1. SCOPE

This specification details The Company's requirement for the supply and delivery of Low Voltage Direct Current (LVDC) switchgear for use in power distribution at the LV Engine trial site.

The LV equipment covered by this specification is for LVDC switchgear for use in indoor substations.

2. REVIEW

This is a PROJECT document and shall be reviewed prior to Business as Usual application.

3. DISTRIBUTION

This is a PROJECT document and is not part of a Manual maintained by Document Control and does not have a maintained distribution list.

4. CONTENTS

5. REFERENCE AND RELATED DOCUMENTS

This specification makes reference to, or implies reference to, the following documents. It is important that all users of standards, specifications, and other listed documents ensure that they are applying the most recent editions, together with any amendments.

5.1 Health and Safety Statutory Legislation and Company Requirements

Health and Safety at Work etc. Act 1974

The Electricity Act 1989

The Utilities Act 2000

CDM Regulations 2015

The Electricity, Safety, Quality and Continuity Regulations 2002

Electricity at Work Regulations 1989

Provision and use of Work Equipment Regulations 1998

ScottishPower Safety Rules (Electrical and Mechanical) 4th Edition

The Distribution code of Licensed Distribution Network Operators of Great Britain

5.2 International, British and Harmonised Standards

BS EN 61439-1 Low-voltage switchgear and controlgear assembles. General rules

BS EN 61439-2 Low-voltage switchgear and controlgear assembles, Part 2: Power switchgear and controlgear assemblies

BS EN 61439-5 Low-voltage switchgear and controgear assemblies, Part 5: Assemblies for power distribution in public networks

BS EN 60947-2 Low-voltage switchgear and controlgear, Part 2: Circuit-breakers

BS EN 60947-3 Low-voltage switchgear and controlgear, Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units

BS 6121-5 Mechanical cable glands. Code of practice for selection, installation and inspection of cable glands and armour glands

BS 5499-1 Graphical symbols and signs. Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout

BS EN ISO 9001 Quality management systems. Requirements

BS 7671 The IET Wiring Regulations

IEC 60068-2-30 Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12h + 12h cycle)

IEC 60695-11-1 Fire hazard testing. Test flames. 50W horizontal and vertical flame test methods

5.3 Energy Networks Association Technical Specifications (ENA TS)

ENA TS 37-2 Public Electricity Network Distribution Assemblies

ENA TS 50-18 Application of Ancillary Electrical Equipment

ENA TS Specification 50-19 Standard Numbering for Small Wiring

6. INTRODUCTION

This specification details The Company's requirement for the supply and delivery of Low Voltage Direct Current (LVDC) switchgear for use in power distribution within the LV Engine project. LVDC switchgear shall comply with BS EN 61439-2.

By way of background, LVAC switchgear is covered by *SWG-03-026 Specification for Low Voltage Fuseboards and Network Pillars.* SWG-03-026 references ENA TS 37-2 which in turn references BS EN 61439-5, the standard for PENDAs (Public Electricity Network Distribution Assemblies). Both ENA 37-2 and BS EN 61439-5 are only applicable for three phase AC systems (up to 1kV), and do not cover DC systems. The closest equivalent standard which covers DC switchboards is BS EN 61439-2, which is the commonly referenced standard for both AC and DC switchboards in the industrial, commercial, and power sectors. If LVDC switchgear is to become more widespread within DNOs, then the industry should seek modifications to BS EN 61439-5 and ENA 37-2 to incorporate the requirements of LVDC switchgear; this specification can then reference these specifications/standards.

The LVDC switchgear covered by this specification is floor mounted distribution panels for use in indoor substations.

7. DEFINITIONS AND STANDARDS

The specification will refer to standard BS EN 61439-2, and also includes the following definitions: -

Approved	Equipment approved in accordance with SP Energy Network's Equipment Approvals Procedure, and which is considered suitable for installation on The Company's networks.
DC	Direct Current
LVDC	Low Voltage Direct Current
SP Distribution plc	The Distribution Licence Holder for the distribution service area formerly known as ScottishPower.
SP Manweb plc	The Distribution Licence Holder for the distribution service area formerly known as Manweb.
SP Transmission plc	The Transmission Licence Holder for the transmission service area formerly known as ScottishPower.
SP Energy Networks (SPEN)	The brand name of the division of ScottishPower Group of Companies that encompasses SP Distribution plc, SP Transmission plc, SP Manweb plc and SP Power Systems plc.
The Contractor	The successful Tenderer (may be one or more)
The Company	Refers to SP Energy Networks
The Engineer	SP Energy Network's nominated representative having authority over technical matters contained in this specification.
The Tenderer	The supplier invited to tender in accordance with this specification.

8. GENERAL REQUIREMENTS

8.1 Equipment Description

The equipment covered by this specification shall comply with BS EN 61439-2. The equipment shall be suitable for use within the LV Engine project. The specification covers the following equipment types:

- Indoor floor mounted LVDC distribution panel

The LVDC switchgear shall meet the specific requirements for the specific equipment type as shown in Appendix A, and the general LVDC switchgear requirements shown in Appendix B.

8.2 Equipment Standards and Specifications

Equipment must comply with all specified requirements, including those in the British Standards, IEC standards, or other primary standards listed in this specification, and all ENA Technical Specifications to which this specification refers. Where equipment is designed to an associated standard or equivalent standard, the Tenderer shall state in the tender all variations from the listed primary standard in equipment design/performance and shall state the title of any associated or equivalent standard. Where components are specified in general terms, and specific types are stated to be Approved items, equivalents may be offered for Approval. However, this shall be made clear in the tender documents and sufficient information on the design and engineering performance of the equivalent components shall be provided to enable a complete assessment to be made.

8.3 Equipment Approvals

Equipment shall be approved before being accepted for connection to The Company's networks in accordance with SP Energy Network's equipment approvals procedure.

9. DESIGN AND CONSTRUCTION

A drawing detailing the overall dimensions of each LVDC switchgear assembly shall be submitted at the time of tender.

9.1 General

The equipment required by this specification shall be suitable for installation within a prefabricated single-skin enclosure manufactured from GRP without space heating.

All assemblies shall be accessible from the front only. It shall be possible to replace from the front of each board any part other than the supporting structures. All removable covers/plates fixed by bolts should have a captive nut type arrangement where practicable.

The minimum operating life of the assembly shall not be less than 30 years.

Insulating materials used for enclosures, barriers and other insulating parts have flame retardant properties.

All fastenings, nuts bolts etc. shall be plated and shall have corrosion-proof locking features.

The main current carrying components (other than those made from aluminium or aluminium alloy) shall be electro-tin or electro-silver plated.

All parts of the assembly shall, as far as practicable, be readily accessible and replaceable without excessive dismantling. The design shall allow cables to be connected from the front. It shall be possible by use of a portable instrument, to readily and safely measure voltages on both sides of all current breaking and/or switch devices of outgoing units.

Storage facilities shall be provided for all loose devices e.g. tools, padlocks. Accidental bridging of phases or between poles and mid-point/earth with tools and the like shall be prevented by the provision of suitable barriers.

Locking arrangements shall be provided to secure doors and prevent unauthorised access. The fixings of any covers etc, which are removable for installation or maintenance operations shall only be accessible while the doors are open.

Removable devices used to facilitate lifting and handling of the assemblies during transport should be such that they do not buckle when the equipment is man handled into the substation. These devices shall be painted yellow or otherwise clearly marked that they are to be removed on completion of installation. Devices may be required to be returned.

The LVDC switchgear shall be painted Admiralty Grey.

All assemblies shall have a name plate mounted on the outside and front of the assembly and include the following information:

(i) Assembly manufacturer's name or trademark;
(ii) Serial number, which shall be unique, making it possible to obtain relevant information from the assembly manufacturer;
(iii) Date of manufacture;
(iv) Nominal voltage rating of assembly including the words "Direct Current";
(v) Normal current rating of the busbar;
(vi) Normal current rating of the incoming unit;
(vii) Reference to the relevant specification i.e. BS EN 61439-2 and this LVDC switchgear technical specification;
(viii) Gross weight, when fully equipped (kg).

9.2 Circuit Identification

It shall be possible to identify each functional unit in a clearly visible manner. All circuit identification labels shall be made of insulating material 75mm x 50mm, mounted in a suitable position to identify each circuit. The labels shall be securely held without the use of screws. It shall be possible to locate them in position and remove them from the front without danger whilst the assembly is live. These labels shall be suitable for engraving with black letters on a white background. The incoming circuit label shall be pre-engraved with the words "LVDC INCOMER". The outgoing circuit labels shall be blank.

All incoming circuits, busbars and outgoing circuits shall be labelled as follows:

- Positive pole: L+;
- Negative pole: L-;
- Mid-point: M;
- Earth E.

9.3 Outgoing Circuits

Cable terminations shall accept cable types shown in Appendix A. The cable mid-point conductor shall be connected directly to the mid-point busbar. The cable earth conductor and protective sheath shall be connected directly to the earth busbar.

Outgoing circuits shall be fitted with MCCBs; ratings are shown in Appendix A. MCCBs shall provide a combined circuit breaker and disconnector function. These shall be a ganged arrangement for the positive and negative circuits. It shall be possible to padlock outgoing circuits in the open position. MCCBs shall comply with BS EN 60947-2.

Access shall be provided for the use of test probes complying with HSE document GS38, Clause 9(a). The access shall permit probes with a sheath diameter of 4mm, and a minimum length of 15mm behind the tip, to make reliable contact. They shall be able to make contact with the top and bottom of the MCCB terminals.

9.4 Incoming Circuits

Cable terminations shall accept cable types and lugs shown in Appendix A. The cable mid-point shall be connected to one side of a removable bolted link.

Incoming circuits shall be fitted with switch-disconnectors in compliance with BS EN 60947-3. It shall be possible to isolate the mid-point busbar from the incoming mid-point circuit with a removable bolted link. These shall be a ganged arrangement for the positive and negative circuits. It shall be possible to padlock the incoming circuit in the open position.

Access shall be provided for the use of test probes complying with HSE document GS38, Clause 9(a). The access shall permit probes with a sheath diameter of 4mm, and a minimum length of 15mm behind the tip, to make reliable contact. They shall be able to make contact with the top and bottom of the MCCB terminals.

9.5 Operational Metering

Where operational metering is required on a circuit it shall meet the following requirements:

- IEC 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use;
- Measure voltage in volts up to at least 120% of nominal system voltage to at least 0.2% accuracy;
- Measure current in amps up to at least 120% of incoming circuit rated current to at least 0.2% accuracy;
- Measure power in kW to an accuracy of at least 0.5%;
- Measure energy in kWh to an accuracy of at last 0.5%.

It may also measure:

- DC ripple voltage;
- DC ripple current;
- Maximum demand.

The operational metering shall have a remote communications module, either RS485 Modbus or Ethernet TCP Modbus.

9.6 Switch-Disconnectors

Switch-disconnectors shall meet the requirements of BS EN 60497-3. Switch-disconnectors shall be of the fixed type. Switch-disconnectors shall have a rated voltage equal or greater to the rated voltage of the assembly. The switch-disconnector shall have a rated current equal to or greater than the current required to be supplied by the circuit it is controlling. The impulse withstand voltage shall be at least 8kV. Manual control shall be made possible with a toggle or rotary switch. An auxiliary volt free contact shall be available to indicate the switch-disconnector position.

The switch-disconnector function can be provided by connecting poles in series in order to achieve the required voltage ratings. Where the Tenderer recommends terminal shields and/or inter-phase barriers these shall be provided.

9.7 MCCBs

The MCCB shall meet the requirements of BS EN 60497-2. MCCBs shall be of the fixed type. The MCCB shall have a rated voltage equal or greater to the rated voltage of the assembly. The MCCB shall have a rated current equal to or greater than the current required to be supplied by the circuit it is controlling. The impulse withstand voltage shall be at least 8kV. The service breaking capacity shall be at least equal or greater than the prospective short-circuit current of the assembly or 8kA whichever is the greater value. The MCCB shall be suitable for isolation. Manual control shall be made possible with a toggle or rotary switch. An auxiliary volt free contact shall be available to indicate the circuit breaker position.

The MCCB function can be provided by connecting poles in series in order to achieve the required voltage ratings. Where the Tenderer recommends terminal shields and/or inter-pole barriers these shall be provided.

The MCCB shall be fitted with adjustable thermal protection (overload) when specified in Appendix A. This shall be self-powered and not require and auxiliary supply for it to function.

The MCCB shall be fitted with adjustable magnetic protection (short-circuit) when specified in Appendix A. This shall be self-powered and not require and auxiliary supply for it to function.

The MCCB shall be fitted with volts free contacts for the following indications:

- Circuit breaker position (ON/OFF);
- Fault trip indication (overload/short-circuit);
- Trip indication (under-voltage release or shunt trip release operation).

The MCCB shall be fitted with under-voltage protection when specified in Appendix A. The under-voltage protection shall monitor the positive pole to mid-point voltage and the negative pole to mid-point voltage (for the avoidance of doubt, two parameters are being monitored). Where an auxiliary supply is required for the functioning of the under-voltage protection relay this shall be +24V DC.

The MCCB shall be fitted with a shunt trip mechanism when specified in Appendix A. Where an auxiliary supply is required for the functioning of the shunt trip this shall be +24V DC.

Makes and types of MCCB shall be subject to individual approval, and full details shall be submitted in tender documents.

9.8 Safety and Operational padlocks

The following shall be pad lockable:

(i) Incoming circuits in the open position;
(ii) Outgoing circuits in the open position

It shall be possible to meet all safety and operational padlocking requirements by means of a padlock with a 41mm square body and with a 4mm to 7mm diameter shackle having a clear inside width of 21mm and inside length of 16mm to 45mm. The holes provided for the shackle shall not be less than 8mm diameter.

Note: A safety padlock, when applied to a ‘Point of Isolation’, will secure the isolation distance of a disconnector to permit work or testing. Operational padlocks are used to prevent operation of switching devices not involving a Point of Isolation.

9.9 Mid-point and Earth Connections

The assembly shall be fitted with a mid-point busbar and an earth busbar, as shown in Appendix C. The mid-point busbar and earth busbar shall be fitted with a removable bolted link and a DC residual current monitor CT.

The mid-point and earth busbars shall be insulated from the metal framework of the assembly; the insulation shall be capable of withstanding a test voltage of 7kV.

A removable bolted link shall be provided between the earth busbar and the framework. This link shall be accessible when all distributor units are in position and cabled. A label reading “Disconnect when segregated HV and LV earths are required” shall be mounted in close proximity to the link. The label shall have a blue background with white lettering in accordance with BS 5449-1. The link shall have a rated short circuit withstand strength equal to the assembly.

The following M12 fastenings with a minimum length of 40mm shall be provided: (a) one connected to the mid-point/earth busbar, projecting forward, with a label reading ‘LV mid-point earth’ in close proximity, (b) one on the framework of with a label reading ‘HV steelwork earth’ in close proximity.

For High EPR sites users will remove the mid-point/earth to frame/earth link.

9.10 Earth Fault Protection

The assembly shall be fitted with a DC residual current monitor (RCM) and CT suitable for the device. The RCM CT shall be fitted in between the mid-point busbar and the earth busbar such that an earth fault flowing from earth to the mid-point shall cause operation of the RCM.

The RCM shall be compatible with a 24V DC supply voltage.

The RCM have an adjustable trip setting and should have a separate adjustable alarm setting. A trip shall provide visible indication on the device, be locally resettable, and shall latch an volts-free auxiliary relay contact. Where an alarm function is provided, this shall provide visible indication on the device, be locally resettable, and shall latch a volts-free auxiliary relay contact.

9.11 Busbars

Busbars shall be rated to at least the rated current of the assembly as defined in Appendix A.

9.12 Terminals for External Conductors

Assemblies shall be designed such that it is possible to “lay in” the outgoing cables to their termination position such that they are not required to be threaded through or behind the assembly.

Suitable cable crimp lugs and cable cleats/glands shall be provided for all incoming and outgoing cable circuits.

Two earth studs free of paint, M12 x 40mm complete with washers and nuts shall be provided, located one on each vertical leg of the supporting structure.

9.13 Auxiliary Supplies

The assembly does not require a 13A socket to be fitted, nor is it required to provide DC auxiliary supplies within the substation.

9.14 Auxiliary Circuits

All auxiliary circuits/small wiring shall be appropriately identified using ferruling in accordance with the identification system set out in ENA TS 50-19.

A readily accessible terminal board shall be provided on the switchboard for the termination of the multicore interconnections. The terminal board shall be either type B or E in accordance with ENA TS 50-18. A multicore cable gland and fixing bracket shall also be provided for a size 20s gland to BS 6121-5.

9.15 Reserve Power

There is no requirement for the fitting of a standby or emergency power source.

9.16 Indoor Floor Mounted Distribution Panels

9.16.1 General

The assembly shall be suitable for floor mounting with the rear of the assembly positioned next to the substation wall. The assembly shall come fitted with a front cover which it shall be possible to remove by one person without the use of special tools.

9.16.2 Transport Frame

Each assembly shall be delivered with a frame to enable the storage of the equipment in an upright position without the need for additional support. The design of this shall be such that there are longitudinal members in contact with the floor, which may be used on rollers during the on-site positioning of the equipment. The frame shall be marked so that it can be removed and returned as required.

10. TESTING

The Tenderer shall confirm in the tender that the equipment offered will be tested to the requirements of BS EN 61439-2.

Dielectric tests equivalent to that required by BS EN 61439-5 and ENA TS 37-2 shall be required.

Copies of all test reports and certificates will be required in electronic form, and one paper copy provided with the assembly.

11. DESIGN VERIFICATION

11.1 General

The Tenderer shall state whether the assembly has been verified to either BS EN 61439-2 and/or BS EN 61439-5. The Tenderer shall provide supporting evidence from the design verification process. Where the assembly has not been verified to BS EN 61439-5 the Tender shall confirm whether the requirements in sections 13.1 – 13.3 below taken from BS EN 61439-5 are met by the assembly. If they are not met the Tenderer shall state what equivalent tests have been carried out and the residual risk of not complying with these requirements.

11.2 Strength of materials and parts – Resistance to corrosion

The test specimen should be subject to a damp heat cycling test of IEC 60068-2-30: Severity – temperature 55°C, 6 cycles and variant 1. At the end of the test, the specimens are removed from the

test chamber. Compliance is checked by visual inspection. The parts tested shall not show rust, cracking or other deterioration. However, surface corrosion of the protective coating is allowed.

11.3 Strength of materials and parts – Properties of insulating materials

DRY HEAT TEST
The complete test assembly should be placed in an oven, the internal temperature is raised to (100 ± 2)°C over a period of 2 to 3 hours and maintained at this temperature for 5 hours. Compliance is checked by inspection that there are no visible signs of deterioration. Deformation of protective covers manufactured from insulating materials is acceptable if they are more than 6mm distant from parts which may have a temperature rise in excess of 40K and do not support live components.

VERIFICATION OF CATEGORY OF FLAMMABILITY
Representative specimens of each of the materials of enclosures, barriers and other insulating parts should be subjected to a flammability test in accordance with test method A – horizontal burning test of IEC 60695-11-10:2013. Compliance should be checked by inspection that each set of specimens can be classified to category HB40 criteria a) or b) in accordance with 8.4.3 of IEC 60695-11-10:2013.

11.4 Strength of materials and parts – Verification of temperature rise

It should be verified that the temperature-rise limits specified in 9.2 of BS EN 61439-1 for the different parts of the assembly will not be exceeded. Verification should be by test as specified in 10.10.2 of BS EN 61439-1.

12. RULES FOR TRANSPORT, STORAGE, INSTALLATION, MAINTENANCE AND DISPOSAL

The switchgear required by this specification should be maintenance free as far as practical. Recommended maintenance intervals for mechanisms, circuit breakers and switches shall be stated in the technical schedules at the time of tender.

Any special tools required for the maintenance and operation of the equipment shall be stated in the technical schedules at the time of tender. The tools shall be located with the equipment and each tool shall be clearly labelled for the purpose for which it has been supplied.

The delivery location shall be confirmed at the time of equipment order. Multiple use packaging is preferred to single use packaging. Packing lists shall be securely fastened to each package in a visible location to permit inspection. Each package list shall detail: description and quantity of parts, The Company's order number, and The Tender's name marked with manufacturer name, location and date of manufacture with batch number for material checking purposes. Instructions for handling, loading and off-loading (including weight and centre of gravity) of packages shall be securely fastened to each package and shall be legible until installation on site.

13. INFORMATION TO BE GIVEN WITH ENQUIRES, TENDERS AND ORDERS

Documents and drawings shall be submitted in electronic format (PDF) in accordance with the table below to show the installation, operation and maintenance requirements inclusive of details of the equipment. The successful Tenderer shall submit detailed drawings, as specified in the Design column in the table below, in electronic format (both in AutoCAD 2000 and PDF) for review before proceeding with manufacture.

Document / Drawing	Tender	Design	Delivery
General Arrangement	Required	Required	Required [1]
Single Line Diagram	Required	Required	Required [1]
Detailed dimensioned drawings		Required	Required
Electrical schematics		Required	Required [1]
Parts listing		Required	Required [1]
3D model and animation		Required	Required

Termination Diagrams		Required	Required [1]
Label Templates		Required	Required
IED and relay inputs and outputs		Required	Required
Installation and commissioning instructions	Required	Required	Required [1]
Operation and maintenance manuals	Required	Required	Required [1]
Data sheets		Required	Required
Storage and packing instructions		Required	Required [1]
Quality Dossier and Test Records			Required [1]

[1] Documents in paper format shall be provided with each equipment ordered.

The drawings supplied shall enable The Company's engineers to readily identify the function of and reference for all parts. A contract drawing list shall be supplied.

14. SAFETY

The equipment shall be designed for operation where safety is the primary consideration. Equipment shall be designed and constructed to ensure that all normal operation, inspection and maintenance activities can be carried out safely, taking account of ergonomic principles of height, force, direction of movement, location etc.

The design and manufacture of the equipment shall meet the requirements of the Health and Safety at Work Act 1974, the Electricity at Work Regulations 1989 and the Provision and Use of Work Equipment Regulations (PUWER) 1989 for the maximum safety of personnel.

The Regulations made under the Health and Safety at Work Act imposes specific duties on the installers and operators of equipment in the UK. These duties apply irrespective of the origin of the equipment. The Tenderer shall take account of these requirement in the design of the equipment.

The CDM Regulations 2015, apply to all equipment supplied into the UK and they impose a mandatory duty on designers (including manufacturers) to ensure that the equipment can be safely installed, operated and maintained by consideration of safety at the design stage.

PUWER places duties on on people and companies, who own, operate or have control over work to ensure that the equipment is suitable and safe for the intended use. As such equipment covered by this specification shall be fully compliant with PUWER. To achieve compliance the Tenderer shall undertake a conformity assessment process to demonstrate that the equipment is compliant with all relavant health and safety requirements for the equipment.

To ensure safety of operational staff and contractors employed by the Company, the equipment shall also facilitate Compliance with ScottishPower Safety Rules (Electrical and Mechanical) and associated Operational Procedures.

The Tender shall declare that the equipment has been assessed for conformity with the above regulations and provide the associated risk assessments identifying necessary controls where applicable.

15. TECHNICAL SUPPORT

The Tenderer shall provide details of technical support, defect and rectification procedures to resolve issues during the warranty period and the operational life of the switchgear. The Tenderer shall

provide primary and secondary contacts supported with an escalation process in response to business priorities. The Tenderer shall take all reasonable care to report known equipment defects that may affect the equipment supplied to the Company throughout the operational life of the switchgear. Safety related defects shall be reported without delay. The Tenderer shall have a traceability system to identify equipment with possible defects inclusive of electronic components and obsolete components no longer manufactured.

Technical support shall include on-site inspections, investigations and attendance at meetings as required. Rectification works shall be performed either on-site or off-site as appropriate ensuring that disruption to operational service is minimised as far as practicable. The Tenderer shall provide the necessary support for changes, extension and maintenance during the life of the switchgear.

16. QUALITY ASSURANCE

The Company has a policy for delivering strong customer performance that aims to exceed our customer and regulatory requirements. The Company works with its suppliers and service providers to accomplish this goal and therefore strong support from our partners is required in realising our year on year improvement objective. Analysis of defective items, on time delivery and general service provision are analysed and will be used to assist in subsequent tender assessments.

16.1 Quality Assurance

The Tenderer shall operate a quality management system and be certified or accredited to BS EN ISO 9001. The Tenderer shall provide copies of its quality management system certificate and a copy of its latest recertification or surveillance audit report. In addition, details of The Tenderer's organisation and quality methodologies for maintaining and continually improving the quality management systems shall be provided.

To aid consideration of the tender, The Tenderer shall submit a proposed quality plan and details of the quality procedures to be applied for product realisation. The quality plan shall clearly identify the quality control check points and the desired outcomes including any re-work loops.

The Approval of the quality plan by both The Tenderer and The Engineer is required prior to commencement of any contract.

NOTE: Organisational charts of the quality section and departments that support production realisation along with the quality policy shall be provided.

16.2 Quality Control

The Tenderer shall operate a documented control of records system. The Tenderer shall store all production and traceability records pertinent to The Company manufacturing or service provision activities. These records shall be easily retrievable, and copies provided on request.

The Company on occasions shall perform factory audits to assure the service or product confirms to the planned arrangements and BS EN ISO 9001. The audits will generally take place prior to the award of a new contact or when the level of conformity or service provision falls below an acceptable level. Appropriate notification along with the audit scope will be shared and agreed prior to audit execution.

Should The Company receive defective item(s) or poor services provision, The Tenderer shall produce a full corrective and preventative report detailing what went wrong and what will be done to prevent recurrence. The completed report will be sent to The Company to review the effectiveness

and to approve the improvement action. Corrective and preventative action reports will be kept and used to assist in subsequent tender assessments.

17. APPENDIX A – LV SWITCHGEAR SPECIFIC REQUIREMENTS

The following table lists specific requirements for each assembly provided for the LV Engine project. General requirements required to be met by all assemblies are provided in Appendix B.

Characteristic	**BS EN 61439 Reference Clause**	**Site Name**	
Assembly Name		**FALKIRK**	**FUTURE**
Application		Electric Vehicle Charging	Electric Vehicle Charging
Type		Indoor floor mounted LVDC distribution panel	Indoor floor mounted LVDC distribution panel
Rated current of assembly	13.2	200A	600A
Incoming circuit rating	13.3	200A	600A
Outgoing circuit ratings	13.3	200A	200A
Rated Diversity Factor	13.4	1	1
Number of outgoing circuits		1	2
Incoming circuit device		Switch-disconnector	Switch-disconnector
Outgoing circuit device(s)		MCCB	MCCB
Outgoing short circuit protection device	6.5	Over-current protection 2xUnder-voltage release: Positive pole to mid-point and negative pole to mid-point	Over-current protection 2xUnder-voltage release: Positive pole to mid-point and negative pole to mid-point
Incoming cable type	9.7, 9.8, 9.9	6181XY 0.6/1kV BS 7889; IEC 60502-1 Plain annealed copper stranded circular 50mm2	6181XY 0.6/1kV BS 7889; IEC 60502-1 Plain annealed copper stranded circular 400mm2
Incoming cable lugs	9.7, 9.8, 9.9	Tyco BLMT-25/95-17	Tyco BLMT-185/400-17
Incoming cable entry direction	9.6	Bottom	Bottom
Incoming circuit operational metering required		Yes	Yes
Outgoing circuit operational metering required		No	No
Outgoing cable type	9.7, 9.8, 9.9	Four core aluminium or copper, SWA armour max 185mm2 core	Four core aluminium or copper, SWA armour max 185mm2 core
Outgoing cable entry	9.6	Bottom	Bottom
Maximum assembly width		800mm	800mm
Maximum assembly depth		600mm	600mm

Maximum assembly height		1800mm	1800mm

18. APPENDIX B – COMMON REQUIREMENTS FOR LVDC SWITCHGEAR

The following identifies common requirements for all LVDC switchgear. Specific requirements for each LV Switchgear type are shown in Appendix A. Where a requirement is not specified the default arrangement provided in BS EN 61439-0 Annex C shall be used.

Characteristic	BS EN 61439 Reference Clause	Requirement
Electrical system		
Earthing system	5.2	TN-S
Nominal voltage (V)	5.3	+/-475V DC
Transient overvoltages	5.4	Category IV Rated impulse withstand voltage 8kV
Rated frequency	5.6	DC
Short-circuit withstand capability		
Prospective short-circuit current at supply terminals I_{cp}(kA)	6.2	8kA
Prospective short-circuit current in the mid-point	6.3	8kA
Prospective short-circuit current in the protective circuit	6.4	8kA
Installation environment		
Location type	8.2	Indoor
Protection against ingress of solid foreign bodies and ingress of water.	8.3	IP41D with switchgear doors closed. IPXXB with switchgear doors open.
External mechanical impact	8.4	IK10
Ambient air temperature – Lower limit	8.7	-25°C
Ambient air temperature – Upper limit	8.7	40°C
Maximum relative humidity	8.8	50% at 40°C
Pollution degree	8.9	3
Altitude	8.10	≤1000m
EMC environment	8.11	A
Installation method		
Type	9.2	Floor standing. Rear of assembly against wall so not accessible.
Stationary/Movable	9.3	Stationary
Maximum overall dimensions	9.4	1000mm wide, 600mm deep, 1800mm high
External conductor type	9.5	Cable
Storage and handling		
Method of transport	10.3	Crane / Forklift / Forklift jack / Transport rollers
Operating arrangements		
Access to manually operated devices	11.2	Authorised persons only
Location of manually operated devices	11.2	Easily accessible
Maintenance and upgrade capabilities		
Requirements related to extension under voltage	12.4	None
Form of separation	12.8, Table B.1	As required to meet design requirements
Current carrying capability		

Ratio of cross-section of the mid-point conductor to phase conductors: phase conductors above 16mm2	13.5.3	100%

19. APPENDIX C – SUBSTATION LVDC DISTRIBUTION LINE DIAGRAM

19.1 APPENDIX C.1 - FALKIRK