 8 and ENA Technical Specification 35-2. However, the transformer shall have a Continuous Maximum Rating (CMR) in accordance with NGED EE Spec 1 and ENA Technical Specification 35-3.

The main tank of the transformer shall be hermetically sealed with cooling radiators directly coupled to the sides of the tank. The pressure changes inside the tank shall be regulated using a pressure/vacuum purge valve.

The Purchaser reserves the right to reject any designs proposed by the Supplier that do not meet the requirements of these specifications. Any deviations from these specifications must be clearly highlighted in APPENDIX 2 to be returned with the tender.

6.2 Rating

The 33/11.5 kV transformer shall be designed to have a CMR as described in ENA Technical Specification 35-3.

The nominal transformer rated power shall be 12 MVA, however, the Supplier shall also provide options for 7.5 MVA, 15 MVA or 20 MVA.

6.3 Voltage

6.3.1 Nominal

The nominal transformer higher voltage shall be 33 kV and the nominal transformer lower voltage shall be 11.5 kV.

The transformer shall be designed to operate for the nominal and highest system voltages expected as documented in Table 6.1.

Table 6.1 Transformer voltage

Nominal System Voltage (kV)	Highest Voltage for Equipment (kV)	Power-frequency Withstand Voltage (kV)	Lightning Impulse Withstand Voltage (kV)
11	12	28	95
33	36	70	170

6.3.2 Power-frequency withstand

The transformer shall be designed to a short duration power frequency withstand voltage as detailed in Table 6.1.

6.3.3 Basic insulation level

The transformer shall be designed to a lightning-impulse withstand voltage as detailed in Table 6.1.

6.4 Impedance

The short-circuit impedance of the transformer shall be proposed by the Supplier to meet the requirements of BS EN 60076-5 whilst maintaining an acceptable level of voltage drop.

6.5 Vector Group

The high voltage winding of the transformer shall be delta connected.

The vector group for the low voltage winding shall be star connected.

6.6 Tapping Range

The transformer tapping range shall be as per Clause 6.0 of Engineering Specification EE Spec 8.

6.7 Connections

6.7.1 General

The high and low voltage phases of the transformer shall be cable connected. Details of specific requirements depending on voltage are described in the following sections.

6.7.2 High voltage phase connections at 33 kV and below

The phase connector shall be provided via Euromold Interface C separable connector bushings (type M400 AR-4) rated 36 kV 1250 A continuous. The connectors shall be mounted on the vertical face of the transformer tank and shall be protected with a weather shield.

Construction and testing requirements for the cable connections can be found in Clause 15.3 of Engineering Specification EE Spec 8.

6.8 Insulating Fluid

The transformer shall be filled with a synthetic ester fluid in compliance with BS EN 61099. The Supplier shall provide details in APPENDIX 1 and a separate data sheet for the proposed ester fluid. The main transformer and auxiliary transformer shall be equipped with labels clearly indicating that synthetic ester fluid has been used.

The transformer shall be supplied to NGED filled with fluid.

6.9 Cooling

The transformer shall have KNAN cooling. The cooling banks alone shall be capable of dissipating the total losses at CMR and when operating at any loading within the normal loading cycle.

The Supplier shall provide a design that integrates the cooler bank into the transformer tank design. The Supplier shall comply with the specific construction requirements for cooler banks attached to the main tank that are detailed in Clause 14.7 of Engineering Specification EE Spec 8.

6.10 Fluid preservation system

The Supplier shall propose a fluid preservation system that minimises the requirement for ongoing maintenance. However, the Supplier shall ensure that the transformer tank is designed to suitably manage the pressure fluctuations due to the thermal expansion and contraction of the internal insulating fluid volume without compromising the integrity of the tank and associated internal components (valves, pipework, aux relays etc.).

6.11 On Load Tap Changer

The transformer shall be fitted with a bolt-on vacuum insulated tap changer. The tap changer shall comply with Clause 15.4 of Engineering Specification EE Spec 8.

6.12 Neutral Earthing

The Neutral Earthing Resistor (NER) shall be dry type and comply with Engineering Specification EE Spec 123.

The Supplier shall provide a design that incorporates mounting the NER on the side of the transformer tank to reduce the overall footprint of the CCS. Where possible this design solution shall avoid inhibiting maintenance access to transformer ancillary equipment located on the transformer tank.

6.13 Losses

The transformer design shall comply with the EU Ecodesign directive, in particular the 2021 requirement for Tier 2 losses.

The Supplier shall ensure that the transformer design meets the Minimum Peak Efficiency Index as detailed in Table 6.2.

Table 6.2 Minimum Peak Efficiency Index

Rated Power (kVA)	Minimum Peak Efficiency Index (%)
7,500	99.581
12,000	99.618
15,000	99.643
20,000	99.684

The Supplier shall demonstrate compliance with the Minimum Peak Efficiency Index in their Offer and provide figures for non-load and load losses within APPENDIX 1.

6.14 Protection

The transformer shall be equipped with the following measurement and protection devices as detailed further within Engineering Specification EE Spec 1 and ENA Technical Specification 35-3:

a) Gas and oil actuated relay (tap-changer)
b) Sudden pressure relief (main)
c) Pressure gauge (main)
d) Vacuum gauge (main)
e) Pressure relief device (main and auxiliary)
f) Winding temperature indicators
g) Current transformers

The Supplier shall provide the necessary current transformers for the overall transformer protection scheme and winding temperature indicator input. Further details of the required current transformers are provided within Clause 15.6.6 of Engineering Specification EE Spec 8 and ENA Technical Specification 35-2.

6.15 Other fittings

The transformer shall be equipped with fittings as detailed within Clause 15.6.7 of Engineering Specification EE Spec 8 and ENA Technical Specification 35-2. The Supplier shall ensure that all fluid and gas sampling valves are located around 1.5m from ground level to allow personnel to access them without having to work at height.

6.16 Testing

As a minimum, the Supplier shall arrange for the following tests to be conducted on the transformer at a certified laboratory:

a) Measurement of winding resistance
b) Measurement of voltage ratio and check of phase displacement
c) Measurement of insulation resistance
d) Measurement of short-circuit impedance and load loss
e) Measurement of no-load loss and current
f) Measurement of zero sequence phase impedance
g) Applied voltage (power frequency withstand test)
h) Chopped wave lightning impulse test
i) Temperature rise test
j) Auxiliary wiring insulation test
k) Magnetic circuit voltage withstand test
l) Determination of sound levels
m) Oil pressure test
n) Vacuum test
o) Frequency response analysis
p) Surface treatment thickness

Further details of the tests listed above can be found in Engineering Specification EE Spec 8, ENA Technical Specification 35-2 and BS EN 60076-1. The Supplier shall provide details of their proposed testing sequence and location of tests with their Offer. All tests listed above shall be witnessed by one or more NGED Engineers.

7 12 kV Switchgear

7.1 General

The 12 kV switchgear shall be designed, constructed, tested and installed in accordance with the requirements of NGED EE Spec 185 and ENA Technical Specification 41-36. The switchgear shall be selected from the list of approved NGED switchgear detailed in the NGED EE Spec 122.

NGED reserves the right to reject any designs proposed by the Supplier that are not on the approved list and do not meet the requirements of these specifications. Any deviations from these specifications must be clearly highlighted in APPENDIX 2.

7.2 Configuration

The 12 kV switchgear shall be configured with one incoming transformer feeder and two outgoing feeders as shown in Figure 7.1.

The 12 kV switchgear shall be configured to avoid cables crossing where reasonably practical for safety purposes.

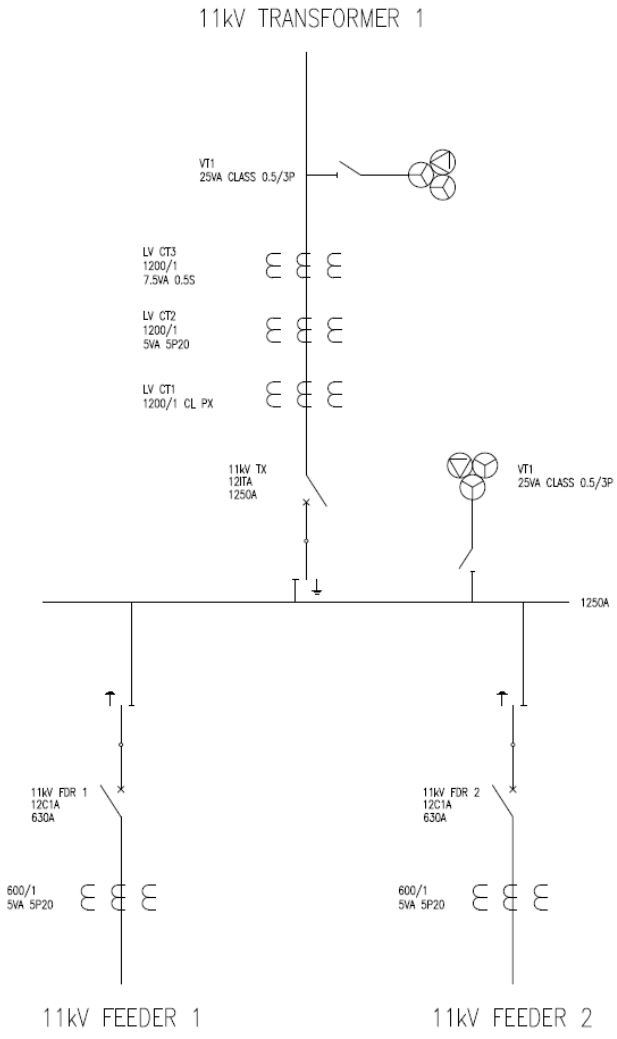

Figure 7.1 12kV switchgear configuration

7.3 Ratings

Table 7.1 details the ratings of each panel of 12 kV switchgear and corresponding type as defined in NGED EE Spec 185.

Table 7.1 12kV switchgear ratings

Item	Feeder 1	Transformer 1	Feeder 2
Circuit reference	11kV FDR 1	11kV TX	11kV FDR 2
EE185 Ref	12C1A	12ITA	12C1A
Rated voltage (kV)	12	12	12
Rated busbar current (A)	1250	1250	1250
Rated circuit breaker current (A)	630	1250	630

The requirements for the ratings for short circuit and insulation levels are detailed in Section 5.3 and 5.4 of this specification respectively.

7.4 Connections

The connections for the 12 kV switchgear shall comply with the requirements stated in NGED EE Spec 185. The HV connections for the switchgear shall be bottom entry and the cable boxes equipped with Euromold Type C interface bushings. All multicore and auxiliary cables shall be top entry. The termination requirements for each circuit type are detailed in Table 7.2.

In certain circumstances, a Type C interface bushing is not available to meet the required circuit breaker rated current. In this instance, a palm lug connection will suffice provided the rating meets the requirements set out in Table 7.1.

Table 7.2 12kV switchgear terminations

Item	Feeder 1	Transformer 1	Feeder 2
Termination requirement	3 x 1C 300mm²	6 x 1C 630mm²	3 x 1C 300mm²

7.5 Protection

The 12 kV switchgear shall be equipped with the Current Transformers and Voltage Transformers as detailed in Table 7.3. These requirements reflect the details that are already captured in NGED EE Spec 185. The Supplier shall ensure that all protective devices, wiring, schemes, instrumentation transformers and all other associated designs and equipment fully comply with the requirements of NGED EE Spec 185.

Table 7.3 12 kV switchgear protection requirements

Scheme	Feeder 1	Transformer 1	Feeder 2
Current Transformers			
3OCIT EIT	3 x 600/1 5VA 5P20	-	3 x 600/1 5VA 5P20
3DOCIT DEIT	-	3 x 1200/1 5VA 5P20	-
LV REF	-	4 x 1200/1 Class PX*	
SBEF	-	1 x 1200/1 15VA 5P20*	
AVC/TRANSDUCER	-	3 x 1200/1 7.5VA Class 0.5S	
Voltage transformers			
AVC/Directional	-	Star/Star/Broken Delta	-
Busbar VT (for reference in case of backfeed from 11kV network)	Star/Star/Broken Delta**	-	-

*Neutral CTs to be mounted externally
**Busbar VT can be mounted on any panel

A busbar VT shall be provided in one of the feeder panels for measurement purposes only. There is no requirement for busbar protection as the 12 kV switchgear consists of only three panels with no bus-section. Customer metering shall be located in the network downstream of the 12 kV switchgear (most likely to be the HV Ring Main Unit at individual distribution substations).

7.6 Measurement

Each 11kV panel shall be fitted with a multifunction transducer capable of measuring voltage, current, real and reactive power as a minimum. Transducers shall be compliant with Clause 5.0 of Engineering Specification EE Spec 136.

7.7 Testing

The Supplier shall ensure that the 12 kV switchgear undergoes routine testing as per Clause 1.7 of ENA Technical Specification 41-36.

8 36 kV Switchgear

8.1 General

The Purchaser shall arrange for 36 kV switchgear to be designed, constructed, tested and delivered to the Supplier for integration within the CCS. The 36 kV switchgear shall meet the requirements of ENA Technical Specification 41-36 and be selected from the list of approved NGED switchgear detailed in the NGED EE Spec 122.

NGED reserves the right to reject any designs proposed by the Supplier that are not on the approved list and do not meet the requirements of these specifications. Any deviations from these specifications must be clearly highlighted in APPENDIX 2.

8.2 Configuration

The 36 kV switchgear shall be configured with one transformer feeder and two outgoing switch disconnectors as shown in Figure 7.1.

The 36 kV switchgear shall be configured to avoid cables crossing where reasonably practical for safety purposes.

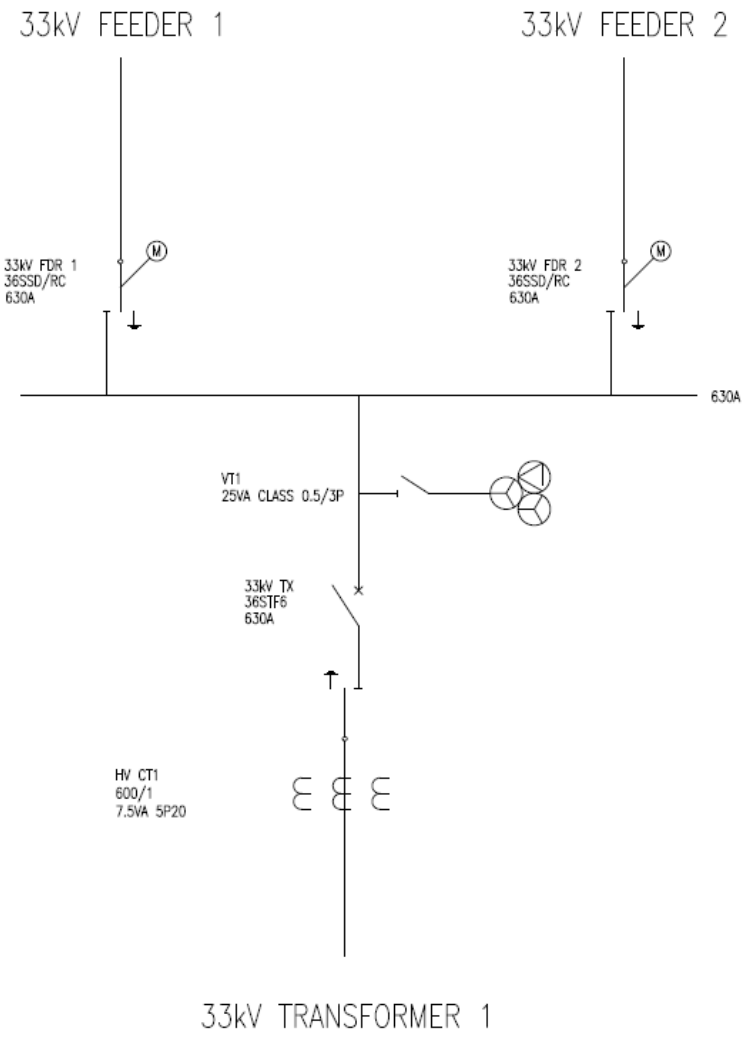

Figure 8.1 36 kV switchgear configuration

8.3 Ratings

Table 7.1 details the ratings of each panel of 36 kV switchgear and corresponding type as defined in NGED EE Spec 183.

Table 8.1 12kV switchgear ratings

Item	Feeder 1	Transformer 1	Feeder 2
Circuit reference	33kV FDR 1	11kV TX	33kV FDR 2
EE183 Ref	36SSD/RC	36STF6	36SSD/RC
Rated voltage (kV)	36	36	36
Rated busbar current (A)	630	630	630
Rated circuit breaker current (A)	-	630	-
Rated switch disconnector current (A)	630	630	630

The requirements for the ratings for short circuit and insulation levels are detailed in Section 5.3 and 5.4 of this specification respectively.

8.4 Connections

The connections for the 36 kV switchgear shall comply with the requirements stated in NGED EE Spec 185. The HV connections for the switchgear shall be bottom entry and the cable boxes equipped with Euromold Type C interface bushings. All multicore and auxiliary cables shall be top entry. The termination requirements for each circuit type are detailed in Table 7.2.

Table 8.2 36 kV switchgear terminations

Item	Feeder 1	Transformer 1	Feeder 2
Termination requirement	3 x 1C 300mm²	3 x 1C 300mm²	3 x 1C 300mm²

8.5 Protection

The 36 kV switchgear shall be equipped with the Current Transformers and Voltage Transformers as detailed in Table 7.3. These requirements reflect the details that are already captured in NGED EE Spec 183. The Supplier shall ensure that all protective devices, wiring, schemes, instrumentation transformers and all other associated designs and equipment fully comply with the requirements of NGED EE Spec 183.

Table 8.3 12 kV switchgear protection requirements

Scheme	Feeder 1	Transformer 1	Feeder 2
Current Transformers			
3OCIT EIT	-	3 x 600/1 7.5VA 5P20	-
Voltage transformers			
Busbar VT (for reference in case of backfeed from 11kV network)	-	Star/Star/Broken Delta	-

A busbar VT shall be provided in one of the feeder panels for measurement purposes only. There is no requirement for busbar protection as the 36 kV switchgear consists of only three panels with no bus-section.

8.6 Measurement

Each 36 kV panel shall be fitted with a multifunction transducer capable of measuring voltage, current, real and reactive power as a minimum. Transducers shall be compliant with Clause 5.0 of Engineering Specification EE Spec 136.

8.7 Testing

The Supplier shall ensure that the 36 kV switchgear undergoes routine testing as per Clause 1.7 of ENA Technical Specification 41-36.

9 Ancillary Equipment

9.1 General

The Purchaser shall arrange for the following equipment to be designed, constructed, tested and delivered to the Supplier for integration within the CCS:

a) Transformer protection and control panel

b) 110 V DC battery charger and distribution board

c) 48 V DC battery charger

d) RTU

The design of this equipment is highly dependent on the individual requirements of the network operator/owner. The basic requirements are captured in the following sections and may need to be tailored to reflect specific network requirements.

9.2 Transformer protection and control panel

The combined transformer protection and control panel shall be designed, constructed, tested and installed in accordance with the requirements of NGED EE Spec 87 and ENA Technical Specifications 48-5 and 50-18.

The cubicles shall be floor standing and front access and suitable for top-entry cable installation. The cubicle shall have the following external dimensions:

a) Height: 2,275 mm

b) Width: 610 mm

c) Depth: 610 mm

The cubicle shall be fixed to the enclosure structure and adequate additional supports provided during transport and offloading to prevent movement and possible damage.

The cubicle shall house both the equipment associated with the protection and voltage control of the transformer. The voltage control relay and associated equipment (including fuses) shall be located on the upper half of the panel. The protection related equipment shall be located on the lower half of the panel. The panel shall have a physical barrier segregating the upper and lower parts. The layout of the equipment shall be optimised to make best use of the space available in the panel, avoiding locating relays and equipment at the upper and lower extremities.

9.3 110 V DC battery charger and distribution board

The 110 V DC battery charger and distribution board shall be designed, constructed, tested and installed in accordance with the requirements of NGED EE Spec 25 and ENA Technical Specifications 48-4, 50-18 and 50-19.

The 110 V battery charger and batteries shall be incorporated into a single cubicle which shall be floor standing and front access and suitable for top-entry cable installation. The cubicle shall have the following maximum external dimensions:

a) Height: 2,275 mm

b) Width: 650 mm

c) Depth: 650 mm

The cubicle shall be fixed to the enclosure structure and adequate additional supports provided during transport and offloading to prevent movement and possible damage.

The sizing of the battery and charger will be dependent on the loads required for the 36 kV switchgear, 12 kV switchgear and other protection related equipment. However, the indicative requirement for a typical installation would be a 10 A charger with a 62 Ah battery (2 nos. 31 Ah strings).

The cubicle shall also be equipped with the following controls, alarms and instrumentation:

a) Circuit breaker (for the incoming supply)
b) Status LEDs (“On”, “Healthy” and “Fault” as a minimum)
c) Alarms (mains fail, high volts, low volts, earth fault and battery fault)
d) Displays (voltmeter, ammeter, float indication and test)

A separate 110 V DC distribution board shall be supplied with the charger and battery cubicle to distribute the supplies to the relevant equipment. The distribution board shall be equipped with 6 nos. 63A outgoing ways. The distribution board shall be wall mounted and located as close as possible to the 110 V battery charger cubicle.

9.4 48 V DC battery charger

The 48 V DC battery charger and distribution board shall be designed, constructed, tested and installed in accordance with the requirements of NGED EE Spec 104 and ENA Technical Specifications 48-4, 50-18 and 50-19.

The 48 V battery charger and batteries shall be incorporated into a single cubicle which shall be floor standing and front access and suitable for top-entry cable installation. The cubicle shall have the following maximum external dimensions:

a) Height: 2,275 mm
b) Width: 650 mm
c) Depth: 650 mm

The cubicle shall be fixed to the enclosure structure and adequate additional supports provided during transport and offloading to prevent movement and possible damage.

The sizing of the battery and charger will be dependent on the loads required for the RTU and associated equipment. However, the indicative requirement for a typical installation would be a 10 A charger with a 62 Ah battery (2 nos. 31 Ah strings).

The cubicle shall also be equipped with the following controls, alarms and instrumentation:

a) Circuit breaker (for the incoming supply)
b) Status LEDs (“On”, “Healthy” and “Fault” as a minimum)
c) Alarms (mains fail, high volts, low volts, earth fault and battery fault)
d) Displays (voltmeter, ammeter, float indication and test)

9.5 RTU

The RTU and associated cabinet shall be designed, constructed, tested and installed in accordance with the requirements of NGED EE Spec 136 and 143 and ENA Technical Specifications 48-4, 50-18 and 50-19.

The RTU shall have the ability to communicate through the following methods:

a) Microwave

b) Fibre optic

c) UHF licenced radio

The design of the RTU and cabinet shall be compact in size, tailored to the equipment located inside the enclosure. The cabinet shall be wall mounted, with fixings that are compatible with Unistrut. The cabinet shall be configured to offer both top and bottom cable entry, with a swing frame door to accommodate additional IO modules as required.

The RTU and associated equipment shall have a design operating voltage of 48 V DC. The design shall incorporate Digital Outputs (for equipment control), Digital Inputs (for alarms, trips and status information) and Analogues (for transducer outputs). As a minimum, the design of the RTU shall accommodate:

a) 10 nos. Digital Output pairs

b) 65 nos. Digital Inputs

c) 20 nos. Analogues

Krone plates shall be mounted inside the cabinet to route the input/output wiring to the relevant RTU modules. The RTU shall incorporate a status common which shall be positive (+48 V).

10 Enclosure

10.1 General

Where applicable the design, construction, installation and delivery of the enclosure shall comply with the requirements set out in Engineering Specification EE 140.

The Purchaser is open to innovative enclosure designs and features that may depart from existing NGED specifications. These are to be proposed in the Supplier's Offer and The Supplier shall demonstrate that the design is beneficial (space, cost saving etc.) whilst maintaining the minimum requirements for personnel access, maintenance and safety.

The enclosure design must be suitable for a minimum service life of 40 years.

The enclosure shall be designed and constructed so that it can be lifted and transported with all the internal equipment (including switchgear) installed in its final position inside the enclosure.

The enclosure shall have no windows. It shall be designed to shed water from its roof and be equipped with gutters and down pipe(s) that are removable for transport. The interior floor shall be of robust maintenance free material such as chequer plate and not wood.

The structure shall have a rating of IP54 with doors rated to IP 4X. Louvres and vents shall be weatherproof. The Supplier shall ensure that the surrounding gap around cables entering the enclosure are weathertight and vermin proof.

All electrical items are to be identified with engraved labels that are mechanically fixed. A building/site nameplate will be fitted to each door.

Appropriate internal/external health and safety signage shall be provided. Fixing points shall be provided for all NGED substation signs to prevent drilling on site.

10.2 Dimensions and Weight

The Supplier shall aim to minimise the dimensions of the enclosure whilst maintaining sufficient clearances for uninhibited and safe access / egress into the enclosure; and operation / maintenance of the internal equipment. The Supplier is expected to collaborate with the Purchaser to finalise the layout of equipment in line with these requirements.

A layout of the enclosure with overall dimensions is shown in Figure 10.1.

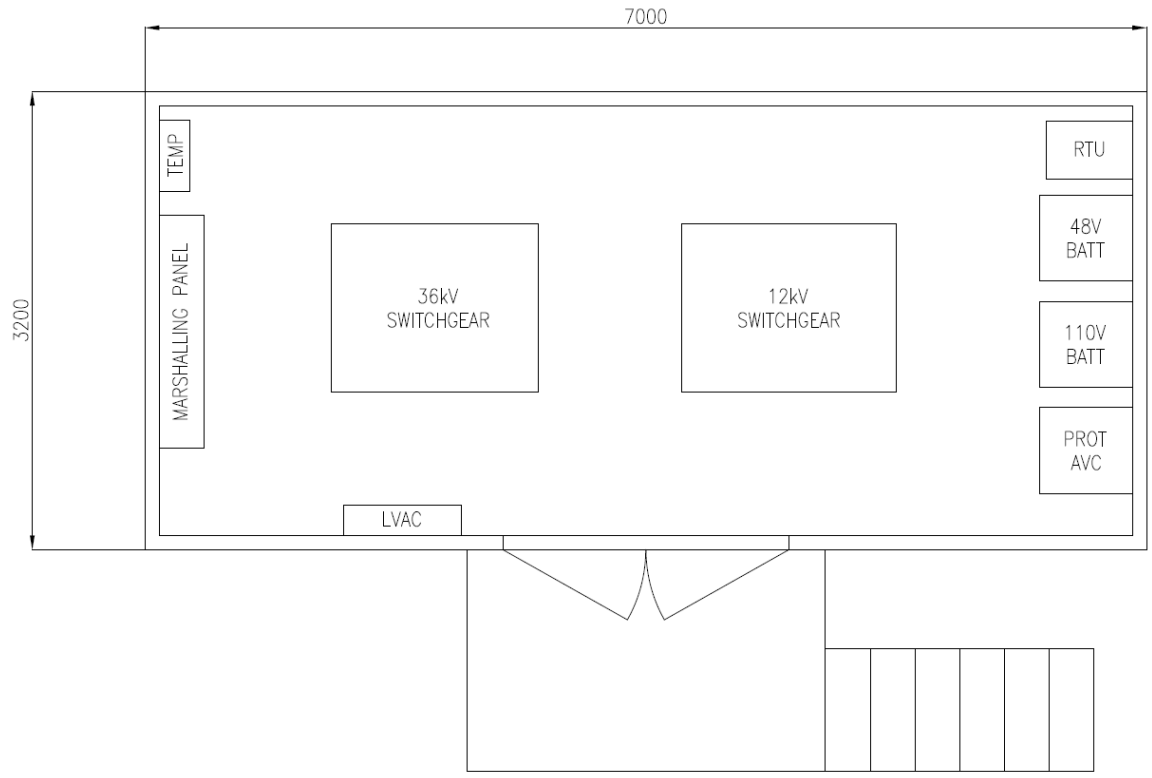

Figure 10.1 Enclosure layout

10.3 Access / Egress

The enclosure shall have a single double access door located centrally along the enclosure's length. The Supplier shall design the double doors in accordance with the requirements set out in Clause 3.6 of Engineering Specification EE Spec 140. There is no requirement for an additional emergency escape door.

The doors shall be provided with internal high security multi-point panic bolts. The Purchaser shall supply the doors with a free-issue euro profile type lock barrel, whilst the Supplier shall provide the associated lock.

The Supplier shall provide and install, where the design makes it relevant, a set of personnel access steps complete with handrail, all hot-dipped galvanised and arranged to bolt onto fixing points to be provided on the enclosure, and incorporating means to take account of ground level variation.

The doors and all associated steelwork for the access / egress to the enclosure shall be earth bonded.

10.4 Thermal and Climate Management

The environmental control system shall be designed to ensure that all internal equipment operates within its nominal humidity and temperature ranges. The environmental control system shall be designed in accordance with Clause 4.7 and 4.8 of Engineering Specification EE Spec 140. The design shall take account of the heat dissipation from the associated electrical equipment during operation.

The enclosure shall have as a minimum the following thermal ('U') values – Roof – 0.2W/m²K, Walls - 0.37W/m²K, Base - 0.35W/m²K. Solar gain needs to be considered and how this is to be effectively dissipated.

10.5 Arc Vent and Over Pressure

The venting arrangement shall be incorporated into the enclosure design. It is envisioned that the solution proposed will be a simple pressure relief panel complete with retaining chains fitted to the rear of the switchboard. The solution will need to maintain building security and have the potential to signal that it has operated.

10.6 Construction and Materials

The enclosure shall be designed in accordance with Clause 2.6 of Engineering Specification EE Spec 140.

The roof shall be designed in accordance with Clause 3.5 of Engineering Specification EE Spec 140.

10.7 Finish

The enclosure exterior finish shall be provided in accordance with Clause 3.7 of Engineering Specification EE Spec 140.

The colour will be a standard 12B29 Juniper Green or Midnight Green BS4800/5252/ unless otherwise requested at time of order.

The internal walls and ceiling will be painted white and be maintenance free for the life span of the building.

The module floor surfaces will be painted and be non-slip for the life span of the structure.

The underside of the base shall be coated to prevent corrosion for the life span of the structure.

10.8 Small power and Lighting

The internal equipment shall be fully wired and connected so that the only additional light current and LV electrical work required is the connection of multicores from sources external to the enclosure via a single marshalling terminal box (such external sources will include primary transformer and neutral CTs, Buchholz, Winding Temperature, tap change control and LVAC supplies).

Internal lighting shall be included. It shall be 230 V and shall provide shadow free illumination of all operating areas. The main lighting switches shall be situated in close proximity to access/egress doors.

The enclosure shall be equipped with two Passive Infrared (PIR) operated LED floodlights to illuminate the external compound surrounding the enclosure.

The incoming LVAC supply shall be equipped with a manual change-over switch integrated with a generator supply point. The switch shall allow the user to manually change between the

standard LV supply (fed from the auxiliary transformer mounted on the 33/11.5 kV transformer) and a temporary LV supply (mobile generator).

10.9 Cable Management

The small wiring shall be contained in appropriately sized, multi compartment, galvanised steel trunking routed around the perimeter of the enclosure, with trunking and conduit drops for lighting and sockets, and tray risers from incoming/outgoing service routes.

It is preferred that multicore / multipair signal wiring between the switchgear and associated panels is routed and contained in galvanised steel ladder rack installed at ceiling level.

The Supplier shall make provision for a marshalling cubicle within the enclosure to provide an interface between the switchgear, transformer and RTU. The external interface between the marshalling cubicle and the transformer shall be equipped with Harting Han Heavy Duty connector sockets. The Supplier shall also provide the associated multi-core cable(s) complete with Harting Han Heavy Duty plugs to be installed between the transformer and marshalling cubicle.

10.10 Earthing

All equipment and metallic components shall be bonded to earth via an earthing ring around the inside of the enclosure. The earthing of auxiliary equipment within the enclosure shall be compliant with ENA Technical Specification 50-18.

The internal earths shall be commoned up near the multicore marshalling box and connected to two externally located 12 mm dia brass studs, one near each diagonal end of the enclosure, which will form the connection point to the existing NGED substation earth system. Due account must be taken of contact between dissimilar metals.

10.11 Transportation and Offloading

The Supplier shall design the enclosure to avoid transport restrictions to the site location, particularly imposed by transport height and width limits from low bridges and narrow lanes. It is envisaged that the overall transport height will not exceed approximately 4.5 m when on a vehicle load bed of 900 mm, and the transport width less than 3.2 m.

The enclosure shall be arranged for vehicle offloading in multiple ways, namely the following in this order of preference:

1. By provision of fully rated lifting facilities for offload by crane; and
2. By provision of jacking facilities to enable jack and roller skid to a height of 1.5m (in the manner of moving a heavy indivisible load such as a power transformer).

The equipped enclosure shall be supplied with Centre of Gravity (CoG) quadrant markings on the rear and side of unit.

10.12 Supporting Steelwork

The Supplier shall be responsible for the provision of all supporting steelwork to allow personnel access to the enclosure and cable routing into the enclosure.

The Supplier shall ensure the HV cable supporting steelwork between the enclosure floor and ground level is fitted with pre-arranged fixing points so that the Purchaser is able to secure the cables with Ellis cleats during the installation.

All supporting steelwork shall be earth bonded.

10.13 Fire Resistance and Detection

The Supplier shall ensure the design is compliant with Clause 2.8 of Engineering Specification EE Spec 140.

Provision shall be included for accommodation of two fire extinguishers inside the enclosure.

The Supplier shall provide a means of fire detection and make an associated volt free contact for remote alarm to the Purchaser's SCADA system.

A system shall be provided that prevents fire from escaping through vents and louvres.

10.14 Intruder Protection

The housing shall be equipped with an intruder alarm. The intruder alarm shall have contacts on all doors and dual technology (PIR/microwave) sensor(s). It shall have an externally mounted self-actuating sounder and beacon and timed cut off, entry/ exit delay, plus volt free contact for remote alarm to Purchaser's SCADA system.

APPENDIX 1 SCHEDULE OF REQUIREMENTS

A1.1 Site Address

To be completed

A1.2 General

Item	Description	Unit	Req.	Offer
Complete System				
1	Overall Site Dimensions			
2	i. Length	mm	17,000	
3	ii. Width	mm	13,000	
4	iii. Height	mm	5,500	
5	Maximum ambient service temperature	°C	40	
6	Minimum ambient service temperature	°C	-25	
7	Maximum service altitude	M	<1,000	

△ - Supplier to complete, no specific requirement from Purchaser

A1.3 Transformer

Item	Description	Unit	Req.	Offer
General Information				
1	Manufacturer		△	
2	Place and country of manufacture		△	
3	Applicable standards	BS EN	60076	
4	Noise enclosure		No	
Rating				
5	Cooling method		KNAN	
6	Insulating Medium		Synthetic Ester fluid	
7	Rated power	MVA	7.5/ 12/ 15/ 20[1]	
8	Rated voltage (HV)	kV	33	
9	Rated voltage (LV, no-load)	kV	11.5	
10	Impedance voltage (75°C, at rated power)	%	△	

[1] The nominal transformer rated power shall be selected from the range at the time of tender.

11	Rated current (HV)	A	1,250	
12	Rated current (LV)	A	630	
13	No-load current	A	△	
14	Number of phases		△	
15	Rated frequency	Hz	50	
16	Vector group symbol		Dy11	
17	Top oil temperature rise	K	60	
18	Winding temperature rise	K	65	
19	Maximum Hot Spot for Temperature for Continuous Rated Load	°C	△	
20	Insulation system of HV winding		△	
21	Insulation system of LV winding		△	
Insulation level				
22	Power frequency withstand voltage (HV/ LV)	kV	70/28	
23	Lightning impulse level (HV/ LV)	kV	170/95	
Tap changer				
24	Position		HV side	
25	Type		OLTC	
26	Technology		Vacuum	
27	Tapping range	%	±10	
28	Tap step	%	1.25	
29	Number of steps		△	
Design details and features				
30	Type of core material		△	
31	Core material grade		△	
32	Specific Watt Loss (at 1.7T and 50Hz)	W/kg	△	
33	Magnetic flux density (voltage and frequency)	T	△	
34	Magnetic flux density saturation	T	△	
35	Insulation Material		Synthetic Ester fluid	
36	Number of windings		△	
37	HV Winding Material		△	

38	HV Winding Conductor Type		△	
39	LV Winding Material		△	
40	LV Winding Conductor Type		△	
41	Current densities at rated power		△	
	i. HV	A/mm^2	△	
	ii. LV	A/mm^2	△	
42	Winding resistances at 75°C			
	i. HV	Ω	△	
	ii. LV	Ω	△	
43	HV Connection Type		M400 AR-4	
44	Manufacturer of HV Connection		Euromold Interface C	
45	LV Connection Type		M400 AR-4	
46	Manufacturer of LV Connection		Euromold Interface C	
47	Losses (75°C, rated voltage, frequency and rated load)	kW	Tier 2 losses	
48	No-load losses	kW	Tier 2 losses	
49	Load losses	kW	Tier 2 losses	
Tests (BS EN 60076)				
50	Measurement of winding resistance		Yes	
51	Measurement of voltage ratio and check of phase displacement		Yes	
52	Measurement of insulation resistance		Yes	
53	Measurement of short-circuit impedance and load loss		Yes	
54	Measurement of no-load loss and current		Yes	
55	Measurement of zero sequence phase impedance		Yes	
56	Applied voltage (power frequency withstand test)		Yes	
57	Chopped wave lightning impulse test		Yes	
58	Temperature rise test		Yes	
59	Auxiliary wiring insulation test		Yes	
60	Magnetic circuit voltage withstand test		Yes	
61	Determination of sound levels		Yes	

62	Oil pressure test		Yes	
63	Vacuum test		Yes	
64	Frequency response analysis		Yes	
65	Surface treatment thickness		Yes	
66	Name of independent testing laboratory		△	
67	Location of independent testing laboratory		△	
Operating details				
68	Maximum sound power level (@ 1 metre)	dBA	70	
69	AC auxiliary supply voltage	V	400/230	
70	DC auxiliary supply voltage	V	110/48	
Mass and dimensions				
71	Transformer dimensions			
	i. Height	mm	△	
	ii. Depth	mm	△	
	iii. Width	mm	△	
72	Total Mass of Transformer (without oil)	kg	△	
73	Overall Mass (Transformer with oil)	kg	△	
74	Shipping dimensions			
	i. Height	mm	△	
	ii. Depth	mm	△	
	iii. Width	mm	△	

△ - Supplier to complete, no specific requirement from Purchaser

A1.4 12kV switchgear

Item	Description	Unit	Req.	Offer
General Information				
1	Manufacturer		△	
2	Place and country of manufacture		△	
3	Applicable standards	BS EN	62271	
Rating				
4	Rated frequency	Hz	50	
5	Number of phases		3	
6	Number of panels		3	
7	Rated voltage	kV	12	
8	Rated nominal current	A	1250/630	
9	Rated short-time withstand current	kA	25	
10	Rated duration of short circuit	sec	3	
11	Arc interruption medium		△	
12	Insulation medium		△	
13	Internal arc classification		AFLR	
Insulation Level				
14	Power frequency withstand voltage (HV/ LV)	kV	28	
15	Lightning impulse level (HV/ LV)	kV	95	
Design Details and Features				
16	HV Connection Type		△	
17	Cable termination requirements			
	i. Feeder		3 x 1C 300mm²	
	ii. Transformer		6 x 1C 630mm²	
18	Auxiliary cable entry type		Top	
Operating Details				
19	AC auxiliary supply voltage	V	400/230	
20	DC auxiliary supply voltage	V	110/48	
21	Measurement transducers		Yes	Yes

Mass and Dimensions				
22	Switchgear dimensions (per panel)			
	i. Height	mm	△	
	ii. Depth	mm	△	
	iii. Width	mm	△	
23	Total Mass of Switchgear (per panel)	kg	△	
24	Shipping dimensions (per panel)			
	i. Height	mm	△	
	ii. Depth	mm	△	
	iii. Width	mm	△	

△ - Supplier to complete, no specific requirement from Purchaser

A1.5 36 kV switchgear

Item	Description	Unit	Req.	Offer
General Information				
1	Manufacturer		△	
2	Place and country of manufacture		△	
3	Applicable standards	BS EN	62271	
Rating				
4	Rated frequency	Hz	50	
5	Number of phases		3	
6	Number of panels		3	
7	Rated voltage	kV	36	
8	Rated nominal current	A	630	
9	Rated short-time withstand current	kA	20	
10	Rated duration of short circuit	sec	3	
11	Arc interruption medium		△	
12	Insulation medium		△	
13	Internal arc classification		AFLR	
Insulation Level				

14	Power frequency withstand voltage (HV/ LV)	kV	70	
15	Lightning impulse level (HV/ LV)	kV	170	
Design Details and Features				
16	HV Connection Type		Euromold Type C	
17	Cable termination requirements			
	iii. Feeder		3 x 1C 300mm²	
	iv. Transformer		3 x 1C 300mm²	
18	Auxiliary cable entry type		Top	
Operating Details				
19	AC auxiliary supply voltage	V	400/230	
20	DC auxiliary supply voltage	V	110/48	
21	Measurement transducers		Yes	Yes
Mass and Dimensions				
22	Switchgear dimensions (per panel)			
	iv. Height	mm	△	
	v. Depth	mm	△	
	vi. Width	mm	△	
23	Total Mass of Switchgear (per panel)	kg	△	
24	Shipping dimensions (per panel)			
	iv. Height	mm	△	
	v. Depth	mm	△	
	vi. Width	mm	△	

△ - Supplier to complete, no specific requirement from Purchaser

APPENDIX 2 NON COMPLIANCE SCHEDULE

The Supplier shall populate the following table with a list of any non-compliances against this specification, documenting the effects that the non-compliance is likely to have on the equipment life and operating characteristics.

Each item shall reference the relevant clause from the specification or reference specification.

Ref/Clause	Non-Compliance