NETWORKS

GENERAL SPECIFICATION FOR CONTESTABLY BUILT HV SUBSTATIONS

Network Assets, HV Station Performance

SPEC-050214-AYB

Note: The following document is highly technical in nature and may be complex to understand. If you are having trouble understanding the content of this document, please reach out to ESB Networks and we will assist you to understand their meaning.

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Title:	**General Specification for Contestably Built HV Substations**
Revision Number:	**2**
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	(ESB Specifications are subject to change, this specification version shall only be used for the purpose/project for which it was issued by ESB to you)
Approved for Issue:	**Specifications Manager ESB Networks**

History of Revisions

Rev No	Date	Revision Content
0	February 2014	First issue
1	Sept 2014	Comprehensive review of document by ESB Networks and ESBI
2	Mar 2021	Comprehensive review of document by ESB Networks and EMP – Full List of revisions given in Appendix H

Note:

This specification will be reviewed at minimum before the Latest Review Date, but may also be reviewed in the interim. Consequently the "Latest Review Date" does not indicate that this particular version of the Specification is current. Accordingly, only the version of the specification issued by ESB to the user for the particular purpose/project shall be used.

ESB Technical Specification Approval

Title	**General Specification for Contestably Built HV Substations**
Specification revision number & date	Doculive Spec. No.: 18133 Rev: 2 Date: Mar 2021 Consultant Reference No.: PE607-F0000-S00-002-008 Date: Mar 2021
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1.0 Terms and Acronyms

The following terms and acronyms are used throughout this document:

EMP	Engineering & Major Projects
LV	Low Voltage
MV	Medium Voltage 20 kV & 10 kV
HV	High Voltage
GIS	Gas Insulated Switchgear
AIS	Air Insulated Switchgear
SF6	Sulphur Hexafluoride
PSDP	Project Supervisor Design Process
PSCS	Project Supervisor Construction Stage
O&M	Operation and Maintenance
SLD	Single Line Diagram
BOM	Bill of Materials
QMS	Quality Management System
CAD	Computer Aided Design
DRA	Design Risk Assessment
DP	Design Package
AC	Alternating Current
DC	Direct Current
NTC	Networks Training Centre
CSS	Commissioning Site Supervisor
DWA	Design Work Area
RUSCD	Reference United States Creepage Distance
CB	Circuit Breaker
XLPE	Cross-linked Polyethylene
PE	Polyethylene
NCC	National Control Centre
DCC	Distribution Control Centre
MCCB	Moulded Case Circuit Breaker
ACO	Automatic Change Over
DSO	Distribution System Operator
TSO	Transmission System Operator
VRLA	Valve Regulated Lead Acid
EPA	Environmental Protection Agency
HSA	Health & Safety Authority
ASC	Arc Suppression Coil
PVC	Polyvinyl Chloride
NFPA	National Fire Protection Association
SCADA	Supervisory Control and Data Acquisition
RTU	Remote Terminal Unit
GRP	Glass Reinforced Plastic
SRM	Soil Resistivity Measurement

CT	Current Transformer
VT	Voltage Transformer
GPR	Ground Potential Rise
LPS	Lightning Protection Study
LED	Light Emitting Diode
AAP	Alarm Annunciator Panel
EGIP	Embedded Generator Interface Panel
BSPM	Bulk Supply Point Metering
OLTC	On Load Tap Changer
FFL	Finished Floor Level
DPM	Design Project Manager

2.0 Scope

The scope of this document shall be to specify the general requirements for the design and construction of HV Substations which the Customer elects to contestably build for handover to, and for operation by ESB Networks.

This document shall be read in conjunction with the associated Connection Agreement and the latest Grid Code applicable.

The Substation 110 kV HV equipment shall be air-insulated, open terminal equipment or Gas Insulated Switchgear (GIS) installed indoors as stated in the Functional Specification.

The 38 kV HV equipment shall be air-insulated, open terminal equipment, installed outdoors or alternatively GIS installed indoors as stated in the Functional Specification.

The MV equipment shall be GIS installed indoors as stated in the Functional Specification.

The design of the station, and the plant and equipment supplied and installed used shall comply with the requirements of:

(a) This Specification;
(b) The Civil Specification for Substations;
(c) The individual ESB Networks Specifications for Equipment and Materials; Where there may be a conflict between this specification and any of the other two specifications mentioned above, the requirements of this specification shall take precedence insofar as it relates to the said conflict however the customer shall seek clarification on such prior to commencement.

The equipment shall be installed by the Customer in accordance with the manufacturer's instructions. These instructions shall be clear, shall be specific to the equipment and shall cover all aspects of equipment installation up to and including putting into service.

The following documents shall be adhered to while delivering the duties outlined above

(1) The Connection Agreement
(2) The Grid Code

The TECHNICAL SCHEDULES & APPENDICES (a) **attached to this specification** and (b) **attached to the individual Product Specifications** for the particular item, shall be completed by the Customer and the equipment manufacturer and signed off by both parties as required and submitted to ESB Networks.

3.0 Health and Safety

3.1 Client

The Customer shall be the Client as defined in safety legislation. The Client shall comply, at all times, with all statutory duties or provisions imposed upon them by any current legislation, new legislation or amendments to legislation which shall be current during the course of the project. The Client shall ensure that all necessary statutory appointments shall be made.

3.2 Safety File

At pre-commissioning stage, a copy of the Safety File shall be submitted to ESB Networks for review. The Original Safety File, fully up to date with As-Builts shall be provided to ESB Networks for retention no later than the energisation date.

The file shall be live and shall be updated regularly and made available on site for inspection during the construction and design review.

The Customer shall provide a risk assessment indicating the risks identified with the Operation and Maintenance of the equipment and how these risks have been mitigated. The risk assessment should cover design, construction and operation and maintenance stages.

Where the Customer is proposing to use non-term contract equipment, the risk assessment should cover upgrades, decommissioning and disposal of the equipment.

The Safety File shall consist of the following:

Section 1: As-built drawings, utility & service record drawings, fire cert drawings, drawings showing emergency and firefighting systems.

Section 2: Specifications.

Section 3: General Information (Contact details of project supervisors, consultants, designers, contractors and sub-contractors).

Section 4: Design Criteria (design statements, applicable codes and standards, loading etc).

Section 5: Building products and materials (data sheets, supplier information, product brochures).

Section 6: Design Risk Assessments and Preliminary Safety & Health Plan.

Section 7: Operation and Maintenance Manuals and schedules and certificates which outline maintenance procedures.

Section 8 Relevant test certificates, guarantees, product and statutory consents.

4.0 Applicable Codes and Standards

4.1 Codes & Standards

See ESB Networks Specification 18081 "**General Equipment Requirements for items supplied by Customer for use on Contestably Built Networks**", Clause 1.03 for applicable standards and precedence of standards.

Materials shall be designed, manufactured, tested and installed according to the ESB Networks Product Specifications and ESB Networks Specification 18081.

Works shall be carried out in accordance with the specifications and drawings issued for the project as listed in the Project Work Pack Register and with the relevant EN Standards. Where no EN Standard has been issued to cover a particular subject then an IEC standard shall be applied, and in the absence of such a standard, clause 1.03.01 of 18081 shall apply to the standard proposed. The latest edition and amendments shall apply in all cases. In case of conflict between the specification and any applied Standard, then the specification shall take precedence.

The Customer shall state in his proposal the standards and codes of practice which he proposes for any items of Plant not covered by EN Standards. The Customer shall submit two English language copies of any standard or code of practice, other than EN or British Standard publications not later than the Initial meeting required by ESB Networks.

4.2 Directives

The equipment supplied, and the Design and Construction of the project shall all be in compliance with the provisions of all relevant Directives of the European Communities relating to work equipment, i.e. in regard to safety of personnel who operate and maintain the equipment. Where appropriate, the equipment shall carry the CE Mark in accordance with Direction 768/2008/EC.

4.3 System of Units

The SI system of units shall be used throughout the project. Temperature shall be in degrees Celsius, electrical energy shall be in kWh and SF6 gas pressure shall be expressed in MPa.

5.0 Service Conditions

5.1 Environmental Conditions

These shall be set out in ESB Networks Specification 18081.

5.2 Network Parameters

These shall be set out in ESB Networks Specification 18081.

6.0 Design Proposed

6.1 Design Requirements

The design shall meet the requirements of the specification and shall make adequate provision for:

- Safety of ESB Networks Operations and Maintenance procedures;
- Safety of members of the Public;
- Reliability and continuity of service;
- Ease of inspection and maintenance;
- Ease and clarity of operation, labelling and naming convention to ESB Networks specification;
- Avoidance of spurious alarms;
- Ability to withstand the severe service conditions specified;
- Freedom from undue vibration and noise;
- Exclusion of vermin, birds and animals;
- Precautions to minimise fire risk;
- Site design consideration for access and egress of emergency services
- Updates to ESB Networks safety rules which may impact design

6.2 Confirmation of Construction in Compliance with Design

The PSDP for the Contestably built plant shall declare, in writing, to ESB Networks that the construction of the works has been completed in accordance with the Design as approved by the PSDP. Due to the phasing of design and variety of engineering disciplines the customer shall provide evidence of ongoing design coordination between these disciplines, e.g. electrical designers verification of civil designs, with clear revision history details identifying modifications made to all designs.

6.3 Interchangeability

To limit the required stock of spare plant and/or spare parts (section 9.8) within the substations, overhead lines or underground cables associated with the project, all equipment and parts thereof performing similar duties shall be interchangeable.

6.4 Design Review

All designs for the contested assets shall be submitted for review by ESB Networks.

Data Sheets and manufacturers details for materials used in the construction where not identified in the design drawings submitted shall be provided in advance for approval by ESB Networks. This includes but not limited to primary plant connector details proving suitability to bus bar force calculations and earthing system materials and installation methods employed.

Where there may be a change to the design already reviewed by ESB Networks, such changes shall also be submitted for review by ESB Networks. Care shall be taken to identify where any changes have been made to a design shall be clearly recorded in the design revision history.

Notwithstanding any review by ESB Networks of any information submitted by the Customer, the Customer's obligations under the Agreement shall not be relieved, absolved or otherwise modified and ESB Networks shall have no liability whatsoever in relation to its review comments or lack of review comments in respect of any designs or information submitted to it by the Customer.

6.5 Design Review Log

Issues identified by ESB Networks during the Design Review Stage shall be logged as an Open item in the Design Review Log. All such issues shall be addressed by the Customer and re-submitted for review. All Open items shall be Closed prior to Pre-Commissioning stage. In any event all issues shall be closed before handover of the contestable assets. Open items critical to a particular phase in the design shall be closed before advancing to the next phase. Advancing the works where open items remain may be done so at the customers own risk and may delay the commissioning and handover phase of the project. Early communication shall be necessary to avoid such delays. Communication channels shall be advised at the project kick off meeting with ESB Networks.

6.6 Plant and Materials

Please refer to associated **Connection Agreement** for details of warranties.

New plant, materials and spare parts complying with product specifications shall be used i.e. the use of refurbished equipment shall not be permitted.

The design life of the Works shall be at least 40 years, with a 20-year lifespan for electronic equipment, or as specified in individual product specifications.

Minimum maintenance shall be required during this time and shall correlate with the reliability, availability and maintainability specified in ESB Networks Requirements.

7.0 Environmental Design and Hazardous Substances

7.1 Environmental Law

The Customer shall comply with all aspects of Irish legislation (in addition to the relevant European legislation) in relation to the environment during all phases of the project. A complete list of current environmental legislation is available on the Irish Government's website (http://www.irishstatutebook.ie).

7.2 Planning Permission

It shall be the responsibility of the Customer, to prepare the planning permission application, to apply for planning permission, and to obtain full planning permission without restrictive conditions for the contestable substation and associated works.

The Customer shall submit to ESB Networks all planning permission documentation associated with all plant to be contestably built including all submittals required in connection with protection of the environment. All documentation shall be submitted to ESB Networks prior to submission of the planning application.

The Customer shall submit to ESB Networks any documents revised or updated as a result of any change and/or update to any of the required documentation submitted as part of the planning application.

7.3 Environmental Compliance

The Customer shall immediately notify ESB Networks of any prosecution instituted by the Environmental Protection Agency, National Parks & Wildlife Service, National Monuments Service, relevant local authority or any other statutory body including any revocation and/or suspension and/or expiry of any licence, consent, permission and/or permit. In addition, the Customer shall notify ESB Networks of any correspondence and/or statutory notices, non-compliances or observations received from the Environmental Protection Agency and/or National Parks & Wildlife Service and/or National Monuments Service and/or local authorities and/or any other statutory body in respect of any licence, consent, permission and/or permit and/or arising from the construction of the works.

7.4 Post-Handover Monitoring

Where there may be a requirement for on-going monitoring of environmental impact of the substation and associated works, after Handover to ESB Networks, the Customer shall be responsible for this monitoring and the associated costs and shall submit copies of the monitoring results to ESB Networks.

7.5 Declaration of Environmental Compliance

Prior to Handover, the Customer shall submit a declaration from a Chartered Environmentalist confirming that the works have been carried out in compliance with all environmental protection requirements of the specification and of the relevant Authorities and also confirming that no environmental incidents occurred during the project.

7.6 Equipment Manufacturer's Declarations

Where the product specifications require manufacturer's declarations, it shall be the Customer's responsibility to ensure that these declarations shall be comprehensive and complete. They shall be submitted with the design review submission.

7.7 Disposal of Material Found to be Hazardous

Equipment manufacturers who supply plant to the Customer for this project shall undertake to dispose of it, should it be found that the plant or its packing contains undeclared hazardous substances, not previously declared, at some stage during its life.

The Customer shall dispose all materials arising from excavations in compliance with current environmental legislation. Material, which may be agreed to be disposed as spoil, shall be removed to approved spoil dumps and copies of waste transfer documentation shall be provided to ESB Networks.

7.8 Excavated Material

All waste and materials shall be managed in a legally compliant manner. Waste records shall be maintained and made available to ESB Networks on request. The Customer shall produce and submit to ESB Networks for review a Waste Management Plan and a Materials Management Plan.

8.0 Quality Assurance

The products and systems to be supplied and installed under this Contract shall conform to the requirements of the specification, to the best accepted international practice for substations of the type and to the severe requirements imposed by the service conditions. As a means of ensuring these objectives the Customer shall maintain a documented quality control and quality assurance system which shall be in accordance with ISO 9000. The Customer shall ensure that the same requirements shall be applied to products, systems, and services supplied by Sub-Contractors and suppliers.

The Customer shall submit his Quality Assurance plan to ESB Networks at pre-design stage. The plan shall demonstrate, to the satisfaction of ESB Networks, that the control measures to be adopted in the design and construction of the proposed works shall result in successful commissioning and long-term performance of the contestably built network.

The Quality Assurance plan shall address, but be not limited to, the elements in the following list:

- Competence of Civil and Electrical Designers, Contractor, and Pre-commissioner. This shall detail the selection criteria used and proven track record of all parties in respect of installation of plant at the voltages relevant to the project.
- Details of Quality Assurance Certification.
- Proposals for compliance with Environmental Legislation and Grant of Planning Permission.
- Material selection, sampling, handling, testing on site and testing off site.
- Site Work Audit and Control plan.
- Pre-commissioning plan.
- Commissioning Plan (where relevant).
- Documentation submittal schedule.
- Legal transactions concerning property transfer and line/cable routes over third party lands.
- Safety File requirements of the Connection Agreement.
- Quality Inspections and Progress Reports.
- Project Programme.

8.1 Audits

During the construction of the project, on-site audits or inspections may be carried out by ESB Networks or their agents to ensure compliance with statutory provisions and agreed engineering designs and/or specifications. The Customer shall ensure that such representatives have unrestricted access to the project as required to carry out this role. Advanced notice shall be given to ESB Networks specifically where works shall be enclosed or buried, thus removing the ability to visually verify compliance with the specification and standards. The customer shall record and document using photographic evidence. Such works shall include a weekly quality report and shall be submitted to ESB Networks. ESB Networks may provide samples of such reports at request.

In the event of non-compliance, the Customer shall take the appropriate remedial action.

Requirement for Construction Monitoring is also outlined in Section 12.3.

8.2 Material Workmanship

All materials and workmanship shall be of a suitable type and quality to ensure that the equipment shall operate satisfactorily in accordance with the relevant product specification.

All works shall be adequately supervised by the Customer and quality control checks shall be carried out by the Customer at regular intervals.

8.3 Disclosure of defects found

In the event of defects identified by the equipment manufacturer, which may cause an impact on equipment lifetime performance the equipment manufacturer shall inform the Customer and ESB Networks immediately. Refer to Appendix C: Manufacturers Undertaking. This applies to quality issues or defects which may subsequently come to light either with this particular equipment or with similar equipment supplied to other customers.

The Customer shall submit manufacturer's declaration of compliance.

ESB Networks as distribution asset owner reserve the right to audit equipment manufacturer to ensure compliance.

In the event of internal or external damage to any equipment, including support structures, during transit to site, the Customer shall inform ESB Networks immediately.

8.4 Product Quality Assessment

If requested during the design review process, the Customer shall make available a fully assembled example of the equipment proposed, for inspection by ESB Networks.

9.0 Handover and Energisation

9.1 Handover Agreement

On foot of the provision of a declaration of fitness for the contestably built assets, the Customer shall enter into a Handover Agreement with ESB Networks in respect of the contestably built assets in the format set out in Appendix D.

9.2 Handover Certificate

ESB Networks shall execute the Handover Certificate (see Handover Agreement) confirming its acceptance of Operational Control of the contestably built assets, when all of the requirements set out in the Connection Agreement, between ESB Networks and the Customer, which shall be due before energisation, have been met. These include, but may not be limited to, the following;

- Safety
  - Receipt by ESB Networks of Original and Up to Date Safety File complete;
- Building Regulations
  - Receipt by ESB Networks of all relevant certificates of compliance;
- Environmental
  - Receipt by ESB Networks of all relevant certificates of compliance;
- Civil
  - Receipt by ESB Networks of all relevant design calculations;
- Electrical
  - Receipt by ESB Networks of Earth resistance test results;
- Operations
  - Receipt by ESB Networks of agreement to the jointly prepared Operations Procedure;
  - Energisation Instructions (Switching plan) drafted and agreed;
  - Receipt by ESB Networks of O&M manuals;
  - Receipt by ESB Networks of all relevant equipment certificates;
  - Receipt by ESB Networks of plant training;
- Commercial
  - Receipt by ESB Networks of all invoiced amounts;
  - Receipt by ESB Networks of all relevant Bonds;
- Satisfactory closure of all issues logged in the Design Log;
- Property
  - Completion of all requirements set out in Appendix 1 of the Connection Agreement;
  - Receipt by ESB Networks of Customer Operators details and contact information
  - Receipt by ESB Networks acceptance of telecommunications method and provider

9.3 Energisation

Energisation shall take place as soon as practicable after ESB Networks accept Operational Control of the contestably built assets.

All outstanding review logs shall be closed prior to energisation.

The Contested assets shall fully comply with duties and programmes set out in the respective **Grid Code**

10.0 Operation and Maintenance

10.1 Operation of Assets to be Transferred

The contestably built plant shall not be energised until fully commissioned and handed over to ESB Networks. Following successful completion of the Commissioning Tests and Handover to ESB Networks of Operational Control of the contestably built assets, the Operational control shall rest totally with ESB Networks. According to the Electrical Safety Rules, apparatus shall be treated as if it were part of the system when it has reached a stage where the apparatus, or part of it, shall be capable of being connected to the system in an approved manner. Treating apparatus as part of the system requires full application of the electrical safety rules for further work to proceed which requires operation of the new equipment."

10.2 Boundaries

Ownership and Operational Boundaries:

Item	Boundary
Ownership	The asset ownership boundary between ESB Networks Distribution circuits and Customer circuits shall be the termination point of ESB Networks conductor termination on the Customer plant.
Operational	The system/operational boundary between ESB Networks Distribution circuits and Customer circuits shall be the ESB Networks interface disconnector or other defined ESB Networks item of switchgear.

10.3 Operation

Operations Requirements for ESB Networks Compound:

Item	Requirements
Station Equipment when part of the system	ESB Networks Safety Rules, Operations and Work Procedures. New Equipment to the Electricity System and Training.
ESB Equipment	Operation, Maintenance and Testing to be carried out by ESB Networks personnel only.
ESB Control Room	Access to be restricted to ESB personnel only.
Customer Switch room	Access by ESB Networks Personnel to be agreed with Customer.
Single Line Diagram	Single Line Diagram of the connection type to be mounted in a prominent location in the ESB Networks control room.

ESB Networks require 24/7 access for the purpose of metering where meters shall be installed on customer side of compound. Access to be agreed and incorporated into deign where required using standard ESB Networks access facilities to ensure safety, security and access shall be delivered for both Customer and ESB Networks.

ESB Networks shall be notified in advance of any change to customer's Operator details and if ownership changes shall be due to occur to ensure continuity of service.

10.4 Operation and Maintenance – Equipment and Tools

The Customer shall supply a list of tools and equipment required for the operation and maintenance of the station and shall identify which tools shall be proprietary to the equipment installed.

Operational equipment such as Switching Rods and Voltage Detectors shall be subject to approval from ESB Networks.

All switching and safety equipment like earth leads and clamp shall be consistent with those utilised by ESB Networks operator staff, these shall be presented and approved in advance.

Digital clocks in the control room form part of the essential operating procedures and shall be supplied.

The Customer shall supply such identified tools and arrange them neatly in each substation in an approved lockable cabinet, all tools shall be clearly marked with their size or purpose and shall be new and unused.

Operating handles required for normal operation shall be mounted adjacent to the relevant equipment and securely stored.

Specialised lifting equipment shall be provided in each substation and shall be handed over in perfect working condition to the satisfaction of ESB Networks, provision shall be made for their neat storage within the substation.

The Customer shall provide for neat and adequate storage of all portable earthing equipment e.g. Earthing Leads and Switching Rods.

Please refer to Specification 18081 for further details

10.5 Key Case

A key case (for keys to lockable compartments) which shall be lockable shall be mounted on the control room wall convenient to the operator's desk.

10.6 ESB Networks Padlocks

Where padlocking facilities suitable for accommodating ESB Networks standard padlock shall be specified, the padlocks shall be supplied by ESB Networks.

The padlock holes shall be approximately 7 mm diameter to accept padlocks with a shaft diameter of 6.3 mm. The overall locking provision shall be suitable for use with padlocks with a shackle bend radius of 30 mm and a shackle length of 23 mm. Multilock systems to be agreed with ESB Networks, please also refer to clause 16.5

10.7 Storage

The Customer shall provide secure and lockable storage in each substation for spare parts of equipment, operating handles for outdoor equipment, portable earthing equipment, tools and all other loose equipment.

Proposals for the storage of these and other tools/accessories (e.g. Switchgear tools, battery tools/ accessories, transformer accessories etc.) shall be submitted to ESB Networks for review. These proposals shall include dimensioned drawings of the proposed storage device, its location and proposed labelling/ identification arrangements for the tools/accessories ,Building layout and M&E services design shall provide for safe access and operation off all systems within the control room to ensure all future personal may carry out their duties effectively.

Control cabinet room layouts shall be reviewed by ESB Network and agreed prior to completion of the civil control room design, this shall be essential where additional cabinets may be required for larger switch yards like looped substations.

10.8 Spare Parts

If materials are not from current ESB Networks contract suppliers, (list provided in functional pack) then the equipment in question shall need to be reviewed and agreed. Where such equipment shall be acceptable to ESB Networks, and ultimately the ownership of the contestable assets reverts to ESB Networks, the Customer shall be required to purchase and keep the required number of spares in a lockable building on the substation site associated with the project and, which ESB Networks shall have direct access to if required.

ESB Networks shall not be liable for any extended outage that results from non-availability of this equipment. Particular attention to be paid to spares with “use by” dates.

The spares shall be delivered prior to energisation of the substation.

Spare parts shall be treated and packed to ensure safe transport and a long shelf life without deterioration.

Parts shall be separately packed. A drawing which clearly identifies the part, quotes the part’s serial number and gives a clear reference to the maintenance manual shall be enclosed in each pack. In addition, installation instructions shall be included in all packs containing spares for cable joints and terminations.

Parts which may be liable to deterioration by atmospheric pollution, humidity or ingress of foreign matter shall be totally sealed in strong polythene bags. Parts which may be subject to deterioration due to condensation shall be protected by packs of silica gel or another approved desiccant.

Packages shall be crated in robust wooden packing cases. Large items shall be crated separately and shall be securely clamped against movement. Small items shall be grouped by type and/or application, to the approval of ESB Networks. Packing cases shall be suitable for safe transit to ESB Networks stores and for long term storage without deterioration under the environmental conditions which pertain there.

Each packing case shall be clearly and indelibly labelled. The label shall provide the following information: case number, ESB Networks name, Project number, description and serial number of contents, shelf life and its expiry date, and where appropriate, lifting and storage/stacking instructions. The shelf life shall be at least five years. Where, because of case size, it shall not be practical to provide the above information on the packing case, the details shall be given in a sealed waterproof envelope which shall be securely attached to the case.

Cases which contain fragile parts shall have the following notice prominently displayed:

“FRAGILE – HANDLE WITH CARE”

Availability of spare parts shall be guaranteed for ١٥ years.

11.0 Warranty

The warranty requirements for all contestably built assets shall be stated in the projects associated **Connection Agreement** (the Agreement) Further details in the ESB Networks 18081 specification and the individual product specifications found in the functional pack provided by ESB Networks.

12.0 Documentation

12.1 Design Submissions

12.1.1 General requirements

All detailed **designs** including calculations, manufacturer data sheets, documentation contributing to a final design, shall be submitted for ESB Network's review. A period of 60 business days shall be allowed for ESB Network's review of any design submission from date of receipt of each submission to date of notification of comments or no comments. The design shall reflect the Connection Agreement, Site specific and associated SLD's provided. If the Customer does not complete the design within 2 years of receiving the work package from ESB Networks, the Customer shall revert to ESB Networks to ensure design shall be in compliance with any revisions to the latest ESB Networks specifications and standards. Designs reviewed by ESB Networks shall not be altered without written notification and agreement. Any modification shall follow PSDP procedures and be clearly documented in the design revision history. All symbols used in electrical drawings shall be in accordance with IEC Publication 60617 and the SI system of units shall be used throughout.

The Customers programme shall be submitted identifying expected design completion dates. Each submission shall include a documents transmittal register. This register shall serve as a record of submissions, revisions made, and identify documents yet to be submitted. A master transmittal register of all designs expected to be submitted shall be included in the initial submission along with the project programme. The master register shall then be updated per submission by the customer.

The functional specifications provided by ESB Networks shall be broken into design packs. DP001 etc. The submissions shall be broken into these packs. The design review logs shall reference the Design pack number and the associated customers documents/drawings number under review for clarity.

All submissions shall be presented to ESB Networks electronically and agreed at project Kick off Meeting.

They shall be made in an orderly and timely manner (as per Section 11.3) during the periods shown for design approval in the Works Programme such that ESB Networks shall have adequate time for their detailed examination and for checking any necessary revisions. These submission dates shall be also identified in the Customers Project Programme.

In programming submissions, the Customer shall allow for the possibility that a resubmission may be necessary before the start of any part of the Works.

12.1.2 Drawings

All drawings shall be dimensioned and where appropriate scaled to standard scales.

All drawings and documents must demonstrate that a quality assurance process has been implemented.

The Customer shall provide further details of their Quality Assurance process if requested by ESB, however the process shall ensure the validation of designs is carried out by competent persons who is independent of the person producing the design.

As a minimum all documents shall have a producer, checker verifier and approver, where:

Producer: The producer is responsible for producing a drawing/document which is technically correct, in accordance with the appropriate standards and specifications and which is clear and concise. The producer shall check the document for correctness before submitting it for verification.

Checker/Verifier: The role of the verifier is to carry out a complete independent check of all aspects of the document/drawing.

Approver: The role of the approver is to ensure that the functions of the producer and verifier have been administered correctly in accordance with the appropriate procedures. The approver shall have an in-depth knowledge of the quality management procedures for their particular area. The approver must also be

satisfied that the document/drawing etc. is fit for release. Note: The verifier shall not be the approver. All drawings shall be submitted initial in printed electronic format e.g. PDF and later in electronic working copy format as the deigns shall be handed over to the system operator for future modification to the design where required post energisation and handover.

Some designs may only be reviewed using working electronic formats and shall be provided when requested. This may be especially pertaining to the design of network system routes via overhead line and cable networks.

Evidence in drawings of design coordination between engineering disciplines shall be critical to satisfying the duties of the PSDP.

The Single Line Diagram and Electrical Substation layout review shall be critical and shall be reviewed in advance of the review of any further designs.

Once reviewed the electrical substation layout shall be the master substation layout for the project. All other designs shall be georeferenced and layered upon this layout.

Earthing, Ducting, Drainage, Foundation and all civil and electrical service layout drawings shall be referenced via a geolocated Xref onto this master substation layout. For clarity the individual layouts shall be submitted with the master layout. Layout designs cannot be reviewed in isolation. This ensures coordination between the design disciples and reduces the risk of conflict between the designs during construction.

The format and layout of the Control and Protection design submitted by the Customer shall be in accordance with the EPLAN P8® standard schematic diagrams issued in the Works Package.

The above schematics shall be used in conjunction with the associated protection elementary drawings outlined in Appendix 2: Protection Requirements of the Site-Specific Functional Specification. For example, the Auto-Reclose function shall not be required if not shown in the associated protection elementary drawing.

Application Notes:

1. The presentation of the station Control and Protection schematic shall be in the same format to the standard referenced above. It shall be complete and easy to follow as it forms part of the Operation and Maintenance (O&M) manual issued on completion of the project.
2. Primary Protection relay codes detailed in the schematic shall comply with those referenced in the associated Single Line Diagram;
3. Non-contestable protection equipment associated with the standard schematic include:
   Primary Protection relays;
   Test sockets;
4. All contestable equipment shall be detailed in the Bill of Materials (BOM) for information only. The equipment listed shall be ESB Networks standard equipment in the high level deigns provided.
5. As part of the schematic design, the Customer shall include:
   Full cable schedule;
   Complete connection diagram;
   Complete wiring details;
   Complete detailed device legend;
   BOM;

Drawings shall be complete in all respects, accurate numerically and geometrically correct and shall be sufficiently detailed to enable plant erection to proceed without the need for further supporting drawings, details or interpretation. Drawings and calculation sheets which may not be easily legible or present difficulty in interpretation shall be returned by ESB Networks to the Customer for resubmission.

All drawings and calculation sheets shall have title blocks which shall be correlated one with the other. They shall indicate the status and following QMS system employed. They shall be numbered in a logical sequence. The first edition submitted for review shall be Revision 0 (zero) and subsequent revisions shall be referred to a Revision 1, Revision 2, etc. Alternative systems shall be subject to ESB Networks' approval. Each revision shall be recorded in a revision block on the drawing and the subject matter of the revision shall be indicated. The revised portions of the drawings and design sheets shall be highlighted.

The drawings shall be free from error messages or generation error notices in the drawing software package.

All technical documents (e.g. drawings, instruction manuals, etc) shall also be provided in electronic format, and shall be delivered via Internet email initially via an electronic printed format and later forming part of the as build packing in working software format.

a. Eplan P8
b. Microstation DGN compatible with Microstation 95 V5.05.08 or
c. AutoCAD DWG – Release 12 or
d. Mise.DXF compatible with Microstation 95 V5.05.08;
e. PLS CADD.bak files

Refer to Section 11.10 below for guidelines on submission requirements following completion of works.

12.1.3 Deviations from Specification

Where the Customer proposes a deviation from the detailed requirements of the specification, they shall make a written application for approval of such deviation to ESB Networks (in addition to highlighting such deviation in the product specification technical schedules shall be returned to ESB Networks) and they shall highlight the proposed deviation on the relevant drawings and design sheets of the submission. Except in the case of a deviation specifically approved by ESB Networks the Customer shall be responsible for ensuring the conformity of the Works with the specification, notwithstanding any general approval or lack of approval of design submissions by ESB Networks

12.2 Customer Works Programme

The Customer shall be required to submit a Works Programme to ESB Networks prior to construction – Appendix 3, Clause 2.3.2 of the Connection Agreement refers.

This program shall identify all key milestones and stages of the project from mobilisation to final commissioning. Typical timeframes for required documentation shall be outlined in Appendix E.

12.3 Design Package (DP)

A fully completed Design Package (DP) shall be submitted in accordance with Appendix F. This shall be considered by the Customer in the Works Programme. The Works Programme shall be submitted prior to the Initial Meeting and shall be subject to agreement by ESB Networks.

Each DP shall be submitted in an orderly and timely manner during the periods shown for review in the Works Programme. Incomplete Design Packages shall not be accepted for review. ***Refer to details outlined in Appendix F: Design Package.***

The Customer shall provide a Design Risk Assessment (DRA) indicating the risks identified with the design and construction of the substation, and how these risks have been mitigated as part of the PSDP duties, this document shall be updated and submitted where changes to design have occurred. Evidence of coordination between designers shall be presented and a final residual risk register for all contested assets be made available prior to energisation.

12.4 Site Document File

The Customer shall maintain at the site a Site Document File incorporating all changes and modifications to the agreed design and specification. The file shall include a Drawing/Document List, a Master Drawing File and a Master Technical Instruction File. The Customer's proposals for the Site Document File shall be submitted to ESB Networks for review.

The latest design revisions reviewed by ESB Networks shall match that of which shall be at the construction site and made available to ESB Networks for review at the construction site itself.

The Drawing/Document List shall be prepared and updated regularly at periods to be decided by ESB Networks. The first issue shall be made within 20 business days of the project start up and shall indicate the various types of drawings and documents which shall be prepared during the project and the anticipated numbers thereof. The list shall be updated as necessary and the status of each drawing/document shall be indicated under one or other of the following headings:

- Issued for review;
- Approved;
- Not approved;
- Approved with comments;
- Issued for construction;
- Issued "as built";

All changes and modifications to the Master Drawing Files and the Master Technical Instruction Files shall be highlighted in red markings.

12.5 Operation and Maintenance Instructions

Operation and Maintenance Instructions shall be prepared in the form of an instruction manual for use by ESB Networks personnel. Draft copies for ESB Networks comment shall be submitted three months before commencement of construction.

Final Operation and Maintenance Instruction Manual shall be submitted to ESB Networks three months before the Handover Date.

Two hard copies and one soft copy shall be submitted in each case.

The preparation of the manual shall be carried out by personnel who shall be trained and experienced in the operation and maintenance of the plant described and who shall be skilled as draughtspersons/CAD operators competent to prepare the required drawings.

The format of the manual shall be on A4 size white paper with neatly typed text and similarly sized manufacturer's printed data sheets. Drawings shall be provided with durable punched reinforced plastic edge and shall be folded to A4 size. They shall preferably not exceed 297 mm in height and shall be arranged such that they may be easily unfolded and refolded as required. The text, printed matter and drawings shall be placed in commercial, durable four ring binders with cleanable plastic or metal covers. The number of volumes shall be adequate for the material to be bound and the instructions shall be correlated into consistent related groupings. Each volume of the manual shall be clearly identified on the front and on the spine of the binder with the title "Operation and Maintenance Instructions", the title of the project, the name of the substation, the volume number and identity of the general subject matter covered in the manual. In addition, suitable provision shall be made on the spine and front for the reference number of ESB Networks.

Each volume shall contain a summary table of contents for the entire manual and a detailed table of contents for that particular volume. Pages shall be numbered sequentially. The Customer's name, address and

telephone number shall be given. Where the volume refers to Sub Contractors plant, the name, address and telephone number of the Sub Contractors shall be given with a clear reference to the items of plant supplied.

Only the manufacturer's printed data which shall be pertinent to the specific plant supplied shall be included. The manuals shall be free from irrelevant matter such as might be contained in manufacturers' general brochures. Each sheet of the manufacturer's instructions shall be annotated to identify clearly the specific item or part installed and the instructions applicable to such installation and where they shall be located. All inapplicable instructions shall be deleted. Plant data shall be supplemented with drawings as necessary to illustrate clearly component parts, systems and control diagrams. Manufacturers' printed instructions shall be supplemented with typed text setting out particular aspects of the installation. The typed text shall be organised into a consistent format under separate headings to provide a logical sequence of instructions.
An Operation & Maintenance Manual shall be provided for each substation and shall include

a. Description of plant, systems and component parts including nameplate data and lists of equipment.
b. Operating procedures including step-by-step instructions for normal and emergency operation.
c. Maintenance procedures, including routine maintenance procedures, guides to troubleshooting, procedures for dismantling, cable jointing instructions, repair and reassembly, procedures for alignment, adjusting and checking.
d. General arrangements and detail drawings for switchgear, control and protection cabinets, transformers, cables and other items of plant.
e. Substation line diagram and elementary schematic diagrams.
f. Schematic circuit diagrams covering control, metering, protection, signalling, indications, auxiliary supplies and all other circuitry.
g. Detailed wiring diagrams and cable lists.
h. Detailed records of all type tests, routine tests and site tests.
i. Spare parts lists.
j. Schedule of lubricants.
k. Details of mechanical and electrical settings.
l. Detailed alarm list, which shall contain a list of all alarm titles, an explanatory note on the alarm functions and a brief description of the action to be taken by the operator on receipt of each alarm.

12.6 Drawings and Information to be Included with the Initial Submission

The following shall be included with the initial submission prior to initial meeting:

a. Proposals for execution of civil works including drawings and information, as required by the product specification, for each section of the works.
b. Proposals for execution of electrical works including drawings and information on equipment, as required by the product specifications, for each section of the works including design calculations.
c. In addition, the Proposal shall include drawings and information on site layout and general arrangement of equipment, e.g. in substations.
d. Proposals for Quality Control and Quality Assurance.
e. Lists of applicable standards and codes other than IEC.
f. Outline Organisation Chart.
g. Reference lists as required by the sub clause on Service Experience.
h. All other information necessary for a full understanding and evaluation of the proposal shall be included. (Electronically completed, printed and signed by equipment manufacturer and Customer) attached to each of the product specifications issued in respect of this project.

i. Preliminary Safety & Health Plan;
j. Residual Risk Register;

12.7 Drawings and information to be Submitted at Initial Meeting

The following shall be submitted at the initial meeting:

a. Preliminary Works Programme
b. Organisation Chart.
c. Mobilisation Chart.
d. Status of Design Documents outlined in Section 5, 6, 7 and 11 of this specification.
e. Coordinate map identifying Construction Site office and Site Entrance.

English language translations of national standards and codes proposed (i.e. other than IEC and BSI publications).

12.8 Drawings and information to be Submitted According to the Agreed Programme

The following shall be submitted according to the agreed programme:

a. Works Programme.
b. Drawing Document List/ Master Documents transmittal register A complete set of As-Built Drawings.
c. Proposal for contents of the Safety File (as per Section 2.2 of this document). Training Plan.
d. GAR sheets completed and returned to ESB Networks (ARA).

12.9 Drawings and information to be submitted before Handover to ESB Networks

ALL documentation outlined in the Safety file in accordance with the current Construction Regulations.

The contents of the Safety File are outlined in Section 2.2.

GAR sheets completed and returned to ESB Networks (ARA).

Full suite of Pre-commissioning mark ups, test results and issues encountered.

12.10 Drawings and information to be Submitted on Completion of Station Works

The following shall be submitted to the agreed programme:

a. Two hard copies and one electronic copy (pdf) of the reviewed “as built” Operation and Maintenance Instructions shall be furnished within one month of the Works being taken over or any portion of the Works being put into service (refer to section 11.3);
b. Two hard copies and one electronic copy (pdf) of the “as built” folders containing all associated electrical, physical and civil works drawings shall be furnished within 30 business days of the Works being put into service;
c. A CAD/EPLAN P8 version of all associated drawings compatible with the formats outlined in section 11.1.2 shall be furnished within two months of the Works being put into service;

d. Guaranteed rated values and characteristics i.e. the Technical Schedules that accompany the Design Review modified where necessary.
e. Test Certificates and general test results carried out on Electrical, Civil and M&E design and equipment.
f. Summary of routine tests and special tests, with copies of the test reports for all plant.
g. General Asset Registration (GAR) Sheets in typed format for both installation phase and commissioning phase return to ESB Networks (ARA). Customer to confirm with ESB Networks on completion.

All test results shall be typed, signed and dated.

12.11 Technical Records

This shall include:

a. Guaranteed rated values and characteristics i.e. the Technical Schedules that accompany the Design Review modified where necessary.
b. Certificates relating to the insulating medium.
c. Summary of routine tests and special tests, with copies of the test reports.

All test results shall be typed, signed and dated.

13.0 Tests

13.1 Test and Inspection

In accordance with the agreed programme the Customer shall submit for the approval of the ESB Networks a Test and Inspection Plan for all items of the Works whether at the Site or elsewhere up to the date of certification of completion in accordance with the provisions of the agreement. Such plan shall be in two parts covering factory tests and site tests respectively. The plan shall include a description of the item or part of the Works to be inspected or tested, the nature and frequency of the inspection and testing, the type and size of samples to be taken (if any), the means of recording the test and inspection data, the name and specific responsibilities of any proposed test and inspection agency and all other information necessary to describe the test or inspection to be performed. Not later than two months prior to the commencement of any particular test full details of the proposed method of test, test parameters and test circuits shall be submitted for ESB Networks approval and following such approval shall become part of the Test and Inspection Plan.

Such plan, as reviewed by ESB Networks, shall be used for the inspection and testing of the Works and shall be revised and resubmitted for ESB Networks review if the Customer desires to change the sequence, method or nature of the test or inspection or if such a change shall be required by changes in the Works Programme or Scope of the Works.

Measuring equipment shall be subject to the ESB Network's review and if required by ESB Networks it shall be calibrated at such independent laboratory as may be agreed. The cost of any such calibration shall be borne by the Customer.

The cost of all tests required by the specification, including the cost of providing samples where needed, shall be borne by the Customer.

No approval of tests or inspection of the Works or portions of the Works by ESB Networks shall not relieve the Customer of his responsibility to complete the Works according to the specification, including the satisfactory execution of all necessary site inspections and tests nor shall it relieve him of his duties and obligations under the Contract.

13.2 Factory Tests

Type and routine tests shall be performed on all equipment as set out in the product specifications.

Items which shall be ancillary to the main equipment, e.g. supporting insulators, terminal bushings, fuses, etc. shall be tested in accordance with relevant IEC standards. If a supplier claims exemption from such tests, he shall submit to ESB Networks certified copies of test reports.

Type tests may be dispensed with if the Customer furnishes evidence to ESB Networks that the relevant type tests have already been performed on identical equipment. In this case the type test certificates shall be submitted with the Proposal. Where the particular product specification calls for type tests to be carried out at an independent testing laboratory or witnessed by an independent party the type test certificates submitted with Tender shall show proof of such independent witness.

In the case of equipment for which specific type tests or routine tests are not called for in the particular product specification, such as control and protection cabinets and AC and DC distribution cabinets, the Customer shall include in the Test and Inspection Plan details of all tests proposed prior to delivery. Certificates of all such tests shall be submitted to ESB Networks.

All tests shall be carried out to the satisfaction of ESB Networks and no equipment shall be dispatched prior to ESB Networks' written approval of the test results. The Customer shall provide adequate notice of factory tests/inspections for 110 kV equipment, in particular ESB Networks non-term contract equipment, to allow ESB Networks to witness the tests if so desired. Witnessing of tests shall not relieve the Customer

of any responsibility with respect to conforming to this specification. If tests shall not be witnessed by ESB Networks, then factory tests certificates shall be forwarded to ESB Networks for review before accepting delivery of the equipment.

13.3 Construction monitoring

During the course of construction of the substation, ESB Networks may require tests to be carried out on the works to confirm compliance with specification and with Customer's design. These tests shall be undertaken by, and at the expense of the Customer and shall be witnessed by ESB Networks.

In conjunction with Section 7.1 of this document, weekly construction progress reports shall be furnished to ESB Networks by the Customer. These reports shall include high quality, time date stamped photographic content to validate all installation works.

14.0 Service Experience

The Customer shall supply details of the proposed location of manufacture of all plant, indicating the number of the particular plant type being proposed that has been manufactured at that particular location.

The Customer shall also include a reference list of locations and Utilities to whom the specific plant type being proposed has already been supplied.

The proposed equipment manufacturer shall have a satisfactory production and service history, in EU Utilities, for each of the items of plant proposed by the Customer. These requirements are set out in the individual product specifications.

Further details are outlined in the product specifications provided by ESB Networks.

15.0 Packing

All packing materials shall conform to Irish Government Regulations which shall be available from the Department of Agriculture, Kildare Street, Dublin 2 (www.agriculture.gov.ie).

The Customer shall ensure that a Delivery Monitor shall be used for equipment susceptible to internal damage from mechanical shock and that these monitors shall be mounted in locations such that they shall be visible without opening the packaging. The Customer shall provide evidence to ESB Networks, that the equipment has not experienced excessive shocks during transportation to its installed position.

The Customer shall identify any Packing features which would contribute to the ESB Network's policy of becoming as sustainable as possible. Developments in the area of Sustainable Packing shall be clearly demonstrated by the Customer.

Plant sensitive to shipping and transport vibrations shall contain shock monitors for review by ESB Networks.

16.0 Training

Before any new HV station has reached a stage where the apparatus, or part of it, shall be capable of being connected to the system in an approved manner where some or all of the station equipment shall be introduced to that location for the first time, any staff who shall be engaged in the operation of the station, shall be provided with training in operation of the station equipment.

For contestable builds, ESB Networks project management shall involve the NTC (training), Operations Policy and Safety unit (switchgear) and Protection Section (relays) at an early stage to take delivery of the

requirements set out for customers from an operations perspective. Enforcement of the provision of these requirements shall be completed by ESB Networks project management as part of the project delivery plan.

The Customer shall submit a Training Plan to ESB Networks and approved by ESB Networks Training Centre (NTC), which shall describe in detail how the Customer proposes to train ESB Networks staff. This plan shall be provided at least 4 months before the training course and at least 4 weeks before plant shall be made part of the system. **The plan shall include requirements and responsibilities for:**

a. Organise training of NTC staff or direct training from supplier.
b. Communicating with ESB Networks local management.
c. Identifying ESB Networks staff for training.
d. Requesting Training from NTC.
e. Delivery Methods.

The courses shall cover **operations training, practical operation of switchgear and systems,** plant familiarisation, fault diagnosis and testing and all aspects of plant maintenance. Training instructors shall be knowledgeable and experienced in the manufacture, erection, testing and maintenance of the equipment and shall have good communications skills in the English language. The training shall be provided on site during the construction period.

Where new switchgear, control or protection systems are being introduced to the ESB Networks System then a minimum of nine months notification to ESB Networks shall be required to address aspects such as Risk Assessment, Documentation production, Training material production and Training delivery. This needs to be project managed by the delivery organisation responsible for the project.

As part of the hand-over process, the Commissioning Manager, shall be satisfied that training has been provided to all relevant parties, before any new station shall be allowed to connect to the system. To meet this requirement:

a. The CSS shall confirm in writing to the commissioning manager that all on-call operators have been trained.
b. The Stations Supervisor shall confirm in writing to the commissioning manager that a satisfactory number of operators have been trained to enable the business needs to deliver for that station into the future.

Operations Policy and Safety Unit shall be responsible for ensuring through certification and/or approval, that those engaged to deliver the training shall be competent to do so.

17.0 Site

17.1 Control of Site

The Customer shall be responsible for the security of the site on 24-hour basis until such time that the responsibility for substation security be transferred to ESB Networks.

Acceptance by ESB Networks of the design of the plant or its components shall not relieve the Customer of his obligation to supply and install plant fully capable of meeting the service requirements and warranties set out in the Connection Agreement.

17.2 Care of the Works

The Customer shall be held responsible for the care of the works generally until their completion, including all work executed and materials deposited on the site by himself or by Sub-Contractors and suppliers.

17.3 Slips

The Customer shall make good any damage or defect caused by slips to any cuttings, excavations or embankments and shall do all necessary work to prevent or remedy the same, to the satisfaction of ESB Networks.

17.4 Co-operation with other Contractors

The Customer shall co-operate with all Contractors in the design of areas of interface. When such designs have been finalised, they shall be submitted for comment to ESB Networks.

The Customer shall also co-operate fully with other Contractors and ESB Networks during the period of site works on the substation and all work on site shall be carried out in such a manner as to cause minimum interference to the work of other Contractors.

17.5 Dual Locking Requirement

Where the ESB Networks substation and the Customer substation share a site, then a dual locking system shall be provided at the entrance to the site so as to allow access to ESB Networks personnel, Customer personnel and third-party personnel as required e.g. cell operators and landowners. No other locking system shall be accepted at the site entrances, this includes a key safe.

17.6 ESB Networks Compound Directions

In the event that the ESB Networks compound may not be situated at the site entrance, it shall be necessary for the Customer to clearly mark directions to the ESB Networks compound. Likewise, if the site exit may not be clearly visible it shall be necessary for the Customer to mark the exit route.

17.7 Overall Performance

The Customer shall be responsible for the overall performance of the contested assets

17.8 Responsibility for Facilities and Sufficiency of Means Employed

The Customer shall make his own arrangements with the relevant supply authorities for all necessary supplies of electricity, water, gas, telephone etc. required for construction and testing and shall pay all installation and running costs charged by the authorities. Where such supplies shall not be available for any reason, the Customer shall make provision for adequate site supplies as may be necessary for the installation and testing of the works.

Any adjacent customer sites impacted by the provision for services above shall be managed by the customer and agreed directly with the customer.

The Customer shall also provide at his expense all necessary machinery, lifting equipment, oil or gas treatment equipment, tools, scaffolding, etc. required for construction. All such equipment shall be maintained throughout the project in good working order.

In particular the provision of a continuous 24/7 three phase AC electricity supply (minimum of 50 kVA) from construction to energisation stage. The Customer shall take full and entire responsibility for the sufficiency of tools and equipment and generally for all means used for the fulfilment of the project, whether or not such means may have been approved of, recommended by, or commented on by ESB Networks.

17.9 Work Prepared Off the Site

The Customer shall give to ESB Networks written notice of the preparation or manufacture, at a place not on the site, of any manufactured material or component to be used on the works stating the place and time of the preparation or manufacture, so that ESB Networks may make inspections at all stages of the work and not only when the material or component is completed.

Any material or component which may be prepared or manufactured without such notice having been given may be rejected if ESB Networks considers that its' inspection was necessary during the process or the preparation or manufacture.

18.0 Physical Requirements

18.1 Access Requirements

The access road to the sub-station site shall be designed to accommodate the vehicles intended to travel along it and bends incorporated into the road shall accommodate the turning circles of these vehicles. Where the access road crosses ditches and streams or creeks, a permanent bridge structure shall be provided. Access to the sub-station shall be provided for by a double gate which shall open inwards. Access within the substation shall be provided by means of a 4.5 metres wide road entrance.

For all substations the road shall be reinforced concrete.

In 110 kV stations it shall be possible to access the 110 kV busbar to allow the connection of a mobile 110 kV switchgear bay in an emergency. This trailer unit shall be 10 metres long (excluding tractor towing unit) and 2.5 metres wide.

Where a transformer may be required in the station the road shall be designed to take the load of the transformer transporter fully laden with the transformer.

In 38 kV stations the road shall be designed to accommodate the vehicles delivering 38 kV switchgear.

All road construction shall be in accordance with Part 2 of the Civil Works Specification. On completion of the works any damage to the road shall be made good prior to handover.

The Customer shall install a compound fence at a minimum height of 2.6 metres and ensure that the entrance gates shall be operating correctly throughout the lifetime of the project. The Customer shall not compromise the integrity of the compound fence by placing any climbing aids against it.

18.2 Passageways and Platforms

Passageways required for operation including those in the control room shall have a minimum width of 1.2mor where otherwise specified in the Designated Work Area (DWA) requirements. Other passageways shall have a minimum width of 1 m.

The Customer shall supply and erect all access platforms, catwalks, stairways and ladders necessary for providing safe and easy access to plant items for operation and maintenance. The Customer shall ensure that the whole of the access system shall be of uniform design and pattern through-out the Works. The design of all access platforms, stairways etc. shall conform to requirements given in the individual product specifications.

18.3 Degree of Protection provided by Enclosure for LV Equipment

All terminal boxes, mechanism boxes, kiosks, cabinets and equipment enclosures shall have degrees of protection provided by enclosure according to IEC 60529 as follows:

Outdoor	IP54
Indoor	IP41

18.3.1 Guards

All moving parts, shafts, couplings, belts, pulleys, bare live conductors and hot surfaces shall be adequately and securely guarded to at least IP2X, in accordance with IEC 60529 and to the ESB Networks review so as to afford complete safety to all personnel. All such equipment shall be risk assessed.

18.4 Condensation

All equipment enclosures such as cabinets, kiosks, mechanism boxes, etc. shall be provided with an anti-condensation space heater. They shall be automatically controlled by a humidistat, the operating range of which shall be adjustable. A method of isolating the power supply to the heater circuit shall be provided at each enclosure. The 230 V AC supply shall be used to operate these heaters.

All enclosures shall be designed to minimise condensation, with provision for ventilation and drainage as appropriate.

18.5 Support Structures for Equipment

All support structures for electrical equipment shall be designed to suit the service conditions specified, the loads imposed on them, and any appropriate electrical clearance requirements.

All outdoor steel structures shall be hot dip galvanised in accordance with the relevant ESB Networks specification in the Works Package. Steel structures for indoor use shall be hot-dip galvanised if specified in the relevant ESB Networks specification.

18.6 Phase Arrangement

The phase arrangement of each bay shall match the phase arrangement as shown in the station layout drawing Phasing shall use R, S, T designations.

This section shall be read in conjunction with the associated HV Substations – Labelling and Signage documentation provided in the functional package provided by ESB Networks.

18.6.1 Busbar and network voltage identifiers

Identifier	Description
A	for 1st or single busbar identification;
B	for 2nd busbar identification;
C	– 3rd busbar identification; – 10 kV bay;
D	Spare;
E	20 kV Bay;
F	38 kV bay in a 38 kV Station;
H	110 kV Bay;
P	38 kV bay in a 110 kV or 220 kV station;
M	Other networks voltage below 38 kV (not to be used for auxiliary supplies);
N	Other networks voltage below 38 kV (not to be used for auxiliary supplies);

18.6.2 Identifying the HV and MV+ Busbars

MV+ denotes 38 kV and MV

18.6.3 110 kV (or higher voltage) stations:

To an observer standing in one of the following positions:

in the centre of an outdoor station (i.e. between the HV and MV+ busbars) and facing the HV busbar

or

facing the operating side of an indoor HV GIS assembly for the highest voltage busbar in the station the following apply:

a. In double busbar stations the nearer busbar shall be A, and the other B (AIS only)
b. Busbar sections to the left of the principal or only busbar coupler/ sectionaliser shall be given odd numbers (starting at 1 and those to the right shall be given even numbers)
c. The bays to the left of the principal or only busbar coupler/ sectionaliser shall be given odd numbers, and those to the right shall be given even numbers.
d. Transformers connected to the left of the principal or only busbar coupler/ sectionaliser shall be given odd numbers, and those to the right shall be given even numbers.
e. The odd or even identification of the MV+ busbar sections follows automatically from the HV/ MV+ transformer numbering. Items (a), (b), and (d) shall be in accordance with long-established practice for 110 kV and higher voltage stations.

Note 1:

Section 17.6.2.1 above applies directly to two-voltage stations with conventional layouts. Application of the coding system to other station layouts and to single-voltage stations shall in general follow automatically but shall be subject to individual approval by ESB Networks.

18.6.4 38 kV stations:

To an observer standing in one of the following positions:

Facing the operating side (the side providing access to the circuit breaker mechanism boxes) of the 38 kV switchgear in an outdoor or hybrid station

or

facing the operating side of an indoor 38 kV GIS assembly the following apply:

a. Busbar sections to the left of the principal or only busbar coupler/ sectionaliser shall be given odd numbers, and those to the right shall be given even numbers.
b. The bays to the left of the principal or only busbar coupler/ sectionaliser shall be given odd numbers, and those to the right shall be given even numbers.
c. Transformers connected to the left of the principal or only busbar coupler/ sectionaliser shall be given odd numbers, and those to the right shall be given even numbers.
d. The odd or even identification of the LV busbar sections follows automatically from the HV/LV transformer numbering.

The layout and bay designation for a typical 110 kV station is outlined in Figure 17.1 below.

Note 1:

Section 17.6.2.2 above applies directly to stations with conventional layouts. Application of the coding system to other station layouts and to single-voltage stations shall in general follow automatically but shall be subject to individual review by ESB Networks.

Note 2: (MV switchboards only)

The feeder bay which contains a busbar earth switch (DEA) for use in a 10 kV/20 kV split busbar shall be located on the right-hand side of the sectionaliser cubicle when facing the operating side of the MV switchboard.

18.7 Bay coding

This section shall be read in conjunction with the associated HV Substations – Labelling and Signage documentation provided in the functional package provided by ESB Networks.

18.7.1 Principal or single busbar coupler/sectionaliser

18.7.1.1 38 kV (or higher voltage) busbars:

The principal or single busbar coupler/ sectionaliser bay shall be coded as follows.

18.7.1.2 E0, F0, H0 etc MV (10 kV or 20 kV) busbars:

The principal or single busbar coupler/ sectionaliser bay shall be coded as follows.

C10 or E10 (in metal clad cubicles the associated riser cubicle shall be identified by “a” added to the sectionaliser number e.g. C10a

18.7.2 Other bays

Bay numbers shall be allocated to bays or to spaces for future bays starting from the principal coupler/ sectionaliser and working outwards. Consecutive odd or even numbers shall be allocated starting from the appropriate principal coupler/sectionaliser number given above.

Additional coupler or sectionaliser bays shall be treated in the same manner as a feeder or transformer bay.

The proposed bay numbering system for non-standard layouts e.g. busbars with no sectionalisers or busbars at right angles to the station roadway shall be subject to approval from ESB Networks.

18.7.3 Back to back bays

Where back-to-back bays are designed into the initial layout then each back to back pair of bays shall be numbered consecutively with the lower number allocated to the bay on the outgoing feeder side of the busbar.

18.7.4 38 kV Voltage regulators (Boosters)

38 kV boosters have a circuit breaker or suitable interrupt device installed on the line side of the voltage regulator. To differentiate this line side voltage regulator circuit breaker from the busbar side circuit breaker, the “line side bay” shall be designated as follows:

38 kV station: F10 (A2 busbar) & F11 (A1 busbar) as appropriate.

110 kV station: P20 (A2 busbar) & P21 (A1 busbar) as appropriate.

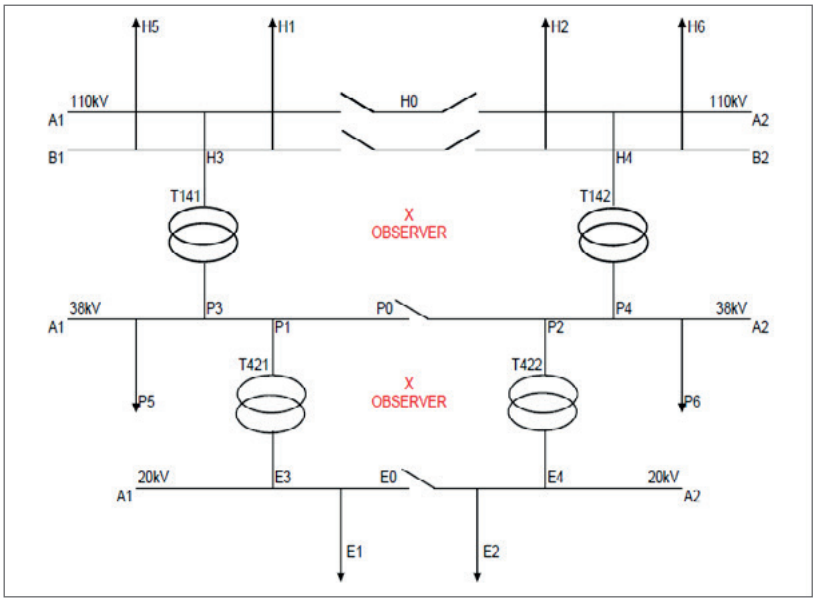

Figure 17.1: Typical 110 kV Station Layout and Bay Designation

18.8 HV Layout

Typical layouts are referred to in the site-specific document for the project.

These drawings show a typical layout. Other layouts e.g. different arrangements, etc. may be feasible subject to ESB Networks review. Any proposed design shall meet the requirements detailed in the following sections.

This section shall be read in conjunction with the associated HV Substations – Labelling and Signage documentation provided in the functional package provided by ESB Networks.

18.9 Clearance Requirements

The specified clearances shall be maintained under all normal, operational and maintenance conditions. These shall allow for the:

Effect of swinging conductors due to crosswinds or short circuit.

Sagging of stranded conductors due to increased temperature or to ice load.

The required clearances for the system in air shall be as follows:

Highest Voltage for Equipment kV rms	**Phase to Ground (mm)**		**Phase to Phase (mm)**	
	A	B	A	B
123	1100	950	1100	950
52	470	360	470	360
24	220	220	220	220

A – Refers to outdoor stations and indoor stations connected to an overhead system.

B – Refers to indoor stations not connected to an overhead system.

Clearance between live parts of the same insulation level which may be operated out of synchronism shall be a minimum of 1.2 times the normal phase to phase value.

Clearance Requirements in outdoor Air-Insulated Substations (mm)			
Rated System Voltage	**123 kV**	**44kV**	**24kV**
Minimum height of bottom of unscreened live bushings above ground	2300	2300	2300
Minimum height of live parts above pedestrian passageway	3400	2900	2600
Minimum height of live parts above vehicle passageways	8000	7000	700
Minimum height of lines above ground (other than the road)	7000	6000	
Minimum finished ground height of compound fence Concrete block wall	2600 3000	2600 3000	2600 3000
Minimum horizontal distance between live parts and compound fence 110 kV Compounds	4600 4500	4600	4600
Minimum distance from live parts to screens, walls etc.	1200	470[1]	
Minimum centre to centre distance between disconnectors and adjacent bay equipment	4500		
Live part to solid wall of minimum height 2100[2]	1100	470	220
Live part to metal screen of minimum height 2100[2]	1200	570	320
Limits of close proximity in horizontal distance	3350	2900	2600

Note

1 – For transmission stations a clearance for 110 kV and above shall be observed.

Limits of Close Proximity as defined by ESB Networks Safety Rules (latest edition) shall be observed:

2 – IEC value shall be 1.8 m. Note: the use of lower walls or screens with an increased clearance shall not be acceptable.

Note: Phase-phase and phase-earth clearances do not apply to manufactured equipment which has been tested to prove compliance with the rated insulation level.

18.9.1 Creepage

The values for the required creepage shall be as set out by ESB Networks in the Site Specific documentation, and shall be used as follows: The specified creepage distance shall be based on the phase to ground voltage across the insulator rather than the phase to phase voltage used previously.

For example, in the case of the 110 kV system, the normal creepage length shall be 43.3 mm/kV x 71.01 kV giving 3075 mm total creepage distance.

The Reference Unified Specific Creepage Distance (RUSCD) for the phase to earth insulators shall be in accordance with IEC 62271-1 and IEC 60815 for rated voltage 123 kV and heavy pollution level 43.3 mm/kV. In certain cases, a higher RUSCD value for very heavy pollution level 53.7 mm/kV may be required. The RUSCD shall be corrected for insulator diameter using the method given in IEC 60815-2.

The Customer shall state the profile factors (as defined in IEC 60815-2 or-3) for the proposed insulator design in Appendix A for all equipment where insulator creepage may be applicable.

18.9.2 Close Proximity Zone

Nominal Voltage	In Radial Direction (mm)	In Horizontal Direction (where access may be possible) (mm)
1 kV to 20 kV	750	2600
38 kV	1000	2900
110 kV	1200	3350

18.9.3 Vicinity Zone

Nominal Voltage	In Radial Direction (mm)	In Horizontal Direction (where access may be possible) (mm)
1 kV to 20 kV	1300	2600
38 kV	1500	2900
110 kV	2000	3350

Bay layout shall be such that it shall be possible to work on any circuit or part of a circuit which may be switched out without coming within the limits of close proximity to any other live circuit. The physical designs provided to ESB Networks shall confirm adequate operational clearance maintained throughout the design.

Busbar force calculations shall be provided to ensure clearances shall be maintained between primary plant during normal and fault operation.

18.10 Loading Condition

The most extreme of the following conditions shall be used to calculate the loads imposed by conductor on support structures:

Item	Temperature	Ice Thickness (mm)	Wind speed (m/s)
1	-20	0	0
2	0	40 (stranded) 10 (tubular)	0
3	0	25 (stranded) 6.25 (tubular)	25

A design wind speed of 50 m/s shall be used to calculate the effect of wind load on structures themselves. Design loads shall not exceed the failure strength of the structure. All calculations shall be submitted to ESB Networks for review and comments.

18.11 Cable Termination

Cable Termination Requirements for ESB Networks 38 kV Incomer Cable.

No	Item	Requirements	
1	ESB Networks Incomer Cable 38 kV and 110 kV	No. Cables	3 per CB (normally) Some 38 kV connections may require 6 per CB, always check with ESB Networks)
		No. cores per cable	1
		Insulation	XLPE
		Sheath	Black (PE) polyethylene
2	Termination Kits for ESB Networks 38 kV Circuit Breaker	Suitable for terminating ESB Networks 38 kV incomer cable	
3	Space in Customer switch room	Adequate space to terminate ESB Networks incomer cable	

Note: Cable size and terminations subject to change, always confirm with ESB Networks.

18.12 Telecoms

Telecom requirements are detailed in Section 5 – Telecoms Specification for the project.

18.13 Fire Separation Clearances

The required separation clearances in outdoor installations between a transformer containing a minimum of 1000 litres of flammable liquid and other transformers or building surfaces shall be in compliance with Clause 8.6.2 of IEC 61936-1.

18.14 110 kV Surge Arresters

A combined surge counter and leakage current meter shall be supplied for 110 kV surge arresters.

18.15 Gas-in-Oil Monitors

The Camlin TOTUS G9 shall be the current approved monitor for ESB Networks use. Kelman units shall not be acceptable.

18.16 HV Connectors

Connectors with integrated strain relief shall be provided for any connectors terminating at transformer bushings or circuit breakers Please refer to ESB Networks Specification 16509 latest revision.

18.17 Noise

18.17.1 General

The Customer shall take all reasonable measures to ensure the noise arising from site activities and operational plant and equipment shall not exceed the noise level exposure limits for both general work areas as specified in the Safety, Health and Welfare at Work (General Application) Regulations 2007.

Noise level exposure from the site shall also comply with the conditions of the planning permission.

19.0 Mechanical and Electrical Services

19.1 Station LV Supplies

19.1.1 110 kV Substations

The Site-Specific Functional Specification shall detail the method by which LV supplies shall be made available to ESB Networks HV station and this shall depend upon availability of MV supply on ESB Networks side. **The arrangement for provision of the LV backup supply shall be agreed with ESB Networks.** Status of which LV supply in use shall be provided to NCC and the local signal system to DCC.

A backup supply shall be required as outlined in the options below. This requirement shall be advised in the relevant Functional Specification. The backup supply shall be capable of feeding the station load, in this circumstance the backup supply shall automatically change over from main supply to feed the station load. The Customer shall ensure that on change over, at no time shall the two supplies be connected in parallel. On entering the station control room, the LV supplies shall be terminated at a suitably rated switched fuse device or MCCB. This fused supply shall then feed the LV distribution board.

A test facility for LV Automatic Change Over (ACO) shall be provided.

Option 1. 110 kV Tail-Fed Substation with one Customer connection:

Customer connection at 110 kV – Primary LV Supply to be provided by Customer with a secondary supply available through ACO on the Customer side.

Customer connection at 38 kV or MV – Primary LV supply from a House Transformer (HoT) on the ESB Networks side with a secondary supply provided by the Customer with ACO on the ESB Networks side.

Option 2. 110 kV Tail-Fed Station with two or more Customers connection:

Customer connection at 110 kV – Primary LV supply to be from a HoT on the ESB Networks side with a secondary supply from the rural network or a standby generator with ACO on the ESB Networks side.

Customer connection at 38 kV or MV – Primary LV supply from a HoT on the ESB Networks side with a secondary supply from a second HoT or from the rural network or standby generator with ACO on the ESB Networks side.

Option 3. 110 kV Looped Station with one or more Customer connection:

Customer connection at 110 kV – Primary LV supply to be from a HoT on the ESB Networks side, with the secondary supply from the rural network or a standby generator, if this may not be practical a supply from the Customer with a standby generator and ACO on the ESB Networks side may be considered upon consultation

Customer connection at 38 kV or MV- Primary LV supply from a HoT on the ESB Networks side with a secondary supply from the rural network or standby generator with ACO on the ESB Networks side

Option 4. Other:

The three scenarios above assume that the connections to the Customer may be over the fence. If the Customer may be remote to the 110 kV Station the following shall be in place – Primary LV supply to be from a HoT on the ESB Networks side with a secondary supply from the rural network or a standby generator.

A fully rated standby supply provided by a diesel generator shall be maintained for 24 hours.

19.1.2 38 kV Substations

Option 1. 38 kV Tail-Fed Substation with one or more Customer connection:

Single connection

A dual primary and backup 400 V supply (with ACO) shall be provided from the main AC distribution board in the adjoining Customer substation.

Multiple connections

The primary LV supply shall be from a HoT on the 38 kV busbar. A backup supply with ACO located on the ESB Networks side shall be provided by the Customer.

Connections with MV Busbar

For 38 kV/MV substations, a MV/400 V HoT feeding a 400/230V ac distribution system shall be connected to the MV busbar. A backup supply shall be provided by the Customer with ACO on the ESB Networks side.

Option 2. 38 kV Looped Substation with one or more Customer connection:

The primary LV supply shall be from a HoT on the 38 kV busbar. A backup supply with ACO located on the ESB Networks side shall be provided by the Customer.

19.2 Station DC Supplies

19.2.1 DSO Controlled 110 kV Stations

A 220 V DC battery and a 24 V DC battery shall be installed. There shall be two battery chargers, one changeover switch panel and one fuse box for each 220 V DC battery. A separate dedicated distribution board shall be required for each 220 V DC battery.

The 220 V DC battery and 24 V DC battery shall each have a standby rating of 24 hours.

Each battery shall be monitored by a Battery Supervision Unit.

19.2.2 38 kV and MV Substations

For 38 kV and MV tail-fed substations, a combined 24 V DC VRLA battery, battery charger, distribution and battery supervisory system shall be designed & installed in accordance with the relevant ESB Networks specification and ESB Networks drawings in the Works Package, in particular those requirements for a fan extraction and heating system.

For 38 kV/MV stations a 220 V DC battery and a 24 V DC vented type plant lead acid battery shall be provided. A separate dedicated distribution board, battery charger and fuse box shall be required for each battery.

19.3 Distribution Boards

The AC and DC Distribution Boards shall be designed & installed in accordance with the ESB Networks Specification 16450.

19.4 Lighting

19.4.1 General

The lighting system shall be such that all parts of a substation may be adequately illuminated. It shall be operated at 230 V, 50 Hz. All luminaires shall give good visual performance and shall be free from excessive glare, stroboscopic effects and flicker from discharge lamps. Safety and amenity shall be important considerations of the lighting design. The Customer shall also take into consideration the following aspects when designing the lighting system.

- Visual Function.
- Cost.
- Legal Requirements.
- Energy Efficiency and Sustainability.
- Light Trespass* and Sky Glow**.
- Maintenance.
- Colour Render Index***

*Light entering other properties.

** Illumination of the night sky due to artificial light pollution.

*** The colour rendering index of the artificial light shall not affect the operator's ability to discern colours on the control panels etc.

The system shall be designed to ensure satisfactory operation and service life under all variations of voltage, frequency and temperature. Appropriate diffusers shall be required for fluorescent lighting system. Luminaires shall be suitably located to facilitate future access – close proximity issues in conjunction with Designated Work Area (DWA) requirements shall be considered in the General Services layout design.

19.4.2 Indoor Lighting

Levels of illumination for particular areas shall be designed to the following values and shall be generally in accordance with CIBS (UK), Code for Interior Lighting. A lighting calculation shall be provided for both indoor and outdoor areas for ESB Networks review. The calculated results shall meet the requirements set out below.

Substation Area	**Average Standard illuminance (lux)**	**Source**
Corridors/Entrance Hallways/Stairs	100	EN 12464-1:2011
Plant Rooms/Switch gear rooms	200	EN 12464-1:2011
Control room: General Control Room Cabinets: Front Control Room Cabinets: Rear	500 450 350	EN 12464-1:2011
Washrooms/bathrooms/toilets	200	EN 12464-1:2011
Store/stockrooms	100	EN 12464-1:2011
Mess Room/Canteen	200	EN 12464-1:2011
Battery Room	250	EN 12464-1:2011

Equipment/plant to be operated require calculation to be made to the vertical face of cabinets and kiosks and shall have a uniformity factor based on the minimum/average illuminance of not less than 0.7, measured on a **horizontal plane 1.5 metres above floor level.**

The light sources shall be the LED equivalent of 58 W high efficiency fluorescent lamps (typically ~ 40 W LED), with a minimum lumen output of 5000 lumens per lamp and suitable for use in starter circuits. The lamp colour temperature shall be standard throughout the installation, or to match the existing where applicable.

Note: All battery room lighting systems shall be ATEX rated, suitable for use in an explosive environment. All luminaires shall comply with BS 4533.

19.4.3 Outdoor Lighting

The average illuminance shall be measured at ground level. In general, sufficient illumination shall be provided to allow safe pedestrian travel anywhere in the substation. **At no part of the outdoor area shall the horizontal illuminance be less than 2 lux.**

For substations located in urban areas these lights shall be controlled by an automatic thermal photo-controlled device that switches on at 55 lux and re-sets at 110 lux. An override switch for manual operation shall also be provided. The fittings shall be mounted to consider safe access for maintenance requirements and safety of personnel. Outdoor lighting shall not infringe on standard clearance requirements; see section 17.9 of this document.

A two-way switch located at the compound entrance shall be required to provide acceptable levels of illuminance for vehicle and pedestrian access to and surrounding the Control Building.

Degree of protection for outdoor lighting shall be IP64.

The proposed outdoor fittings shall meet the requirements set out in 18080 and the warranties in the connection agreement. All Outdoor lighting columns shall be ground mounted and retractable to facilitate maintenance at ground level.

All external lighting systems shall be installed at least 2 metres from the electrical compound boundary.

19.4.4 Lighting Switches

Lighting switches shall generally be plastic, 230 V, 15 A, "AC only" type capable of operating at their full rated capacity.

Switches shall be one way, two way or intermediate as required and where mounted together they shall be fitted in a common box. For surface installations they shall be fitted with fixed grids and in flush installations the grids shall be adjustable. Switches mounted externally shall be of weather-proof pattern fitted with machined box and cover joint, neoprene weather-tight seals to the appropriate IP rating, and external fixing feet.

Switches shall be mounted 1.4 metres above finished floor level. Switches controlling battery room lighting shall be mounted outside the room, adjacent to the access door. Any light switch located closer than 1.5 metres from the battery room door shall be an explosion proof type., ATEX rating. Please refer to section 18.12

19.4.5 Emergency Lighting (I.S. – 3217: 2013)

Emergency lighting shall be provided in all ESB Networks rooms and basements adjacent to main control equipment. Emergency lighting shall comply with BS 5266 where not in conflict with the specification, and shall be provided by self-contained light fittings in the control building which shall be arranged so that a minimum illumination not less than 30 lux shall be provided in all areas to ensure the safe movement of personnel, safe access to and exit from any part of the substation building.

On failure of the AC supply the emergency lighting shall be automatically illuminated. Self-contained illuminated "Exit" signs complying with BS 2560 shall be provided in each room over the doors of emergency escape routes. These units shall provide sustained lighting of the legend and of the door threshold while AC supply shall be present, and for a minimum of 1 hour after its failure. The unit in the battery room shall be suitable for use in a possibly explosive atmosphere. Test facilities shall be provided for checking that the emergency lighting system shall be in working order.

Power cables for the emergency lighting system shall either have an inherently high resistance to fire and physical damage, or shall be enclosed in a suitable conduit, ducting, trunking or channel so as to obtain the necessary protection from fire and physical damage. The wiring shall be equally resistant at joints.

Wiring of the emergency lighting shall be exclusive to the installation and kept separate from the wiring of other circuits. This shall be necessary to protect them from faults on other systems and protect them during maintenance or alteration of other services.

Ducting, trunking or channel that may be used for emergency lighting shall be clearly marked as such.

19.5 Power Facilities

A minimum of two double gang single-phase socket outlets per room shall be installed. The socket outlet for the battery room shall be located on the wall immediately outside the battery room. Single-phase socket outlets shall be rated 13 A, 230 V 50 Hz and shall be 3 pin shuttered type fitted with stainless steel or satin chrome front plates, to BS 1363.

Two 3-phase socket outlets rated at 16 A, 230/400 V, 50 Hz AC shall also be provided in the control room and the store. The indoor socket outlets shall be rated for 16 A and shall be 3 pole, neutral and earth, to IEC 309.

Socket outlets installed externally shall be protected to IP2x. Socket outlets shall be mounted at 0.4 metres above floor level in all rooms.

Power facility requirements for ESB Networks 38 kV single room substations are outlined in drawing PG406-D009-109. A three-phase socket outlet shall also be installed in this room.

Power facilities shall be in accordance to the National Rules for Electrical Installations, Fourth Edition ET101:2008 or with the I.S. 10101 when it becomes valid, with the exception that ring circuits shall not be permitted.

19.6 Ventilation

The ventilation system shall be designed to ensure that adequate ventilation shall be provided for plant and personnel under the range of Service Conditions described in the Section 4 of this document.

The building shall be naturally ventilated with the exception of an extract system in the toilet. Rooms shall be ventilated. The following air change rates/hour shall be required in specific areas:

Toilet	12 (Extract only)

All areas in the buildings including the HV cable room shall be suitably ventilated to ensure that no area becomes a confined space (per HSA Code of Practice for Working in Confined Spaces) due to the presence or reasonably foreseeable presence of hazards or lack of oxygen.

19.6.1 Battery Room Ventilation

Natural Air ventilation shall be in accordance with I.S. EN 62485-2:2018 section 7.3. A battery room ventilation calculation shall be submitted for review.

19.7 M&E Design Calculations

The Customer shall calculate heat gains and losses under the specified conditions for each part of each building, taking into account solar radiation, thermal transmittance through roofs, walls, floors and windows, fresh air requirements, heat emission from installed electrical equipment and lighting, personnel, infiltration and any other sources.

The Customer shall be responsible for determining the heat transfer coefficients for all materials used in building construction. In the event of any change in materials, design or method of building construction, the Customer shall at all times be responsible for rechecking the design of all systems to ensure that they shall be capable of meeting the specified design requirements.

19.8 Heating

Heating in the control building shall be provided by electrical heater controlled by thermostats. The heating system shall be deigned to maintain a room temperature above 15 ° C. Where sealed batteries are contained within the control room the room temperature shall be maintained to a minimum of 18 ° C.

The battery room shall be heated by heaters which shall be suitable for use in a possibly explosive atmosphere. They shall be controlled by a capillary mounted in the battery room and a thermostat mounted on door outside the battery room or a suitable ATEX rated system

19.9 Bunds and Bund Water Management Systems

All plant that contains greater than 1,000 litres of insulating oil, including standby diesel generators, whether installed permanently or temporarily, shall have an associated secondary containment bund installed in conjunction with a certified bund dewatering/separation system.

The bund design shall be in accordance with the applicable sections of the following:

- EPA Guidance Note on the Storage and Transfer of Materials for Schedules Activities 2004.
- Please Refer to details outlined in Civil Specification; Part 1 & 2Gravity discharge bunds shall not be installed.

The secondary containment bund shall be a 'local' containment type as described in the EPA Guidance Note on the Storage and Transfer of Materials for Schedules Activities 2004.

The main parameters of a site-specific secondary containment bund design shall be risk assessed from the following perspective:

a. risk to personnel;
b. risk to the environment;

The bund shall be designed as much as possible to ensure that the failure or malfunction of a component results in a safe condition in relation to the two risks mentioned above.

The bund dewatering/separation system shall be designed in accordance with:

- European Standard EN 858-1:2002 Separator Systems for Light Liquids: Principles of Product Design, Performance and Testing, Marking and Quality Control.
- European Standard EN 858–2:2003 Separator Systems for Light Liquids: Selection of Nominal Size, Installation, Operation and Maintenance.

Only full retention separators shall be used (by – pass separators shall not be permitted).

The performance of the selected bund dewatering/separation system shall have independently assessed type test certification to Class 1 discharge standards i.e. shall discharge less than 5 ppm of oil to the environment during all operating conditions.

All bunds shall be designed to extinguish flammable liquids from their associated plant.

All primary plant bunds (Transformer, ASC etc) shall be designed to remove falls risks/requirement of fall arrests for future operators while also ensuring adequate freeboard and vehicular protection around the bund and associated primary plant plinth.

19.9.1 Commissioning

The system shall be fully commissioned before handover. A full maintenance check and containment test shall be carried out immediately before handover.

19.10 Electricity Supplies for Auxiliary Plant

The permanent electricity supplies for auxiliary plant shall be provided as follows:

a. 400 V 3-phase 50 Hz 3 or 4 wire for power.
b. 230 V single phase for lighting, anti-condensation heaters etc.

For 110 kV installations

a. 220 V DC for essential control and indication supplies;
b. 220 V DC for switchgear motor supplies, and 220 V DC or 400/230 V AC for circuit breaker;
c. 24 V DC for alarm schemes;

d. 48 V DC for Telecoms equipment NCC; 48 V DC for Telecoms equipment DCC;

For 38 kV and MV installations

a. 24 V DC for essential control and indication supplies;
b. 24 V DC for switchgear motor supplies and 24 V DC (MV) or 400/230 V AC (38 kV) for circuit breaker motor supplies;
c. 24 V DC for alarm schemes;
d. 48 V DC for Telecoms equipment NCC; 48 V DC for Telecoms equipment DCC;

The equipment that shall be provided under this contract shall be capable of operating reliably within the following voltage ranges without deterioration:

a. DC Equipment
   From 85 % nominal voltage up to 110 % nominal voltage.
b. AC Equipment
   From 85 % nominal voltage up to 110 % nominal voltage.

19.11 Drainage

The Customer shall ensure that the surface water discharge from the Works shall be attenuated in accordance with Sustainable Urban Drainage Systems (SUDS) principles prior to discharge to the existing drainage network. For the avoidance of doubt, existing attenuation systems on site may not be used to attenuate the surface water discharge from the Works compound.

19.12 Hazardous Areas

All electrical equipment and associated wiring in the ESB Networks substation battery room shall be specified to the required ATEX requirements as laid down in I.S. EN IEC 60079-0:2018 and installed in accordance with I.S. EN 60079-14:2014&AC:2016.

The Customer shall comply fully with the relevant ATEX regulations in all areas where an explosive atmosphere may be present.

Following construction, the customer must provide a completed Explosive Atmosphere ATEX Certification. This sample form can be found in appendix H and available directly on the HSA website https://www.hsa.ie/eng/topics/atex/

The Customer shall take full account of any special requirements concerning equipment containing SF6 gas or transformer/reactor oil and equipment with exposed live or moving parts as well as the battery and valve rooms.

The Customer shall provide plant, equipment and other services, accordingly, including all facilities, to ensure the safety of the operating and maintenance personnel.

The Customer shall provide drawings to define all the hazardous areas taking account of all sources of hazards under normal and abnormal operating conditions.

Persons carrying out electrical installations in a potentially explosive atmosphere (i.e. battery room) shall have a minimum ATEX qualification equivalent to Compex EX 01 –EX 04 (installation, inspection and maintenance of Ex ‘d’, ‘n’, ‘e’, ‘p’ and ‘i’ electrical installations) plus relevant experience.

The Customer shall comply with the following regulations and standards for all areas where an explosive atmosphere may be present:

- SI 299 of 2007 – 2007 Safety Health & Welfare at Work (General Application) Regulations) Part 8: Explosive Atmospheres
- EN 60079: Explosive atmospheres
- EN 60079 -10: Classification of Areas – Explosive gas atmospheres.
- EN 60079-14: Design, selection & erection.
- EN 60079–17: Electrical Installations, inspection and maintenance.

The Customer shall assess the risk arising from potentially explosive atmospheres. The ATEX specific risk assessment shall be submitted for review by ESB Networks.

The Customer shall classify places where explosive gas atmospheres may occur under normal and abnormal operating conditions into hazardous or non-hazardous areas and classify hazardous areas into zones. The hazardous area classification drawing shall be submitted for review by ESB Networks. These drawings shall be retained and included in the Risk Assessment documentation.

The Customer shall display a warning sign at each point of entry to the hazardous area in compliance with Part 8 of the 2007 General Application Regulations.

The Customer shall be responsible for ensuring that all electrical equipment installed in any hazardous area shall be designed and tested to suit it. The designs and the certificates of conformity for the equipment shall be submitted to ESB Networks for review.

All exposed live or moving parts shall be fitted with screens or enclosures rated IP2X.

Electrical items (light fittings, heaters, thermostats etc.) in the Battery Room shall conform with EN 60079 – 14: and shall be suitable for a Zone 2, Gas Group IIC, Category 3G, Ex rated (e.g. Ex d flameproof, Ex m encapsulated, Ex e increased safety or Ex ic intrinsic safe for instrumentation), with a maximum temperature class of T1 (450 °C). Note that this electrical equipment shall not be installed in close proximity to the batteries which shall be zoned as ATEX Zone 1 IIC T1 area.

All Ex 'i' equipment and associated glands in the hazardous area (Battery Room) shall have an IP 20 minimum rating. All other Ex equipment and glands shall have an IP 54 minimum rating. If the equipment has an IP rating greater than IP 54 (e.g. IP 66) then a red fibre or white nylon washer shall be fitted onto the gland before connecting to fitting.

All cables used in a hazardous area shall be sheathed with thermoplastic, thermosetting, or elastomeric material. They shall be circular and compact. Any bedding or sheath shall be extruded. Fillers, if any, shall be non-hygroscopic (i.e. having little or no tendency to absorb moisture). There shall be no PVC insulated cables allowed throughout. The insulation shall be XLPE and outer sheaths shall be LSHF (low smoke halogen free).

The Customer shall ensure that an initial inspection of the electrical equipment and installation shall be completed by a competent person before the equipment shall be commissioned (EN 60079-17 Section 3.5). The inspection record shall be submitted for review by ESB Networks.

Heating circuits inside Battery Rooms shall be provided with RCD (30 mA sensitivity) protection.

20.0 Miscellaneous

A mains powered clock with digital twenty four hour reading shall be installed in the ESB Networks control room, on top of the row of control cabinets in a central position facing the operator's desk. This clock shall have a reserve enabling it to continue operating for two hours in the event of a failure of AC supply to it.

The clock shall be synchronised with Co-ordinated Universal Time (UTC). This synchronisation shall be based on a radio time code which shall be obtained from the GPS satellite system. An automatic daylight-saving time change facility shall be included.

The Customer shall install the clocks as per manufacturer's instructions.

The details of the clock proposed shall be submitted to the ESB Networks for review.

20.1 Fire Detection and Fire Alarm System for Substations

20.1.1 General

The Fire Detection System used in the substation shall be manufactured, designed and installed in accordance with ESB Networks Specification 16701.

The control room cabinet layout shall be designed to allow for free movement of an operator while cabinet doors shall be opened in the event of an emergency. Cabinet doors shall not inhibit exit from many areas within the control room.

A manual fire alarm system and an automatic fire detection and alarm system shall be provided in the substation to secure early warning of the outbreak of fire in any part of the control building. The building shall be divided into a number of zones for the purpose of identifying the location of any outbreak of fire. In the case of control room and open area of protection cabinets which have computer decking floor with sub-floor beneath, the cable space between floors shall be considered as a zone separate from the room above.

The fire detection and alarm system shall be designed, manufactured and installed to the highest standards of reliability and in accordance with the best modern practice by a specialist manufacturer. The system and components shall be proven in service over a number of years. Only companies experienced in design and installation of firefighting equipment shall be reviewed by ESB Networks and the design, installation, supervision, testing and commissioning shall be performed by the approved sub-contractor only.

All major specialised firefighting equipment and devices shall be identified as available in the local market, i.e. an established maintenance and spares service shall be available locally. Firefighting equipment in the form of portable fire extinguishers shall be provided at various locations throughout each substation.

The buildings shall be designed to minimise the possibility of fire spreading internally and also with respect to the surroundings. This in particular pertains to exposure protection. All zoning for fire protection purposes shall have the same rating as walls, i.e. windows, doors, openings, ducts, PVC pipes, cable barriers, and shall be coated in accordance with manufacturers' recommendations. Passive fire protection including fireproof coatings, fire rated doors and walls shall be included according to fire load evaluation as per NFPA.

Escape routes and emergency exits shall be easily noticeable. Coloured signs and lights shall be selected to ESB Networks approval. Design features for all fire preventive measures shall be co-ordinated to suit the systems of the substation building. Warning signs and all equipment which shall be operated by the Fire Brigade and/or local personnel shall bear inscriptions in English.

Design, manufacture, installation, commissioning and testing of the protection system shall be done according to the latest NFPA Codes of Practice and Standards. All materials, pumps, equipment, devices to be used for fire protection and fire detection systems shall be approved or listed by the following approved authorities: F.M. (USA), U.L. (USA), V.D.S. (Germany), L.P.C. (FOC) – UK.

Where the Fire Detection System may be shared between the Customer and ESB Networks Rooms, the Customer shall maintain the system and associated records on a regular basis.

The firefighting installation shall be ready for operation before commissioning the substation.

A Certificate of Completion for the Fire Detection System shall be provided in the Safety File.

20.1.2 Portable Fire Extinguishers

Portable fire extinguishers of a suitable size and type shall be located in indoor areas at each room exit. CO_2 or dry powder extinguishers in accordance with NFPA10 and shall be provided for use in all areas.

At the indoor locations the extinguishers shall be securely wall mounted. Details of fire extinguishers and their location, including manufacturer's description brochures, shall be submitted to ESB Networks for comment.

Portable fire extinguishers shall also be mounted outdoors on the Control Building wall in a suitable, visible cabinet

The number and location of fire extinguishers shall form part of the overall design of the Fire Detection system.

20.2 Intruder Detection

All Intruder Detection Systems used in the substation shall be designed and manufactured in accordance with ESB Networks Specification 16702. The ESB Networks and Customer control buildings shall each have a separate intruder alarm system.

The Customer shall supply the keypad engineering code for the Intruder Detection System with the Safety File.

A Certificate of Completion for the Intruder Detection System shall be provided in the Safety File.

20.3 Auxiliary Equipment List for Control Building

- The following items shall be provided by the Customer prior to handover;
- Temporary Earthing Facilities (on a case by case basis – refer to section 21.8.3);
- Wall mounted Eyewash Facility to an approved Industrial standard;
- First Aid kit to an approved Industrial standard;
- Signage;
- Notice board and safety notices;
- Filing Cabinet;
- Operators Desk and Chair;
- Digital Clock;
- Apron, gloves and full visor helmet for the battery room where required. This equipment shall be located on the hallway wall adjacent to the Battery Room;

21.0 Control Cable Installation

21.1 Cable Specification

All cables used in the substation shall be designed and manufactured in accordance with ESB Networks Specification 16118.

21.2 Application

Cable types include screened multicore and screened/unscreened multiple twisted pair cables.

Screened multicore cables shall be used for all outdoor circuits and for all circuits involving voltages greater than 50 V. Multiple twisted pair cables shall be used for all control, status and alarm connections to DCC SCADA equipment. It may also be used for 24 V or 48 V applications totally within the control room. The use of unscreened cable for any particular application shall be subject to the approval of ESB Networks. Multiple twisted pair cables cannot be used for any outdoor circuits.

Conductor cross-section shall be rated for the relevant current-carrying duty and circuit voltage drop. The Customer shall ensure that the cross-section of the wiring shall be adequate for the operating current and voltage conditions.

The screens of screened control cables shall be connected to the earth grid at both ends of the cable by the shortest practical connection.

The screens of all SCADA cables shall be earthed only at the RTU.

Each multi-core/multi-pair cable shall be used for one type of duty and at one supply voltage level for example, a cable used for connections to instrument transformers shall not include connections for switchgear operation.

Cable use shall also be on a switchgear bay basis where possible. This requirement shall be reflected right through the station including control rooms.

Cables and wires for any particular circuit shall have a dielectric test level at least matching the minimum level of the equipment to which it shall be connected and rated duty at least equal to that of the equipment to which it shall be connected.

Wires and cable cores of circuits with different voltage ratings shall be segregated unless they may be rated for the higher voltage rating.

AC and DC circuits shall not be carried on the same cable. Cables shall be fitted with numbered permanent identification tags at termination points. Suitable glands shall be used to connect cables to mechanism boxes, cabinets, etc. Spare glands shall be ‘blanked off’ as required to retain IP rating.

A pad-lockable marshalling box or kiosk shall be provided for each 110 kV AIS bay to act as a marshalling point between the control room and the various cable termination locations in the bay. The fabrication detail shall be in accordance with drawing ESB Networks drawing PG406-D010-097-001.

Separate boxes for 38kV bays may be used for instrument transformers and switchgear if desired. The overall proposal shall be submitted for comment by ESB Networks.

21.3 Routing and Arrangement

Cable routes shall be chosen so as to minimise the pick-up of induced voltages liable to cause damage or interference.

Routing and arrangement of cables shall be approved by ESB Networks and shall be planned to provide an orderly formation, free from unnecessary bends and crossings, which shall permit the removal of any one cable without undue disturbance to adjacent cables.

Cables shall be installed so that no temporary or permanent bends shall be made which may be sharper than those recommended by the manufacture and confirmed as acceptable by tests. There shall be no joints in cables laid entirely within the substation.

Where cables entering the control building or pass from room to room within a building, fire barriers shall be provided.

Provision of cable ducts for future development works shall be installed at the initial development stage.

21.4 Laying of Cables

All buried pipes and ducting requirements shall be in accordance with Part 2 of the Civil Works Specification PE607-F0000-S00-004.

Cables shall be laid in concrete troughs with reinforced covers, this type of trough shall be used for cables exiting the building and running between it and each bay. The type and method of removing the covers shall be agreed with ESB Networks.

The Earth Grid conductor shall not be run within the concrete trough.

In addition to the main arterial troughs, approved ducting shall be used from the cable trough to each item of plant within each bay. Cable ducts to HV plant shall be directly encased in the concrete plinth for each item of plant. On exiting, the duct shall be suitably located within the concrete plinth so as to minimise the length of exposed cable to the equipment. The Customer shall ensure that the cable shall be appropriately supported by means of metal cable tray along its exposed length to ensure secure support and to prevent damage. The pipe ducts shall be buried at the minimum standard depth required.

Cable Tray shall be in accordance with IEC61084 BS 61537:2007. Cable Tray shall be heavy duty, hot-dipped, galvanized steel with perforated tray base suitable for fixing cables. Heavy duty gauge with returned flanges to BS 61537:2007 shall be utilised. Constructed from mild steel and hot dipped galvanised to BS EN 10346:2009.

Where cables may run across roads or enter buildings the cables shall be run in Concrete encased pipes. All pipe ducts shall be brushed clean immediately prior to installation of cables. The Customer shall deal with and dispose of water and other extraneous materials so as to avoid risk of damage to cables.

The pulling arrangements for power cable installation shall be subject to ESB Networks review. The cable shall be lubricated as per ESB Networks/Manufacturer requirements. The lubricant used shall have no deleterious effect on the cables or other surrounds. At the point of cable entry into the pipe or duct, a bell mouth of suitable soft material shall be provided to prevent damage to the cable during installation. Suitable barriers shall be provided where cables enter the control building to prevent ingress of vermin and water. The type of barrier shall be approved in advance by ESB Networks.

Indoor cables shall preferably be run under false floors or in ducts in the floors, the ducts shall have removable covers. Glass Reinforced Plastic (GRP) removable covers shall be considered for 38kV and MV single room substations.

Indoor cables which may run above floor shall be supported by suitable metal trays or racks. Protective covers shall be placed over trays etc. where the cables may be exposed to damage from falling material or moving equipment.

Precautions in particular dedicated labelled trunking shall be required for cables between batteries and the first fuse location to guard against any possibility of a short circuit between poles or between an individual pole to earth.

Where cables enter a building or pass from room to room within a building – in particular cables between an ESB Networks Room and adjacent Customer Room – fire retardant barriers shall be provided, and materials used such as vermiculite shall not have any reaction with cables.

21.5 Electrolytic corrosion

Special care shall be required for any connection between copper and aluminium to avoid electrolytic corrosion. In this situation connectors containing a sealed bimetallic joint shall be required.

Every precaution shall be taken to ensure that cables and accessories shall not be installed in a manner or under conditions likely to cause electrolytic or other corrosive action or damage to or be detrimental to the performance of the cables during operation.

Spare glands shall be 'blanked off' as required to retain IP rating.

21.6 Supports

The Customer shall supply and install all the supports, racks, trays, cleats, saddles, clips and other parts required to carry and secure the cleats without risk of damage, in a neat and orderly manner. The spacing of all supports, racks, cleats, saddles and clips shall be subject to ESB Networks review.

Support structures for cables shall be free from rough edges and sharp corners. If such support structures shall be of mild steel, they shall be hot-dip galvanised.

Cable connections to kiosks, boxes, cabinets etc. shall be at least 300 mm over ground. Vertical portions of cable runs shall be supported by clamps, saddles on ladder racking or in conduit or trunking. All cables shall be securely supported at a point not more than 1.0 metres from their terminations.

All accessories shall comply with ESB Networks Hot Dip Galvanising Specification 05030, including treatment of cut parts. Plastic Cable ties shall not to be used for support, and all plastic accessories shall be UV rated.

21.7 Jointing

No jointing or splicing of LV control cables shall be permitted.

22.0 Substation Earthing

22.1 Standards

This section shall be read in conjunction with the associated Earthing Practice drawings referenced in sub-section 21.9 of this specification.

The relevant standards to be used are:

- IEEE Standard 81-2012 – IEEE Guide for measuring earth resistivity, ground impedance, and earth surface potentials of a grounding system.
- IEEE Standard 80-2000 – IEEE Guide for Safety in AC Substation Grounding.
- International Telecommunication Union ITU-T Directives Volume VI Limits for people safety related to coupling into telecommunications system from AC electric power and AC electrified railway installations in fault conditions.
- IEC 60028 – International standard of resistance for copper.
- EN1011 – Welding. Recommendations for welding of metallic materials.

22.2 Inputs

Design of the earthing system shall include but not be limited to the following inputs.

- Soil resistivity measurements.

  Multiple sets of soil resistivity measurements (SRM) shall be taken over and adjacent to the proposed site using the Wenner four-probe method with an appropriate calibrated earth resistivity tester. The number of sets and maximum inter-probe distance used shall be agreed in advance with ESB Networks.

- Soil model.

  A multi-layer resistivity soil model shall be developed using appropriate software (CDEGS, with multi-layer RESAP and MALZ modules capable of modelling up to 5 soil layers). Justification shall be provided for the soil model(s) selected, with reference to supporting information such as trial pit data (if available) and information regarding the local geological conditions (bedrock types, etc.), where appropriate. Plots of measured (apparent) resistivity versus probe spacing shall be provided in linear/linear format along with the soil model selected. Tables shall also be included showing the measured apparent resistance and/or resistivity versus probe spacing for each of the sets of SRM taken. In cases where there may be poor agreement between sets of SRM, sensitivity analysis shall be carried out and any modifications/simplifications/assumptions made in deriving the soil model clearly explained.

- Earth fault short-circuit level.

  In designing the earthing system, the relevant system equipment design earth fault short circuit levels shall be used as the starting point of the design study. If preliminary calculations show that this results in an impractical design from the point of view of ensuring touch and step voltage safety then the predicted results from short-circuit studies shall be used in its place, with an appropriate safety margin to be agreed with ESN Networks. Independently of the earth fault short circuit level used for evaluation of touch and step voltage safety, the earth grid conductors and equipment bonding conductors shall nevertheless be sized so as to be capable of thermally withstanding any expected future increases in system earth fault short-circuit levels (subject to the design parameters referred to below).

- Earth fault current distribution.

  If appropriate, an earth fault current distribution calculation shall be completed taking into account the conductive and inductive effects of cable-sheaths on underground cables and/or shield-wires on overhead lines. A value of the calculated earth fault current shall be stated (i.e. that current which returns to remote earth via the earth grid causing GPR and touch/step voltages). The methodology used for the earth fault current split calculation shall be agreed in advance with ESB Networks.

- Conductor short-circuit rating calculation.

  Sizing of earth grid conductors and equipment bonding conductors shall be carried out according to the IEEE-80 standard, with the design parameters to be agreed in advance with ESB Networks

- Earth fault clearance time.

  The design earth fault clearance time for purposes of sizing the earth grid conductors and equipment bonding conductors shall be 0.5s. The design earth fault clearance time for purposes of assessing touch and step voltage safety shall either be as per the table below or shall be based on expected earth fault clearance times by local network protection and shall be agreed in advance with ESB Networks.

110 kV earth fault: Backup protection	0.5 s
38 kV cross country earth fault:	0.65 s
20 kV earthed neutral system earth fault:	2.0 s

22.3 Modelling

A conductive computer model (CDEGS) shall be used to compute the surface potentials at and in the vicinity of the substation. Surface voltage profiles shall be calculated at an appropriate resolution in order to accurately capture the worst-case touch and step voltages that may occur. The profile spacing resolution to be used for each of the different touch, step and surface voltage plots shall be agreed in advance with ESB Networks.

22.4 Reporting

The Customer shall issue a report to ESB Networks which shows the following:

- Values of earth grid resistance/earthing system impedance, earth fault current and ground potential rise.
- Plots of touch and step voltages at and in the vicinity of the substation and connected elements.
- Plots of surface voltage contours in the vicinity showing, if appropriate, the 2 kV contour and the relevant contour from Table 1/5 of International Telecommunication Union ITU-T Directives Volume VI.
- Details of any mitigation measures required (i.e. insulative surface layers, earth grid extensions etc.) to either reduce the local touch or step voltages or to address transferred voltages to third party infrastructure.

The Customer shall produce drawings showing the relevant surface voltage contours (2 kV and the appropriate contour from Table 1/5 of ITU-T Directives Volume VI) superimposed onto ordnance survey maps. The Customer, in conjunction with the telecommunications provider, shall identify an appropriate location for the telecommunication junction box.

22.5 Earth Grid Installation

An experienced earth grid installation contractor shall be used. The earth grid shall be installed in soil (not backfill) with the specified minimum layer of bedding material above and below the conductor. A cross section detail shall be provided in the earthing layout drawings. Conductors shall be stranded copper connected via compression clamps or exothermic weld (no bolted connections).

The earth grid installer shall consult the overall earth grid layout and earthing practice drawings to ensure that tails from the earth grid shall be directly connected to the final installed plant location avoiding earth tails running across the compound. The fault current path shall be as short and direct as possible from the plant down to the main earth electrode. The Customer shall ensure that connection surfaces shall be clean and free from contamination.

Any earth conductor exiting the ESB Networks compound shall have the capability of being broken by means of a removal 'link'. This 'link' shall be located in a chamber outside the ESB Networks outer fence and its GPS co-ordinates marked on the As-Built drawings. This shall also apply to any earth brought out from the ESB Networks Compound by the customer in order to reduce the fault current.

During the installation of the main earth grid the Customer shall produce high quality photographs of each individual joint and earth grid installation along with corresponding GPS co-ordinates including any earth rod installations prior to excavations being backfilled. A ductor test shall be carried out and results presented to prove continuity in circuits. Such works shall include a weekly quality report and shall be submitted to ESB Networks. ESB Networks may provide samples of such reports at request.

22.6 General Earth Grid Requirements

This section specifies the installation of the substation earth grid system and the bonding to earth of equipment housings, structures etc. The earth electrode systems together with all earth connections shall be designed and installed in accordance with the recommendations contained in "IEEE Guide for Safety in Substation Grounding" IEEE Std. 80.

Where the Customer substation may be directly adjacent to the ESB Networks substation, the two earthing schemes shall be directly connected by a number of accessible interconnection points with a suitable chamber to remove link.

The earth electrode system shall consist of a grid of copper conductor with mesh size designed to limit touch and step voltages to safe values as recommended in IEEE Std. 80. If safe values of touch and step voltages cannot be achieved by a conductor grid alone earth rods and/or counterpoise may be added as necessary.

Preliminary studies may show that it may not be possible to achieve safe values for the ESB Networks substation on a standalone basis. In this situation any proposal to use external connections to the Customer earthing system or connections to shield wires or counterpoises to achieve safe values shall be agreed with ESB Networks.

The detailed design shall be carried out using a reputable computer programme such as CDEGS.

The resistance of the earth electrode system shall typically be less than 1 ohm for 110 kV substations and 20 ohms for 38 kV substations, however this may be very much installation and location dependent, so if these values of earth resistance may be exceeded, they shall be referred to ESB Networks and any appropriate mitigation measures shall be agreed.

Earthing conductors in proximity to control cables, cable sheaths, compressed air pipes and other services, which may become conductive during earth faults, shall have adequate separation (at least 300 mm below) from these services and shall be run in PVC pipes.

22.7 Tests

Prior to drawing up designs the Customer shall carry out a series of soil resistivity measurements at the site. These measurements may be witnessed by ESB Networks. The measurements shall be made using the Wenner four-electrode method. Readings shall be taken for variations in probe separation in steps of 1 metre up to 5 metres and continuing in steps of 10 metres up to 60 metres (and more if possible).

Positions for probes shall be chosen on the basis that they may be the most likely to give accurate results. At least two series of measurements shall be made at the substation site, the directions of measurements being approximately at 90 ° to one another.

Probe positions adjacent to existing earth systems or other buried metal objects shall be avoided as far as possible. Soil layer resistivities and earth electrode resistance shall be derived from the measured data.

On completion of the earthing installation the following tests shall be performed by the Customer to verify that the earthing system resistance shall be within specification and that touch and step voltages shall be within tolerable limits. The earth grid shall be tested before substation switch-in by current injection. (The fall-of-potential method may be acceptable as an alternative method subject to ESB Networks approval).

- earth resistance/earthing system impedance tests;
- voltage gradient tests (to measure the extent of the relevant Surface Voltage Contours in several directions leading away from the earthing system);
- step voltage tests;
- touch voltage tests;

The test methods shall be subject to ESB Networks approval. A detailed method statement shall be provided by the Customer to ESB Networks for agreement. As ESB Networks may wish to witness the test they shall be given 1 months' notice to allow them the opportunity to do so. A declaration of fitness for the earth grid shall be provided by the Customer.

In the event of the required limits being exceeded the Customer shall modify the earthing system to attain values within the specified limits.

22.8 Specific Earth Grid Requirements

Where earth conductors may be led through building materials such as concrete at least 50 mm green PVC ducts shall be grouted in during construction. The ducts shall be located as close as possible to the associated plant removing the risk of tripping hazard.

The Customer shall ensure that all components shall be capable of carrying the prospective earth fault currents, without deterioration, throughout the life of the substation.

22.8.1 Conductors

Conductors shall in general be 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) stranded annealed copper. The proposed conductor and associated connectors shall be issued to ESB Networks in advance of purchase.

In locations where primary fault current may flow, either as a result of direct contact between high voltage parts and earthed parts or as a result of flashover, the conductor shall always be installed in double connection, i.e. there shall be two independent 95 sq.mm stranded copper connections between the item of equipment and the earth grid. In other locations a single 95 sq.mm conductor shall be sufficient. For 38 kV stations, 50 sq. mm stranded copper connections shall be used.

Please adhere to earthing practice drawings provided in specification.

In this procedure "single connection" means 1 x 95 (or 50) sq.mm and "double connection" means 2 x 95 (or 50) sq.mm.

The 95 sq.mm shall be equivalent to flat upper conductors of 30 x 5 mm and 50 x 5 mm respectively.

Where steel structures supporting high voltage, equipment form part of the earth conductor, the cross-section of steel equivalent to a 2 x 95 sq.mm stranded copper conductor shall be 760 sq. mm.

Earth rods, if required, shall be copper-clad steel with minimum dimensions of 12.5 mm diameter and 1800 mm length.

Grid conductors shall be laid at a minimum depth of 600 mm (110 kV substations) or 460 mm (38 kV substations) below ground, refer to IEEE 80 for earth grid design practices. Where there may be a choice, soil which may likely have a lower resistivity shall be selected. Backfill soil shall be well-compressed around the earth conductors as tightly as possible in order to reduce contact resistance.

If there may be occasional areas of rock at a higher level than the bottom of the grid conductor trench, the conductor may be laid on the rock on a layer of soil and covered with well compacted soil or with weak-mix concrete in a manner which shall provide permanent and secure protection for the conductor.

Exposed earth conductors shall be installed inconspicuously in vertical or horizontal formation and shall be neatly fastened to supporting surfaces.

Earthing conductors in proximity to control cables, cable sheaths, compressed air pipes and other services, which may become conductive during earth faults, shall have adequate separation from these services and shall be run in PVC Pipes.

22.8.2 Connections and Joints

The surfaces of all joints and connections shall be thoroughly cleaned immediately before jointing or connection. Joints shall be of low resistance and shall be fully rated, mechanically sound, secured against loosening and, if necessary, protected against electrolytic action.

Grid conductor splices, grid intersections and joints where the earthing conductors from equipment, housings and structures may be connected to the grid shall be made using an approved compression system or by an approved exothermic welding system. Bolted connections shall not be used below ground on the main earth electrode.

Connections to the earthing terminals of equipment, housings and structures shall be made using bolted connections. Tinned lugs shall be used for connections to galvanised steel parts.

The Customer shall ensure that all bonding connections shall be accessible and maintainable Adequate clearance shall be provided between earthing fitting and finished concrete capping level. Please refer to earthing practice drawings and palisade fence drawings provided in the specification.

The number of splices in the grid conductor shall be kept to the minimum necessary. Splices shall be made by overlapping the conductors and using two H-crimp compression connectors. Refer to ESB drawing PG406-D009-405 for further details.

Earthing conductors connecting equipment, housings and structures to the grid shall be as short as practicable and shall be made as spur connections, i.e. they shall not break the continuity of the grid conductor. Where these conductors may be in double connection, the conductors shall be connected such that the fault current always has two independent paths into the grid.

There shall be consistency between the two conductors where the two conductors shall be crimped together. This shall be to ensure a uniform adequate pressure shall be applied to both conductors during crimping. Bird caging of earth grid due to sharp bends in the copper conductor shall be unacceptable.

In order to provide mechanical protection and also allow visual inspection of the condition of the conductor, flexible connections shall have clear PVC insulation.

22.8.3 Temporary Earthing Facilities

It may be necessary to connect normally live parts to earth for maintenance purposes by means of temporary flexible earth leads. Fixed earthing points shall be provided at each disconnector. Such earthing points shall be connected to the earth grid system by means of a double earth conductor. Fixed earthing points shall be installed on the same side of the associated plant as the overhead earthing stirrup. This shall be to ensure an operator may safely apply and remove portable earthing leads using an earthing rod. The precise arrangement shall be subject to ESB Network's review.

The Customer shall supply the temporary earth leads for the substation. The number, type, length and cross-sectional area of the temporary earthing leads required at a particular substation shall be reviewed on a case-by-case basis with ESB Networks therefore the Customer shall provide details in advance of purchase.

The leads shall be flexible copper complete with a clamp at each end. The HV connection shall be made to stirrups which the Customer shall install on the HV conductor at the appropriate location on each side of each disconnector and shall be submitted to ESB Networks for review.

The precise arrangement for temporary earthing facilities shall be subject to ESB Network's review.

22.9 Earthing of High Voltage Equipment Structures

The metal parts of high voltage equipment and the equipment support structures which shall be at earth potential shall be connected to the earth grid by double connection. Earth conductors shall be kept short and direct, with few bends. Where items of equipment, or parts thereof, shall be mounted on a steel base or support structure and all the metal parts at earth potential shall be securely bolted together and to the base to provide effective electrical connections equivalent in current carrying capacity to 2 x 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) stranded copper conductor, it shall be sufficient to earth the base or the steel support structure.

Ducting to carry earth conductors shall be cast into the concrete plinths, existing the plinth only at the location required to avoid potential trip hazards and tampering with conductor. Final location of plant shall be closely coordinated between the civil and electrical designs,

Exceptions to this requirement include those items outlined in Sections 21.9.3, 21.9.5 and 21.9.6 below.

The earth conductor between the earth grid and the substation equipment shall be covered by green PVC.

Refer to the following drawings for earthing of high voltage equipment structures;

- ESB Networks drawing PG406-D010-132 for 110 kV stations.
- ESB Networks drawing PG406-D009-405 for 38 kV stations.

22.9.1 Galvanised Steel Structures

Galvanised steel support structures shall be considered as part of the earth circuit for the equipment mounted on them, provided that:

- the structure shall be connected directly to the grid by a double connection
- the rating of the current path in the steel structure shall be equivalent to a double connection in 95 sq.mm copper having a steel cross-sectional area of 760 sq.mm.
- the joints in the steel structure shall be bolted or welded such that a durable electrical connection shall be assured.
- the earth circuit in the structure does not comprise parts which shall be normally removed in the course of routine maintenance and may not be securely replaced.
- the equipment shall not be one of those items, described below, which shall be required to have a direct connection from its designated earth terminal to the earth grid.

22.9.2 Galvanic Action

The Customer shall protect all joints between dissimilar metals against corrosion. In particular where a copper earth conductor may be supported on galvanised steelwork or connected to structural rebar, contact between the two shall be prevented, in order to avoid galvanic action. Contact shall be avoided by use of insulated conductors for connecting equipment to the earth grid. The conductors shall be secured to the steelwork by means of copper or metal clips or saddles.

All connectors in contact with galvanised steel shall be tinned. Where possible, connections shall be made to vertical faces only.

22.9.3 CT's, VT's and Coupling Capacitors

The designated earth terminal on each unit shall be directly connected to the grid by a double connection (110 kV Substations) or a single connection (38 kV Substations). The support steelwork shall also be connected to the grid by a double connection (110 kV Substations) or a single connection (38 kV Substations), but the conductor used for earthing the equipment may also be used for earthing the structure, provided it remains unbroken.

22.9.4 Circuit Breakers

Bases and steel support structures shall be connected to the grid by a double connection (110 kV Substations) or a single connection (38 kV Substations), as per Paragraph 21.9.1.

Where the mechanism may be integral with the chassis, and the requirements of Paragraph 21.9.1 regarding continuity and current rating shall be satisfied, it need not be separately earthed.

22.9.5 Line/Earth Disconnectors

Bases or steel support structures shall be connected to the grid by a double connection as per Section 21.9.1.

There shall be a double connection between each earth blade (i.e. one double connection per phase) and the station grid. The manufacturer's designated earthing terminals shall be used for all connections. If a flexible connection may be provided by the manufacturer between the earth blade and the disconnector base, it shall be sufficient to connect the base of the disconnector to earth with a double conductor. The steel support and the fixed earthing point (if fitted) shall have a 2 x 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) connection, usually from the same earth conductor.

Manual operating handles, where they exist on disconnectors, shall be connected by means of flexible copper conductor of 50 sq.mm section to the supporting steelwork.

22.9.6 Surge Arresters

As well as earthing for power frequency flashovers the earth conductor shall provide a low impedance path for high frequency surges.

Because of the protective function of lightning arresters, it shall be important that close attention be paid to the earthing requirements. A low impedance path for high frequency discharge currents shall be achieved by ensuring that there shall be a high-density mesh in the vicinity of the arresters, thus providing multiple discharge paths. In addition, it shall be desirable that earth conductors from the arrester to the grid shall be as short and straight as possible. In high resistance locations consideration of the use of driven earth rods in the vicinity of the lightning arresters may arise. The earthing terminal of the arrester and the supporting pedestals shall be separately bonded to earth by single and double runs of 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) copper respectively. Each sperate surge arrester earth conductor to have a double H-crimp connection onto the earth grid and have separation between each H-crimp.

High voltage arresters for 110 kV shall incorporate combined milliammeter and discharge counter in the earth lead. Note: the discharge counters shall not be required for 38 kV and MV station surge arrestors.

The mounting arrangements for milliammeter/discharge counters are to be as follows:

1. Milliammeter/counters may be mounted on lightning arrester support structures at about 1.6m above ground level. The housing shall be bolted to the structure.
2. The connection from the arrester terminal to the counter shall be insulated cable, 95 mm 2 copper, NYY 0.6/1 kV or similar.
3. The connection of this cable to the bushing terminal of the counter shall be insulated to prevent accidental contact, using for example suitable heat shrink insulation.
4. The earth terminal of the counter shall be connected to earth grid with 2 x 95 mm 2 Cu. conductors.
5. A sign indicating the possibility of electrical hazard shall be fixed to the structure beside the counter.
6. The base of the support structure shall be earthed in the usual manner. i.e. by separate double connection.
7. Each separate surge arrestor earth conductor to have a double H-crimp onto the earth grid and have separation between each H-crimp

Earthing ducts shall be designed and installed in all concrete plinths to allow the earthing conductor pass from equipment to earth grid without being exposed to alleviate security issues and trip hazards.

22.9.7 Control/Marshalling Kiosks and Relay Panels

All structural and metallic parts of kiosks intended to be at earth potential shall be securely bonded to the kiosk frame, which shall in turn be connected to the earth grid by a double connection. All moveable parts (i.e. doors/lids) shall be earthed by a flexible earth. A collector bar or appropriate means shall be provided for earthing CT or VT secondary windings and these shall be bonded to the grid by the same connection. Doors shall also use flexible earths.

Earthing of internal components shall be carried out in accordance with the drawings in the attached Work Package for 110kV and 38kV Stations as appropriate.

It shall be essential that each component shall be earthed directly to the internal earth bar and that each connection shall be as short and direct as possible.

22.9.8 Line Towers and Portal Structures

Steel towers, including the individual towers of portal structures shall be connected to earth by double connection. This requirement applies to structures located within the grid area. If the structure may be marginally outside the safety fence a double connection shall be run from the grid to a potential control ring surrounding the structure. The structure shall be bonded to the potential control ring by double connection.

Where overhead shield wires may be provided on the transmission lines, they shall provide the necessary connection from the end tower to the line portal structure, which shall be bonded to the grid.

22.9.9 Control and Relay Buildings

Control and relay buildings within the grid area shall be encircled by potential control rings. A separate earth busbar of not less than 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) cross-sectional area shall be installed within the building to act as a collector bar for all internal earth connections from equipment earth terminals, frames and housings. These internal earth connections shall be made with conductors of not less than 25 sq.mm copper cross-sectional area. The busbar shall be connected to the grid by a minimum of two 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) stranded copper conductors, connected to the busbar at well separated points. The two stranded connectors shall connect by the shortest distance to different points on the grid.

22.9.10 GIS Buildings

Special considerations for GIS requirements are detailed in Section 10 of IEEE Guide for Safety in AC Substation Grounding (IEEE Std. 80-2000).

22.10 Fences

A distinction shall be made between the safety fence which surrounds the compound in which the high voltage equipment shall be mounted and the property fence which defines the boundary of the Customer property.

Where site conditions permit, the outer perimeter loop of the earth grid shall be run outside the safety fence at a distance of l metre from the fence. This shall be the required arrangement where the property fence surrounds the safety fence at some distance.

All earthing connections from main electrode to palisade fence require PVC conduit ducts where they transition through concrete capping. The earth connection shall be located on that side of the post facing the compound (protects against access to connection from outside the compound).

Exposed metal parts of the fence shall be bonded together and connected to the perimeter earth loop at appropriate points. This arrangement provides protection against touch voltages to persons touching the safety fence from the outside.

Where, due to site restrictions, the safety fence also serves as the property fence or where site conditions do not permit the perimeter earth loop of the grid to be placed 1m outside the safety fence, it shall be placed l metre inside the fence, in which case the fence shall be independently earthed by means of earth rods and, if considered desirable, a dedicated buried earth loop placed under the fence.

Plastic covered chain-link fencing shall not be bonded to earth.

The correct earthing of metallic substation fencing by connection to the earth grid at a number of points shall be extremely important from the safety viewpoint. It shall be therefore essential that all constituent parts of the fence shall be solidly bonded. This may usually be realised by welding or bolting the parts together. However, some fence designs do not achieve this. A substation palisade fence was found to have the horizontal carrier rails passing through open slots in the upright support stanchion. When painted it may be likely that a very poor electrical connection shall be realised between the upright stanchion and horizontal rails.

Where such fencing may be used it shall be necessary to apply bonding connections between the parts in question in order to ensure electrical continuity. Consequently, it may be much more convenient if fencing having a bolted fixing arrangement may be provided.

The capping cast at the base of the palisade fence must not encroach with the earth connection lug to the fence, ample distance between top of capping and bottom of lug shall be provided to safely maintain the connection. Please refer to detailed drawings

The minimum fence requirements are:

- The fence shall be earthed at each corner.
- The fence shall be earthed at every second section (approximately every 10 m).

There shall be no metallic connection between the safety fence and the property fence or between the property fence and the fences of adjoining third party properties. Third party properties to be highlighted and discussed with ESB Networks.

22.11 Entrance Gates

The safety fence shall be bonded at intervals to the perimeter earth loop using a single 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) stranded copper conductor. All constituent parts of the fence shall be solidly bonded together. All gates in the safety fence or wall shall be connected to the same earthing system as the fence, irrespective of whether the perimeter earth loop may be inside or outside the fence. The gate shall open inwards only.

22.12 Railings, Handrails, Railways etc.

Where there may be railings, handrails, railways etc. in the vicinity of the substation they shall be made discontinuous at appropriate intervals.

22.13 Water Supplies

Water supply pipes to the substation shall be polythene or PVC.

22.14 Substation Auxiliary A.C. Supply

If applicable the L.V. neutrals of the house transformer and the auxiliary standby transformer shall be connected to the grid at points close to each neutral. The neutral busbar at the L.V. distribution board shall be switched to the appropriate transformer neutral over a wafer of the mechanically interlocked MCCB's.

22.15 House Transformer

If applicable the unit substation tank and cable end box shall be connected to the grid by a double connection.

22.16 Miscellaneous Items

Miscellaneous items such as compressors, diesel generators, lamp standards, compressed air tanks, fire extinguisher frames etc. shall be connected to earth by a single connection. Buildings housing such ancillary equipment shall be encircled by potential control rings.

Building steelwork, cladding and miscellaneous support steelwork shall be bonded to earth. Structures and metalwork which may become live at high voltage under fault conditions shall have a 2 x 95 sq.mm (110 kV substations) or 50 sq.mm (38 kV substations) stranded copper connection to internal earth loops. Other shall be connected to earth with a minimum of 1 x 50 sq.mm stranded copper conductor.

All miscellaneous steelwork including doors, handrails, gratings (steel casing), cable trays, support brackets, corner angles on cable ducts etc. shall be bonded to earth. Doors shall be bonded to earth by means of a flexible clear sheath connection.

22.17 Control Cable Sheath and Screens

Please refer to associated cable and control wiring within ESB Networks Specification 16118.

SCADA cable screens are to be earthed on at the RTU cabinet in the control room.

22.18 Installation

All internal earth bonding and the connections to the bonding from equipment, housings and structures shall be neatly fastened to the building structures, always running in horizontal and vertical formations where possible. The earth grid systems and the bonding of equipment enclosures, structures etc. to earth shall

be installed with the utmost care to ensure that, during the life of the substation, all components shall be capable of carrying the prescribed earth fault currents.

22.19 Transferred Potential and Hot Zones

When fault current may be flowing from a grid to General Mass of Earth the grid may assume a potential rise above the general earth. Such potentials may be transferred to outside locations over telephone circuits, low voltage power lines, fences, cable sheaths, metal pipes or railways, and may constitute a serious electrical hazard to the general public. Transferred potentials are, in fact, touch potentials but they shall not be amenable to the same control as internal touch potentials.

The potential gradient surrounding the grid shall be represented by a series of contours for reasons described hereunder the important contours or hot zones shall be these corresponding to 430 V/650 V and 2 kV.

ESB Networks substations earth grids shall be typically designed to minimise the expected earthing system impedance, the expected GPR and the extent of the 2 kV and 650 V/430 V Hot Zones (insofar as may be practically/reasonably be achieved).

Typically, grid potentials shall be exported from substations. However, circumstances may also arise where hazardous potentials may be imported over a power line from an adjacent substation. The latter possibility shall be studied as a special case. The following measures shall be required to prevent the export of hazardous potentials.

22.19.1 Telephone Circuits

Incoming telephone cables shall not transfer more than 650 V (110 kV substations) or 430 V (38 kV substations) to remotely installed equipment. This shall be achieved by isolating the incoming telephone cable with specialised isolating equipment and terminating an underground cable at a point in the hot zone which does not exceed 2 kV.

The effect of hazardous potentials depend on both magnitude and duration and the recommended design values shall be given in the following table for a typical situation.

Duration of faults t (s)	Admissible Limit (V)
$t \leq 0.1$	2000
$0.1 < t \leq 0.2$	1500
$0.2 < t \leq 0.35$	1000
$0.35 < t \leq 0.5$	650
$0.5 < t \leq 1.0$	430
$1.0 < t \leq 3.0$	150
$t > 3.0$	60

Source: Table 1/5 ITU-T Directives Volume VI

In summary all metallic cored service cables and metallic connections to any remote earths (such as metal pipework) entering the station 'hot zone' shall be insulated to a level of 20 kV. The 430/650 V zone indicates the area within which buildings, services etc. shall be subjected to the 430/650 V and may transferred elsewhere unless prevention measures may be taken. The 2 kV value indicates the point outside which a 2 kV telephone cable shall be terminated.

The 2 kV value shall be the typical insulation level for telecommunications cables. It shall be assumed that all telecommunications cables forming a circuit destined towards an ESB Networks substation shall have this

level of insulation. (An insulation level of, for example 600 V, would necessitate running the 20 kV insulated cable a much longer distance away from the substation).

The junction box terminating the telecommunications cable shall be located outside the 'hot zone'. Connection from the junction box to the substation building shall be by 15 kV insulated cable. Details of the connection design shall be agreed with Eir.

22.19.2 Distribution Voltage Power Circuits

The following situations shall be avoided in design practice.

A distribution system design which permits transmission substation grid potentials to be exported directly on cable sheaths to distribution substation earth grids. Unless special preventative measures shall be employed, particularly hazardous conditions may arise where a 20 kV/LV substation may be fed from a 110/20 kV substation by a cable, the sheath of which shall be earthed at both substations. In that case the high grid potentials of the 110 kV substation may be exported directly to multiple customer premises connected to the LV network.

For the 20 kV earthed neutral system, in the case of 110 kV earth fault current flowing into a 110/20 kV substation earth grid, it may be possible for a portion of this to find its way to the connected 20 kV/LV substations, raising the potential across the 20 kV substation earth grid resistance – this would only be significant however if the combined sequence impedance values of the 20 kV circuit were significantly less than the impedance of the 20 kV cable sheath.

Under no circumstances shall an LV (380/220 V) supply enter or leave an ESB Networks HV substation, the transformer feeding the LV supply supplies to the station shall be located inside the safety fence. Where an LV line in the vicinity of the substation runs in a radial direction from the substation an examination of the transferred potentials shall be made. **In particular LV Networks within 500 metres of the substation shall be examined.**

The neutralising of LV Networks in the vicinity of a substation may result in transferred potentials.

Standby supplies to ESB Networks HV substations from ESB Networks distribution Networks shall enter the substation on dedicated circuits arranged to prevent the export of grid potentials. The transformers shall be mounted within the substation earth grid perimeter.

22.19.3 Buildings in the Vicinity of a Substation

Care shall be required in the case of existing third-party buildings near the transmission station. This shall be especially important in the case of farm buildings where, in addition to telephone and power lines, there may be fences, railings, buried metal pipes etc. – some possibly running in radial directions from the grid.

Third party buildings located adjacent to a substation shall be isolated from the substation grid potentials.

22.19.4 Customer Ancillary Buildings

Ancillary buildings owned by the Customer and located outside the safety fence shall be treated as follows:

If the buildings may be within the influence zone of the earth grid, the grid shall be extended to the buildings and all metallic structures and facilities in the buildings bonded to it. A potential control ring shall be placed around the building at a distance of I m. Care shall be taken to prevent the export of transferred potentials from the buildings to the public domain on telephone or other services.

If the buildings may be outside the influence zone of the earth grid they may be isolated from the grid and separately earthed, taking care to prevent the transfer of potentials from the grid to the buildings on interconnecting cables and services. In this case it shall be recommended that all metalwork in the buildings be bonded to a local earth at the building. **However, if the ancillary building includes a control room or if there may be substantial interconnecting services it shall not be possible to isolate the two earth electrodes from one another.**

22.20 Drawings and Information

Drawings and information describing the various types of connectors and joints shall be included as per Appendix F.

The following drawings and information shall be submitted to ESB Networks for review prior to installation of the earth grid.

22.20.1 Before Installation of the Earth Grid

- Earth resistivity test results;
- Earth grid design calculations;
- Earth mat design drawings for substation yard and control building as well as;
- Grid potential rise contours;
- Substation equipment earthing layout drawings; Proof of coordination in design (elec, civil layouts)
- Details and descriptions of materials to be used e.g. clamps, connectors etc.;
- Details of jointing methods;
- Test methods for verification of design values;
- Tool crimp certification/calibration pull & ductor test results for sample copper and accessories to be used;
- Installation program and installation methodology;
- Proposed earth electrode conductor and bonding conductors;

22.20.2 Before Handover and After Installation

- Test results of Earth grid resistance;
- Test results of step and touch voltages;
- Test results of Grid potential rise;
- Test results of Ductor tests and joints;
- As-built drawing of installed earth grid;
- As-built drawing of earth system of control building;
- High quality photographs of each individual joint and earth grid installation along with corresponding GPS co-ordinates including any earth rod installations.
- Final test results;

23.0 Lightning Protection

23.1 General

A risk assessment shall be conducted based on the methods contained in IEC 62305 Protection Against Lightning, Part 2, Risk management. This risk assessment shall determine whether a lightning protection system (LPS) may be required or not at the substation.

If it may be determined that an LPS shall be required, then design of the LPS shall be based on the methods contained in IEC 62305 Protection against lightning, Part 3, Physical damage to structures and life hazard (i.e. the protection angle and rolling sphere methods). Use of the surrounding topography to assist in lightning protection shall be permitted.

The substation earth grid shall be used as the earth termination system in the LPS. Steel structures (busbar gantries/towers) may be used as the down conductor system, with appropriate calculation. The air termination system may consist of shield-wires/roof meshing or lightning finials.

Protection of the substation control building internal equipment shall be required as per IEC 62305 Protection against lightning, Part 4, Electrical and electronic systems within structures.

All input parameters to the study shall be agreed with ESB Networks.

Measurement of the resistance of the LPS to remote earth shall be required.

24.0 Lattice Steel Masts and Girders

24.1 Quality of Material

At the discretion of the Customer some or all of the mast and girder members may be of high tensile steel, but all bolts shall be of high tensile steel. High tensile steel having a specified minimum yield stress greater than 390 N/mm^2 shall not be used except by special agreement with ESB Networks.

Galvanising shall be in accordance with ESB Networks Specification 05030 in the Works Package.

24.2 Design Loads

The external applied loads for which the masts and girders shall be designed shall be calculated by the Customer. These loads shall be ultimate loads and shall be the loads with which the structures shall be tested. All pull tests on anchor bolts shall be carried out and certified by an independent Contractor.

Design stresses in members shall be generally in line with the requirements of Manual 52 of the American Society of Civil Engineers, “Guide for design of Steel Transmission Towers”.

24.3 Lightning Rods and Earthing

Lightning rods shall be fitted to the top of the masts. The rods shall be 3500 mm in length. A 13.5 mm dia. hole for an earthing connector shall be provided on every mast leg. This hole shall be located about 500 mm above ground level. Its precise position shall be agreed with the mast fabricator.

24.4 Foundations

The masts shall be fixed to concrete foundations designed and installed by the Customer The design shall be submitted to ESB Networks for comment.

25.0 Control and Protection

25.1 Control Room

The ESB Networks substation shall have a dedicated control room from which centralised control shall be exercised. The control room shall normally be unmanned but shall be visited by operations staff on a regular basis and when fault conditions arise. Normal supervision and remote control of the substations shall be exercised from the DCC and or the NCC. The control room shall have an operator's desk and shall house control and protection equipment and auxiliary power supply equipment.

25.2 Centralised Control

Control shall be available from the control cabinet situated in the control room. A mimic diagram of the switchgear arrangement, in single line form, shall be provided on the control cabinet and it shall represent as closely as possible the physical disposition of the bay switchgear. Refer to ESB Networks drawing in Work Package.

The Customer shall allow sufficient space on the mimic panel for future expansion. The Customer shall consult ESB Networks for exact requirements.

Where the mimic may be arranged with vertical busbars using a single cabinet **(separate panels not acceptable)**, then the higher voltage busbar shall be on the left-hand side and the lower voltage busbar on the right-hand side. Where the mimic may be arranged with horizontal busbars, then the higher voltage busbar shall be on top and the lower voltage busbar on the bottom.

Illuminated control and discrepancy type switches shall be incorporated in the mimic and shall be used for the operation and position indication of all motorised equipment.

The position of relevant switchgear devices shall be monitored on the mimic by means of semaphore indicators. Semaphore Indicators shall be provided for:

- All Customer 110 kV switchgear devices in 110 kV stations (over the fence connections);
- All ESB Networks GIS and MV Metal Enclosed disconnectors and earth switches in 110 kV substations;
- All ESB Networks GIS and MV Metal Enclosed disconnectors and earth switches in 38 kV substations

These semaphores shall assume a mid-position in the event of loss of their 24 V DC supply. LED semaphores shall be also acceptable.

Position indication facilities shall be required for all motorised disconnectors and earth switches with the exception of maintenance earth switches in 110 kV bays. All motorised 110 kV AIS earth switches shall be locked/unlocked by a key switch (per bay) located on the mosaic/mimic cabinet.

Mimic colours are referenced in relevant ESB Networks drawing in the Works Package Specifications.

25.2.1 Control and Discrepancy Switch

If a switch position agrees with that of the item of switchgear it controls, then its discrepancy lamp shall be illuminated with a steady light. Discrepancy between the position of the control switch and that of the item of switchgear shall result in the lamp being illuminated with a flashing light. Turning the control and discrepancy switch into agreement shall cause it to be steadily illuminated.

The switch shall require two independent movements to effect operation and the procedure shall be as follows. Consider that the item of switchgear shall be open with its control and discrepancy switch in agreement and steadily illuminated. In order to perform a close operation, the control and discrepancy switch

shall first be turned clockwise through 90° to the closed position. It shall then be illuminated with a flashing light as its position shall be in disagreement with that of the item of switchgear. Next the switch shall be depressed and impulse in the clockwise direction. The item of switchgear shall now close and the fact that the close operation has been completed shall be announced by the flashing light in the switch changing to a steady light. The procedure for opening shall be in the reverse with movement of the switch being in the counterclockwise direction.

For 110 kV stations a 220 V DC control supply shall be used for

- all motorised 110kV AIS and GIS equipment;
- 38 kV GIS circuit breakers and MV Metal Enclosed circuit breakers;

A control supply shall be required for motorised AIS equipment, 38 kV GIS circuit breakers and MV Metal Enclosed circuit breakers in 38 kV substations.

In 38 kV substations where there may only be 38 kV switchgear present, i.e. tail fed or looped configuration, then the control auxiliary voltage shall be 24 V DC.

The control and discrepancy switch shall be connected to the circuit breaker Close Coil and to Trip Coil No.1.

Both positive and negative sides of the supply shall be switched to carry out any close command, to the circuit breaker, and any open/closed command to the disconnector (typically manual operation in 38 kV AIS substations). Only the positive side of the supply shall be switched for any open command to the circuit breaker, and protection related tripping the flashing light for switch position discrepancy purposes shall be provided by a flicker relay operated at 24 V DC.

25.3 Circuit Breaker Close Circuit

Refer to ESB Networks drawing in Work Package for information on the close command circuit for the circuit breaker. This shall be viewed in conjunction with the relevant protection elementary provided.

For 38 kV stations equipped only a 24 V DC supply (no 220 V DC supply), all cables directly connected to the close and trip coils of the ESB Networks 38 kV circuit breaker shall be 4 x 6 sq.mm. The positive and negative standing 24 V DC supply to the circuit breaker shall be wired using 4 x 6 sq.mm cable.

Text labels shall be fitted to the electrical Open/Close pushbuttons and shall be designated ‘OPEN’ or ‘CLOSE’. The text shall be black lettering on a white background. The colour of the pushbuttons for ‘Close’ and ‘Open’ shall be black and white respectively.

25.4 Mosaic Indication ON/OFF Switch

For 110 kV stations, all 24 V DC supplies for switchgear control and position indication shall be isolated by means of a key operated ON/OFF switch. This switch shall be called the Mosaic indication ON/OFF switch.

For ESB Networks 38 kV stations, all 24 V DC supplies for switchgear position indication shall be isolated by means of an ON/OFF switch located on the 24 V DC distribution board. This switch shall be called the Mosaic indication ON/OFF switch. A mimic light pushbutton located on the mosaic/mimic cabinet shall be required to test the mimic lights.

25.5 SCADA Remote Control ON/OFF Switch

A SCADA Remote Control ON/OFF switch shall be provided on the control cabinet for each bay to allow parallel operation of the motorised equipment to be extended to the NCC/DCC (“ON” position) or not extended (“OFF” position) as required. Remote switchgear position indication, alarms or measurands, shall not be controlled by the switch. Such indication shall be available at the NCC/DCC regardless of whether

the switch may be on or off. The switch shall have provision for remote indication of both its positions. Both positive and negative of each circuit shall be switched.

In AIS stations the SCADA Remote Control ON/OFF switches shall be located on the mosaic/ mimic cabinet.

In substations equipped with GIS and Metal clad/Enclosed switchgear, this switch shall be located at each operator panel.

25.6 CT and VT Secondary Circuits

For 110 kV AIS stations all protection CT and VT windings from each single-phase instrument transformer shall be cabled to marshalling boxes adjacent to the instrument transformer in the switchyard. Marshalling cabinets shall be installed at a reasonable height, i.e. the bottom of the box shall be no more than 1.2 metres above ground. Each instrument transformer secondary star winding shall be earthed at only one point. For spare windings this point shall be the marshalling box. The other windings shall be earthed at the first cabinet to which the winding shall be connected in the control room.

For 38 kV AIS stations, all protection CT and VT windings shall be cabled directly back to the Control Room.

All CT wiring within cabinets, kiosks panels, etc. shall be done in 2.5 sq. stranded black coloured conductors. Mandatory file terminal arrangements for protection CT and VT circuits are outlined in the associated contestable protection elementary drawing. The orientation of the CT terminals shall be as indicated on this drawing.

VT star-connected and open-delta connected circuits for protection and indication metering shall be protected by high-speed MCB's e.g. Siemens 3RV1611-ICG14 type or equivalent located in the marshalling box. The VT MCB's shall be fitted with the auxiliary contacts, one to block inappropriate operation of impedance protection relays and one for signal purposes. Any proposed alternative MCB shall match the auxiliary contact operation time performance of the specified units. However, billing meter VT circuits shall be protected by sub fuses in the marshalling box. Please refer to latest Metering specification provided by ESB Networks.

VT star-connected circuits may be connected to both protection and metering systems. The VT Circuits shall be routed via the protection cabinets where the winding used for metering shall be sub-fused for each metering system e.g. indication metering, SCADA metering, disturbance recorder etc.

All CT circuits and billing meter VT circuits shall be implemented in 4 x 6 sq.mm cable and VT circuits shall be implemented in 4 x 1.5 sq.mm cable.

To allow commissioning and future testing and maintenance, there shall be facilities at a sufficient number of locations for secondary injection of current/voltage along the CT and VT secondary circuits.

The design shall be so that future commissioning, maintenance and testing of CT and VT circuits shall be possible without the disconnection of any wiring. This shall be achieved through the use of terminals with test facilities.

25.7 Protection

Reliability shall be the single most important attribute of the equipment covered by this specification as regards both dependability and security. Under no circumstance shall a single component defect have the potential to initiate an unwanted trip command. The protection equipment including test facilities shall be compatible with existing network equipment.

Housings shall conform with ESB Networks specified IP rating, and shall be adequately ventilated to ensure that excessive temperature rises do not occur.

25.8 Phase Designations

The three phases shall be designated as R, S and T, in counter clockwise vector rotation.

25.9 SCADA

In 110 kV substations the Customer shall install and connect the RTU and telecoms 48 V DC battery & charger. I

In 38 kV stations, the telecoms DC requirement shall be provided by the station 24 V DC supply.

The Customer shall also be responsible for terminating all cables at these cabinets.

Sufficient space shall be allocated in the battery room for the 48 V DC battery. Sufficient space shall be allocated in the control room for all SCADA cabinets. A layout drawing indicating the positioning of all cabinets in the control building shall be submitted to ESB Networks for review prior to the construction of the control building.

The Customer shall be responsible for installing all cables between substation equipment and the SCADA cabinets. Each of these cables shall be dedicated to a particular function i.e. remote control, status indication, alarms or measurands. All of the cables to SCADA (except for measurand cables) shall be multiple twisted pair cables. The measurand CT and VT cables shall be of the appropriate 4 x 6 sq.mm or 4 x 1.5 sq.mm multi-core types.

Details for Telecoms are outlined in Section 5, Telecoms Specification.

25.10 Remote Control

Remote control facilities shall be provided for the following functions:

- Circuit breaker open and close commands:

  This shall be implemented by the provision of 24 V DC interposing relays in the relevant protection cabinets. The SCADA remote control switch shall remove the circuit breaker control supply from the contacts of the interposing relays.

- SCADA advance warning (110 kV Stations only):

  A facility to allow the control centre to energise an outdoor audible alarm to warn anyone in the station of the imminent operation of 110 kV switchgear by remote control. The audible alarm (operating at 220 V DC) shall be energised from a 24 V DC remote control command and shall be held on for a period of time by an adjustable timer.

25.11 Status indication

Two-bit (i.e. confirmation of “OFF” and “ON” position) status indication shall be provided for the following functions by potential free contacts. It shall be permissible to group one side of potential free contacts into a common return where it may be practical to do so.

Position indication (ON and OFF) of ESB Networks motorised circuit breakers, disconnectors and earth switches.

Status indication of the SCADA advance warning system for 110 kV only.

Position indication of each bay’s SCADA ON/OFF switch.

Position indication also required for Auto reclose ON/OFF status.

Position indication of Customer switchgear (refer to DCC and NCC Signal List requirements).

25.12 Interlocking

The interlocking system shall be installed using only switchgear primary auxiliary

contacts. Interposing relays cannot be used for multiplying switchgear contacts.

Interlocking requirements are outlined in the Site-Specific Functional Specification.

25.13 Alarms

All substation alarms shall be wired to an AAP unit in 38 kV and MV substations both diode and surge protection (e.g. Phoenix type Termitrab) type terminals shall be installed in the Alarm Annunciation Panel- refer to ESB Networks drawing in Work Package.

A serial cable shall be directly connected between the AAP Unit and the DCC RTU. Any signals between the AAP Unit and the NCC RTU shall be hardwired via the diode terminals.

For 110 kV stations, a parallel or interposed connection shall be acceptable.

A potential-free contact shall be provided for the station general alarm (Cello Unit).

25.14 Tele protection Equipment

The Customer shall supply and install tele protection devices, including all primary relay fibre terminations and patch leads (e.g. feeder differential protection), on specified circuits as required by ESB Networks.

25.15 Star Couplers

Star couplers shall be required to provide ESB Networks with remote access to the protection relays. A star coupler shall be required for each manufacture's protection relays.

In 110 kV substations the star couplers may be installed either in a dedicated star coupler cabinet., in a protection cabinet or in the disturbance recorder cabinet.

A dedicated EGIP remote interrogation wall mounted panel shall be required for 38 kV and MV substations. This design shall be in accordance with the relevant ESB Networks Drawing in the Works Package.

25.16 ESB Networks-Customer Outdoor Interface Kiosk

Where an ESB Networks 110 kV substation and a Customer 110 kV substation adjoin each other, all connections between the ESB Networks substation and the Customer shall be routed through an outdoor interface kiosk provided by the Customer. This kiosk shall be located on the dividing fence between the adjoining compounds. The kiosk shall be accessible from both compounds.

All terminals shall be of the phoenix URTK/SP and URTK/S type (CT and VT type terminals respectively), and isolation type terminals for marshalling of power supply, position indication and interlocking requirements. These terminal types facilitate provides isolation between ESB Networks – Customer for commissioning and testing purposes.

The Kiosk design shall consider proximity of thermostat to the heating element i.e. not directly above.

A single-phase AC outlet with a suitable IP rating, shall be provided externally on the side of the kiosk for commissioning purposes.

25.17 ESB Networks-Customer Indoor Interface Cabinet

For 110 kV Substations Where an ESB Networks 110 kV substation and a Customer 110 kV substation adjoin each other, all connections requiring interposed relays between the ESB Networks and Customer substations shall be routed through an indoor interface cabinet in the ESB Networks Control Room. All interposing relays shall be located inside this cabinet.

Typical interface requirements are shown in ESB Networks drawing PE406-D800-026-001.

25.18 ESB Networks-Customer Indoor Marshalling Box

For 38 kV and MV substations, an indoor wall mounted marshalling box located in the ESB Networks Control Room shall be provided by the Customer The electrical interface requirements are outlined in the relevant ESB Networks Drawing in the Works Package.

25.19 Embedded Generator Interface Protection (EGIP)

Embedded Generator Interface Protection (EGIP) shall be designed to disconnect the generator from the ESB Networks during abnormal system conditions by tripping a dedicated circuit breaker, located as close as practically possible to the interface between the Customers equipment and the ESB Networks distribution network.

For GIS 110 kV or 38 kV applications, all EGIP devices shall be installed in a separate stand-alone protection cabinet in the ESB Networks Control Room.

For AIS 110 kV or 38 kV applications, all EGIP devices shall be incorporated within the protection cabinet in the ESB Networks Control Room.

For GIS MV applications, all EGIP devices shall be installed in the ESB Networks switchgear LV cabinet.

25.20 Maintenance Testing Facilities

On-line and off-line facilities shall be provided for in-situ testing of all meters and protection relays by injection of test currents and voltages into the secondary circuits of CT's and VT's. It shall be possible to test a particular relay or meter independently of any other instrument connected in the same circuit. These facilities shall also enable secondary current and voltage outputs of CT's and VT's, respectively, to be measured.

In order to allow connection of portable test equipment without disturbing the small wiring, accessible test points in the form of test terminal devices shall be provided at all cabinets containing CT and VT secondary circuits.

The protection relays shall be connected through a test socket/test switch combination. The specified test socket and test switch shall be mandatory. The test switch used shall provide for automatic disconnection from the load and the short-circuiting of the CT secondary. VT's shall be disconnected and open-circuited. It shall be impossible during operation of the switch for CT's to be open-circuited or VT's to be short-circuited. Trip circuits shall also be disconnected. All CT and VT terminals shall be of the specified type. In the case of metering circuits these terminals shall provide adequate test facilities. Please refer to associated protection elementary for test socket standards.

25.21 General Electrical Requirements

Electrical equipment shall be designed and manufactured in accordance with this document and the individual product specifications.

The works shall be designed to ensure continuity of operation under all working conditions and to facilitate inspection, maintenance and repairs. All reasonable precautions shall be taken in the design of equipment and of the works, to ensure the safety of personnel involved with the operation and maintenance of the works.

Outdoor electrical equipment shall be designed so that water cannot collect at any point.

All kiosks and cubicles shall be fitted with door-operated internal illumination lamps and shall be adequately ventilated to prevent condensation.

Mechanisms shall be constructed to prevent sticking due to rust and corrosion and the bearings of exposed operating shafts shall be designed so as to prevent moisture seeping along shafts to the interior of equipment.

All equipment shall operate without undue vibration and shall meet the substation audible noise requirements.

All equipment shall be designed to minimise corona and other electrical discharges.

25.22 Electrical Equipment Enclosures

All enclosures, mechanism boxes, control kiosks, marshalling cabinets etc., shall be suitable for the most onerous site conditions for the life of the equipment. Equipment enclosures for electrical equipment shall comply with IEC 60079 and IEC 60529 as applicable. All electrical panels shall be of vermin-proof construction. Unless otherwise specified, equipment enclosure classes shall be as follows:

Equipment Type	Location	IPW Rating
All Electrical Equipment	Indoors – General	IP55
	Indoors – in clean air-conditioned rooms	IP52
	Outdoors and indoor areas that are subject to water spray, or heavy condensation	IP65

To prevent contact with live parts, all electrical and control equipment shall have a minimum touch protection of at least IP2X. A 'Maximum Voltage' label shall be provided on the inside of each door;

Each enclosure shall be complete with doors and suitable labels and shall be provided with an external earthing terminal. Removable gland plates shall be provided where required and shall allow control cable entry from underneath the enclosure only.

All stainless steel shall be grade A4 as per ISO 3506-1 (AISI 316) or better unless otherwise stated in the product specifications.

In instances where enclosures may be in exposed locations, they shall be protected against ingress of dust.

Padlocking shall be provided where required, as per individual product specifications.

25.23 Anti-Condensation Heaters

All equipment, such as control cabinets, marshalling kiosks, and mechanism boxes etc., which shall not be mounted in a temperature-controlled environment shall incorporate electric anti-condensation heaters which displace sufficient heated air to avoid condensation. Appropriate provision shall be made for ventilation of the enclosure.

The protected equipment shall be designed so that the maximum permitted rise in temperature shall not be exceeded if the heaters may be energised while the equipment may be in operation.

Safety measures shall be taken to ensure that no direct contact with any part at a temperature higher than 60°C shall be possible i.e. IP2X screen required.

The anti-condensation heaters shall be fed from an isolatable 230 V single phase supply and shall be thermostatically controlled or by a humidistat. Labels shall be provided on the switch stating, “Heater Supply”. Heater terminals shall be shrouded and labelled “Heater”.

25.24 Electromagnetic Compatibility

The equipment shall conform to Standards IEC 60204-1, IEC 61000-6-2 and IEC 61000-6-4. High voltage and electronic equipment supplied for the Works shall be designed such that it does not cause maloperation of any other equipment.

The Customers design shall eliminate electromagnetic interference from lightning strikes to the building or to equipment installed outside of the building. The Customer suppliers shall detail measures taken to eliminate electromagnetic interference to control equipment or to low level control circuits from power cables or from power switching devices.

25.25 Control and Protection Cabinets

All control and protection equipment shall be installed in cabinets, which shall be designed, manufactured and installed as per ESB Networks Specification 16480.

Protection and control relays shall be capable of being removed from the cabinets for maintenance purposes.

Location of all display and operable equipment shall take into account good ergonomic design and the height of an average person standing on the floor to operate and view the equipment, or to access the equipment for troubleshooting and maintenance purposes. Access ladders, platforms or other temporary access systems shall not be required. This shall form part of a risk assessment on the cabinet design carried out by the Customer and submitted to ESB Networks for review.

25.26 Remote Diagnostic Access

Remote diagnostic access to allow remote interrogation and diagnostic monitoring of the control systems from a remote location from a contracted maintenance support centre shall be as detailed below.

All external communications ports provided to allow access to the control system shall be designed to prevent unauthorised access. This shall be carried out by means of modem dial-back, password control, physical switches or other suitable method agreed with the ESB Networks.

If the system supplied offers remote log in for system administrator purposes this communication shall have strong authentication security such as Secure Shell (SSHv2) rather than Telnet.

26.0 Metering

26.1 Billing and Metering

Bulk Supply Point Metering (BSPM) shall facilitate the calculation of internal ESB Networks Distribution system losses.

It shall be connected at the interface between the Transmission System and the Distribution System. This may usually, but not exclusively, be at 110 kV to 38 kV/MV transformers and normally utilises CTs and VTs associated with the low voltage side of the 110 kV transformers.

Main and Check Metering shall be required utilising two metering cores;

- CT's – Cl. 0.2S – two metering secondary windings, one dedicated to BSPM and one shared with e.g. SCADA, OLTC.
- VT's – Cl. 0.2 – two secondary windings, one dedicated to BSPM and one shared with e.g. SCADA, OLTC.

ESB Networks Meter Asset Management shall supply appropriate Main and Check Metering Cabinets approximately 600 mm x 600 mm x 250 mm. Main and Check Cabinets shall be separate, and each may contain two meters.

Where Revenue CT's and VT's may be installed on 38 kV GIS equipment the secondary wiring shall be installed in dedicated ducting and wired to an independent marshalling box.

Details for Revenue Metering are outlined in Section 4, Revenue Metering Specification of the Works Package.

26.2 Local Bay Metering

All measurand requirements for each bay shall be outlined in the station Single Line Diagram. A multi-function meter connected to a programmable multi-transducer shall be provided for bays requiring Volt, Amp, Watt and VAr measurands.

For 110/38 kV transformer bays, a dedicated transducer shall also be required for measurement of the 38 kV open-delta voltage to DCC.

All secondary outputs from the CTs and VTs shall match the corresponding transducer input rating.

27.0 Equipment and Physical Layout

27.1 Battery Room Layout

The following requirements shall be met:

a. The floor shall be designed to take the load of the batteries with margin to be taken into consideration for future extension

b. Shall be impermeable, coated in chemically resistant paint (IS EN IEC 62485-2:2018 Section 9.2d) with anti- slip properties. The floor finish in all battery rooms and enclosures shall be slip-resistant and acid or alkali resistant as appropriate for the battery chemistry employed. The floor shall be given a protective coating of acid-resistant, non-skid ceramic floor tiles or an approved acid-resistant epoxy coating applied in accordance with the manufacturer's specifications.

c. Where a cell failure may cause spillage of electrolyte, the spillage shall be contained e.g. by use of a retaining tray adequate to contain the electrolyte of at least one cell or monobloc battery. (We may follow up with getting this item as part of the manufacturers scope of supply).

d. The FFL shall be 20mm lower than the adjacent room floor. In order to eliminate the lip between the floor levels at the battery room doors, the floor slab shall be sloped to merge the two levels with a gradient not exceeding 1:50.

e. In the absence of a retaining tray that an almost undetectable slope of 5 to 10 mm away from the door towards a back corner be installed.

f. Wall mounted heaters located at low level.

g. Battery room door specifications:
   - The door/s to be fitted with internal emergency mechanism (panic bars) and shall swing outwards from the battery room.
   - Where a battery room may be fitted with more than one door then one door shall be designated as the main access door with requirements as above. The remaining door shall be equipped with an internal mechanism (Panic Bar) only.
   - The internal/external door shall be a minimum width of a door and a half for new build substations. Battery room door shall not be less than 800mm wide and 2000mm high and the inside surfaces of the door shall be protected by an approved light-coloured acid resistant paint.
   - The internal door shall be fire rated and fitted with automatic door closers.

h. The battery room shall have the following labels installed:
   - On the outside of the battery room door:
     - Ex warning sign in compliance with the ATEX regulations
     - Restricted Access
     - Dangerous Voltage (DC. 60V)/Risk of electric shock
     - Prohibition sign for fire, naked flames & smoking
     - Warning sign indicating the presence of corrosive liquids
     - Warning sign indicating slippery floor when wet
   - Battery bank & charger identification labels.
   - On the external wall of the battery room, between the two high level and the two low-level vents:
     - 2 x Ex warning signs in compliance with the ATEX regulations and an additional note: "Zone 2 area extends to 500mm around the vents"

Ventilation of the battery room shall be natural having vents located on two external perpendicular walls to meet the required number of air changes per hour to ensure that the hydrogen concentration shall be

maintained at a non-explosive level in accordance with IEC 62485-2: 2010-06 Section 7.1 & 7.2). The ventilation design of the battery room shall be submitted to ESB Networks for review 10 business days prior to any related works commencing on site.

To prevent the escape of hydrogen into adjacent rooms/spaces:

- Ensure that all opes in the battery room that lead into adjacent rooms shall be sealed
- The battery room ceiling shall be gas tight. False ceilings shall NOT be installed in the battery room as it becomes an unvented space.

The light fittings shall not be installed directly over the battery, but rather in between the battery rows, oriented in parallel to the battery racks, as the area immediately above and surrounding battery (i.e. 0.5 metres radius from every cell) shall be classified as Zone 1.

All fittings within the battery room shall be ATEX rated. Refer to section 18.12 – Hazardous Areas.

Battery stands and their support rails shall be insulated to 2 kV. They shall be treated with acid resistant coatings.

Earthing and bonding shall not be applied to the battery and the battery room equipment.

Please refer to ESB Networks Specification 16632 and associated Civil Specification.

27.2 Control Room Layout

The control room shall house the control and protection equipment shall be centrally located. The equipment shall be mounted in sheet metal cabinets. These shall be deployed in groups on a functional basis, there being control cabinets, protection cabinets, and auxiliary power supply cabinets. ESB Networks may review all cabinets before being dispatched to site.

There shall be a clearance of 1.2 metres between the cabinets, in order to form a 'walkway' between the rows of cabinets in the control room.

Requirements include provision for a control cabinet, protection cabinets, DC and AC distribution cabinets, a battery supervision cabinet, disturbance recorder, signals annunciator cabinet and a star coupler cabinet. Such requirements may not be exhaustive and shall be subject to review by ESB Networks.

Typical layout Control Rooms located in 110 kV and 38 kV buildings are outlined in standard drawings in associated Work Package. These drawings are included in the Functional Specification. Sufficient space shall be provided for future cabinets to cater for the full development of the station.

Control room cabinet layout drawings shall be submitted to ESB Networks for review.

Control Building layout designs for GIS and metal-clad equipment shall be subject to review by ESB Networks.

27.3 Control Room Flooring

For 110 kV stations, the control room floor shall be a heavy-duty type 'tiled' floor with suitable supports on which it shall be suspended. Uni-struts shall be laid on the floor, which shall be used to secure all cabinets in place.

For 38 kV substations, the control room floor shall be a solid floor designed to support all equipment. There shall be adequate means provided for securing this equipment. There shall be adequate means of routing cables to all equipment whether from above or below i.e. ducts/trenches etc.

The Control Room floor shall be subject for review by ESB Networks before being installed at site.

27.4 Equipment and Materials

All equipment and materials shall be new and of the highest quality and shall be capable of withstanding the stresses imposed on them under the most severe electrical, mechanical and atmospheric conditions which may occur in service. Repair of damaged equipment or materials shall not be allowed without the prior review by ESB Networks. All damage shall be notified to ESB Networks during construction.

27.5 Equipment to be supplied to Exact Requirements

Some items of equipment may be supplied by the Customer but shall be bought to ESB Networks exact order requirements for compatibility with ESB Networks systems.

Order details for protection relays are given in the relevant elementary diagram.

Order details of Telecoms equipment are given in Section 5 Telecoms Specification.

Order details of Revenue Metering equipment is given in Section 4 Revenue Metering Specification.

Order details of other such equipment are given in the Order Details for equipment to be supplied to exact requirements, Section 1 Functional Specification.

27.6 Labels, Plates and Signage

Each item of equipment shall be provided with a rating plate giving the type and serial number together with its ratings and service conditions and any other information required by IEC Recommendations and by other specifications.

Labels and nameplates shall be provided to clearly identify the function and circuit designation and phase of each item of HV and LV equipment.

Please refer to all labelling requirements set out in the specification pack. The Customer shall advise in advance where there may be ambiguity with regard to labelling. Prior to commissioning ESB Networks shall survey the installation to ensure labelling shall accurately allow for safe commencement of commissioning and energisation.

All switchgear bays and all cabinets shall be labelled front and back and at each operating position. All withdrawable equipment including detachable doors/panels shall be labelled both on the withdrawable item and on the fixed part with which it mates.

All rating plates, nameplates, labels and wiring plates shall be of non-corrosive material. Where etched labels may be proposed, clear Perspex covers shall be provided to prevent dust accumulation obscuring inscription text. Inscriptions shall be clearly legible from the operating distance and shall be in English throughout.

General requirements are given in the attached Work Package drawings;

In general, all labels shall be screw fixed. Labels shall not be fitted to removable items, e.g. trunking covers. When plant is fully erected, additional labelling shall be provided where in the opinion of ESB Networks the labelling already provided may be inadequate.

Bay names for tail-fed substations shall be agreed with ESB Networks prior to fitting of associated labels.

Full details and locations of all plates, labels and signage shall be clearly shown on the drawings and shall be subject to ESB Networks for review.

Full details and locations of all plates shall be clearly shown on the drawings and shall be submitted for ESB Networks review.

27.7 Surface Treatment of Metals

Specifications define what surface treatment of metals shall be provided on the particular item of the substation. If it shall be requested by the specification that the equipment requires hot dip galvanising it shall be treated as defined in the relevant ESB Networks specification in the Works Package.

27.8 Paints and Painting Procedures

27.8.1 General

All paints shall comply with the relevant ESB Networks specification in the Works Package.

Paints shall be delivered to the Customer in sealed containers and except where specified shall be applied without admixture of any kind. Paints in any system shall be obtained from one manufacturer, and priming coats, undercoats, and finishing coats shall comprise a system recommended by the manufacturer.

The systems shall be capable of performance to C5-M High Durability level of protection standard as per EN ISO 12944.

Where the specification refers to paints manufactured by a specific manufacturer, the Customer may propose an alternative equivalent paint which shall be subject to ESB Networks review. If an alternative paint may be proposed, the Customer shall provide complete details and specifications of the paint he proposes to use.

Paint shall be stored in a lock-up store where the temperature shall be between 5°C and 30°C. Any storage conditions specified by the manufacturer shall be observed and all materials shall be used as delivered and within 12 months from date of manufacture.

All paint shall be applied in accordance with the manufacturer's instructions. Paint may be applied by brush, roller, or airless spray equipment, provided the specified dry film thickness of the coating system shall be obtained and the manufacturer's instructions observed.

Spraying equipment shall be so designed and operated as to achieve a coat of specified minimum thickness and free from surface defects especially craters, pinholes, ravelling, sagging, dry patches, etc. and with an even and uniform appearance and complete adhesion. ESB Networks may require witnessing a demonstration of the proposed procedures before work commences.

Where practicable, tracer coats shall be used in priming coats and undercoats. The convention and specification for the various coats shall be agreed before painting commences and shall comply with the paint manufacturer's recommendation.

The build-up of paint in bolt holes shall be avoided by good painting practice.

If heating or ventilation may be employed by the Customer to secure suitable conditions to allow work to proceed, care shall be taken to ensure that treatment of a local surface area does not cause adverse conditions on other surfaces.

27.8.2 Painting of All Metalwork Other Than Cold Rolled Steel

Except for galvanised surfaces all steelwork shall be blast cleaned to BS 7079, second quality finish with an amplitude not exceeding 50 microns.

Before priming, surface defects such as cracks, surface laminations, deep pitting, fins at saw cuts, burrs, sharp edges etc. shall be removed. Where extensive grinding has been necessary the dressed areas shall be re-blasted to remove all rust and provide an adequate paint key.

Where the specification calls for the painting of galvanised surfaces they shall be thoroughly degreased and washed by high pressure hosing. Paint shall then be applied as for ungalvanized steelwork but excluding the intermediate coat.

The surfaces of non-ferrous metals and light alloys shall be thoroughly degreased and if necessary, all contamination removed by light abrasive sweeping. Paint shall then be applied as for ungalvanized steelwork.

The insides of all cabinets, control boxes, kiosks etc. shall be painted as above to a light or white finish and for cabinets etc. to be installed outdoors, this shall be followed by a coat of anti-condensation or thermal barrier type paint to a light or white finish.

27.9 Alternative Systems

Not Applicable.

27.10 Handling Works Coated Items

The precautions to be taken when handling, storing and transporting items having surfaces prepared and coated at works shall include the following:

- All wire ropes and chain slings used for hoisting and securing loads shall be covered to protect coatings and prevent scoring, chaffing and other damage.
- Softwood timber bearers with a sufficient contact area to prevent crushing shall be provided at all stages. Bearers shall be level and sufficient in number to prevent distortion of members. Beams used to support coated items stored externally shall be sufficiently high to ensure that the lowest parts of the stored members shall be clear of splashing from rainwater and from passing vehicles.
- Adequate softwood bearers shall so be used to support coated items during transport to site.
- Vertical timber packings shall be used to separate members to prevent chaffing of coatings. The methods used for securing loads to transport vehicles and wagons shall ensure that coatings shall not be damaged by the use of unprotected chains or other equipment used to secure loads in transit.
- Coated items shall preferably be stacked in single layers. Where conditions require stacks of more than one layer, softwood packing shall be used between layers.
- Items shall be stacked in such a manner as to permit free drainage of rainwater from the surfaces and to avoid ponding. If covers may be provided for coated items, timber bearers or other form of support to the approval of ESB Networks shall be used to ensure that covers shall not be in contact with coated surfaces. The arrangements for ventilation under the covers to minimise condensation shall be to the approval of ESB Networks.
- Precautions shall be taken at all stages to prevent coatings being contaminated by oil, cement, soil, chemicals or other deleterious agents. Should any contamination occur, the contaminating agent shall be removed immediately by swabbing or brushing, and the surfaces washed well with clean water.
- Coated items shall be loaded and unloaded by hoisting equipment. They shall not be moved by sliding or skidding, except with the prior approval of ESB Networks.
- Small components without packing shall be handled singly and with care. They shall be stored on pallets and precautions taken to prevent chaffing of coatings.

Note: All damage to protective coatings shall be repaired promptly by an approved method to an approved standard. Details of any proposed repair method shall be approved by ESB Networks.

27.11 Steelwork below Ground Level

Only steelwork below ground level which shall be solidly encased in dense concrete to give a minimum cover of 100 mm may be ungalvanized.

Galvanised steel under or at ground level and not encased in concrete shall have additional tar epoxy protection.

27.12 Welding

Welding of proprietary items, including switchgear enclosures, shall be carried out in accordance with an approved standard or code of practice. The welding plants and processes used shall be suited to the materials, configurations and purposes of the welded parts. Only qualified welders, certified for the type of welding required, shall be employed. The Customer shall exercise strict control over the welding conditions and parameters and shall continuously monitor the standard of welding achieved in accordance with the requirements of the Clause on Quality Assurance, to the satisfaction of ESB Networks.

All welds/cut parts shall be treated to retain required corrosion protection integrity.

27.13 Oil and SF6 Gas

Sufficient oil and gas necessary for testing, putting into service, and first filling of tanks for all oil or gas filled operated equipment, including adapters necessary to fill/top up equipment e.g. DIN connectors, shall be included in the scope of work.

Certificates of compliance for all oil and gas shall be provided to ESB Networks for review.

27.14 GIS Room Fire Sealing

All HV and LV cable penetrations or openings leading to the GIS room shall be suitably fire sealed. The fire seals shall provide a minimum of a 90-minute fire resistance rating.

All fire seals shall be designed to sustain any mechanical loading which may be reasonably foreseen during the lifetime of the fire seal. Where there may be a risk that someone may inadvertently step, stand or lean on a fire seal which may not be adequately mechanically rated the risk shall be suitably mitigated.

The mechanical load bearing capacity of the fire sealing shall be identified on the fire sealing in a suitably visible location.

Any support steelwork used in the design and installation of the fire seal shall not form a closed loop around a single phase of the HV cables as this may lead to circulating currents being induced in the support steelwork. Any support steelwork installed shall be hot dip galvanised to the required specification. Any support steelwork installed shall also be bonded to the earth grid as per the required specification.

The supplier's fire seal label shall be affixed adjacent to the fire seal in a suitably visible location and shall state, as a minimum, the supplier contact details, date of installation and the standards to which the fire seal complies.

27.15 GIS SF6 Extraction System

GIS cable basements/pits fully below ground level shall be fitted with an SF6 extraction system. The extraction fan shall be installed above ground level to facilitate ease of maintenance, thereby limiting any requirement to enter the basement or pit.

28.0 Pre-commissioning and Commissioning

Prior to handing over of the Works or any section of the Works, the Customer shall carry out pre-commissioning tests in accordance with the provisions of the specification. Such tests shall be carried out at the Customer's risk.

Pre-commissioning testing shall be carried out in accordance with the Pre-commissioning Requirements document **ESB Networks Pre-Commissioning Standards for HV Stations**.

Prerequisite (On site) to the commissioning phase:

- Single Line Diagram
- Signage and Labelling
- A2 Relay Elementaries
- Scada Database complete
- Live Comms
- RTU Wiring schedule
- Earthgrid Drawings/GPR Study and Results
- Control Room Earth Bonding details. (With Customer Control Room)
- Incoming HV Cable disconnected and insulated.
- Customer HV Cable disconnected and secure.
- Manual/Mechanical close removed from Customer incomer.
- 24/7 AC Supply available
- Permanent AC Supply neutralising point identified.
- Customer commissioner available for Interface Testing.
- Secure control room/heating, lighting, fire, small power complete.
- Control room fitout/ table, chair, filing cabinet, rubber mat etc.
- Welfare facilities.
- Safe Parking

28.1 Pre-commissioning

When all pre-commissioning works have been satisfactorily completed, the Customer shall provide certification from suitable Professionals that the works shall be ready for commissioning by ESB Networks. This certification shall include, inter alia, confirmation of compliance in the following areas:

- Environmental;
- Construction to Specification;
- Planning Permission;
- Fire Certification;
- Route consents;
- Property ownership;

Documents shall be handed over at this stage including the following:

- Material certificates and test result sheets;
- Pre-commissioning documents for review (as per DP011):
  - Completed Pre-Commissioning checklists contained in Section 9 of Works Package
  - A ‘red line’ copy of all pre-commissioning schematics and drawings;
  - A ‘CAD marked-up’ copy of all pre-commissioning schematics and drawings;
- Copy of Safety File (as per section 2.2);
- Independent cable test results;
- All labelling completed and satisfactory to ESB Networks requirements

The Commissioning Plan shall allow for a 10-day review period of pre-commissioning documentation prior to commencement of commissioning.

Documents to be made available on site prior to Commissioning stage include the following:

- Material certificates and test result sheets;
- Single Line Diagram (A2 format);
- Protection elementary drawings (A2 format);
- The 'red line' pre-commissioning schematics;
- Two 'CAD marked up' copies of the 'red line' pre-commissioning schematics;
- Earthing Installation Report (as per Section 21.5);
- Defects Log (and remedial action taken);
- Labelling of all plant and equipment shall be completed.
- All required tools for operating primary plant shall be available within the substation compound.
- An on-site meeting shall take place between the Pre-Commissioner, Design Project Manager (DPM) and the Commissioner, or their representative. The meeting shall be used to:
- Handover the pre-commissioning documentation.
- Confirm that pre-commissioning is complete and of good quality. It may not be feasible to confirm everything at this meeting, but spot checks shall be completed e.g. No earth faults present, visual inspection of the quality of work, labelling, operation of the CB and associated position indication.
- Pre-commissioning of some items may not be completed for acceptable reasons. This shall be detailed on the pre-commissioning handover certificate and agreed by all parties

28.2 Pre-commissioning Test Schedule and Inspection Plan

Before commencement of the tests the Customer shall submit for ESB Networks review a detailed schedule of all tests and inspections to be carried out together with complete sets of the proposed measurement, recording and reporting forms for each part of the Works. Following their review by ESB Networks these submissions shall become part of the Test and Inspection Plan (refer to section 9 of ESB Networks Pre-Commissioning Standards document).

The Customer shall be responsible for the measurement, recording and reporting of the Pre-commissioning tests. As each item is completed its completion shall be certified by the Customer.

The Customer shall provide and bear the cost of competent test personnel, instrumentation and test rigs together with all auxiliary personnel, electric power and other services necessary for the completion of the tests.

The Customer shall give ESB Networks written notice of 5 business days after which they shall be ready to carry out the Pre-commissioning tests.

Proximate notification of each particular test or inspection shall be given to ESB Networks no later than 24 hours prior to the scheduled commencement of the particular test.

28.3 Pre-commissioning Requirements

The Customer shall ensure all pre-commissioning schematics and drawings include mark-ups of all changes carried out during the design review process.

The Pre-commissioning tests shall verify the correct functioning of individual parts of the Works and of systems involving more than one item of equipment. The tests shall include tests, and other tests as may be directed by ESB Networks, for the following:

- Dielectric withstand insulation resistance and earth resistance;

- Correct wiring and connections as outlined in the cable schedule and wiring/ termination drawings;
- Correct functions and operating characteristics
- Station battery discharge test;
- Operational check (local and remote) of all motorised and manual switchgear, transformer tap change mechanisms control and position indication;
- Polarity of MCBs, including verification of voltage and current rating;
- Connection of AC and DC power supplies to all protection relays and integrated electronic devices, e.g. signal systems, battery chargers, battery supervisory equipment, etc;
- Current transformer burdens and polarities;
- Condition of SF6 gas and insulating oil;
- SF6 gas density/pressure monitoring devices;
- Calibration of temperature measuring and transformer supervisory devices;

All equipment shall be fully functional and operational before handover for commissioning (refer to Appendix G: Pre-commissioning Checklist).

28.4 Commissioning

28.4.1 Protection Settings

The Customer shall be required to submit a protection settings request for all primary protection relays at least 10 weeks prior to commencement of commissioning works. This request shall be submitted to ESB Networks.

28.4.2 Design Modifications and Snags

The Customer shall be fully responsible for the design of the assets until they shall be taken over by ESB Networks. The customers designers shall support the commissioner through the commissioning process, completing any design changes required, documenting any modifications and ensuring these shall be made available in the As-built file.

All changes to the design made on site during the pre-commissioning and commissioning phase shall be logged in the design review log and their associated drawings submitted for review. The Customers PSCS and PSDP shall adhere to their obligations until the final handover of the contested asset. All modifications to the design made on site shall be submitted as part of the review process.

All design and site snags shall be closed out prior to asset handover to ESB Networks. The customer shall be responsible for the project until hand over to ESB Networks.

The customer shall be required to submit a protection settings request for all primary protection relays at **least 10 weeks prior** to commencement of commissioning works. This request shall be submitted to ESB Networks.

28.4.3 Commissioning Testing

Final commissioning tests shall be carried out by ESB Networks.

The Customer shall provide suitably qualified assistance as required to the ESB Networks commissioner to facilitate the efficient commissioning of the station. Any construction work in the station required during the commissioning stage shall be carried out only under the control of the ESB Networks commissioner. The Customer shall continue to carry out the role of PSCS during the commissioning phase.

28.5 Operation of Assets to be Transferred

The contestably built plant shall not be energised until ESB Networks accept Operational Control of same. The Customer shall enter into a Handover Agreement in respect of the contestably built assets in the format set out in Appendix D: Handover Agreement.

Following successful completion of the Commissioning Tests and Handover to ESB Networks of Operational Control of the contestably built assets, the Operational control shall rest totally with ESB Networks. ESB Networks Safety Rules shall apply from the handover date set out in the Handover Certificate of the Handover Agreement.

29.0 Ratings

29.1 Normal Current Ratings

Every current-carrying part of the equipment shall be capable of carrying its rated current continuously under the specified conditions. Under no conditions shall the rated maximum temperature of the equipment be exceeded.

The current ratings specified shall be the continuous current ratings required under the specified maximum ambient temperature conditions.

29.2 Short-Circuit Current Ratings

Electrical equipment shall be adequately supported and braced to withstand the forces associated with the maximum short-circuit currents specified or pertaining, whichever shall be greater. The equipment shall be considered as being operated at the maximum permitted continuous temperature prior to inception of the short-circuit.

The final temperature attained as a result of the passage of short-circuit current shall not cause permanent damage, or deterioration sufficient to reduce the normal operating characteristics below the specified or most onerous operating requirements whichever shall be highest.

29.3 Nominal Voltage Ratings

Unless specifically stated otherwise, any reference to voltage rating shall be deemed to refer to the nominal rated voltage or voltages of electrical equipment. Standard voltage levels in accordance with IEC 62271-1 and IEC 60038 shall be adopted, unless otherwise specified or agreed with the ESB Networks.

The temperature rise of electrical equipment continuously operating at the specified minimum or maximum voltage shall not exceed the temperature rise when operating at nominal voltage by more than 5 °C.

Appendix A: Insulator Creepage Distance Schedule

This schedule shall be submitted with the Design Review

Description		**Offered**
Creepage distance to earth		
Heavy pollution		
Creepage factor (l/S) RUSCD (43.3 mm/kV)	mm	
Corrected USCD	mm	
Insulator profile factors		
Alternating sheds	Yes/No	
Spacing versus shed overhang (s/p)		
Minimum distance between sheds (c)	mm	
Creepage distance versus clearance (l/d)		
Shed angle (α)	degrees	
Creepage factor (l/S)		
Very heavy pollution		
RUSCD (53.7 mm/kV)	mm	
Corrected USCD	mm	
Insulator profile factors		
Alternating sheds	Yes/No	
Spacing versus shed overhang (s/p)		
Minimum distance between sheds (c)	mm	
Creepage distance versus clearance (l/d)		
Shed angle (α)	degrees	

Appendix B: Environmental Design and Hazardous Substances Declaration

Customer shall attach manufacturers declaration of materials used per IEC Guide 113.

Customer shall attach manufacturer's declaration of all substances in the equipment which shall be classified as hazardous.

Appendix C: Manufacturer's Declaration of Compliance to Disclosure of Defects found

Customer shall attach manufacturer's declaration of compliance with specification requirements for: Disclosure of defects found.

Appendix D: Handover Agreement

Form of Handover Agreement of the Scheduled Contestable Components

THIS HANDOVER AGREEMENT is made the [ ] day of [ ] 20[ ] and is effective from [ ] day of [ ] 20[ ]

BETWEEN:

(1) ESB Networks Ltd whose registered office is at Clanwilliam House, Clanwilliam Place, Dublin 2 (hereinafter called the "Company"); and

(2) [ ] (the "Customer"), whose registered address is [ ] and Company Registration Number is [ ] (hereinafter called the "**Customer**") (hereinafter collectively referred to as the "Parties")

WHEREAS:

A. This Handover Agreement is made to facilitate the Company's operational control of the Contestable Components that are more particularly shown on the single line diagram attached at Schedule 1 hereto (the "Scheduled Contestable Components") after the Commissioning phase and pending the formalisation of the property transfer from the Customer to ESB in accordance with the provisions of the Connection Agreement entered into on the [ ] day of [ ] 20 [ ] relating to [insert name of Windfarm] (hereinafter referred to as "the Agreement") and in accordance with the terms and conditions contained therein between the Company and the Customer and the terms and conditions of this Handover Agreement.

B. The references and definitions used in this Handover Agreement shall have the meaning assigned to them in the Agreement unless otherwise stated herein or where the context otherwise requires. THE PARTIES HEREBY AGREE in consideration of the Company and ESB paying the Customer the sum of €1 the Parties hereby agree that the following terms and conditions shall apply to this Handover Agreement:-

1. The Company confirms that the Scheduled Contestable Components are substantially complete following the conclusion of the Commissioning phase, in accordance with Appendix 3 of the Agreement with the exception of the Snag List attached at Schedule 2 hereto.

2. The Customer hereby certifies that he has taken-over the Scheduled Contestable Components from his contractor/supplier (which means in practical terms that risk and title in the Scheduled Contestable Components have passed to the Customer).

3. The Parties agree that the Company shall assume operational control of the Scheduled Contestable Components on the time and date recorded on the executed Handover Certificate subject to the principle that any faults arising from Commissioning, energisation and/or all defects covered by the warranties set out in the Agreement shall be rectified by the Customer in accordance with the provisions of the Agreement. It is agreed and accepted that it is intended that the target handover of the Scheduled Contestable Components shall occur on the [ ] day of [ ] 20[ ] and confirmation of the precise timing of actual handover shall be certified by the Parties in the same format as the Handover Certificate set out in Schedule 3 attached hereto.

4. Subject to the terms of Clause 1 above occurring, the Parties agree that access to the Scheduled Contestable Components for the Customer shall be subject to agreement from ESB. Further, at the request of the Company, the customer will complete outstanding items on the Snag List and will resolve all faults arising from Commissioning, energisation and/or all defects covered by the warranties set out in the Agreement. The access route to the Scheduled Contestable Components shall be maintained by the Customer until the formalisation of the property transfer from the Customer to ESB in accordance with the Agreement, as appropriate.

5. The Parties agree that ESB Safety Rules shall apply to the Scheduled Contestable Components.
6. This Handover Agreement shall be read as supplemental to the terms of the Agreement and in the event of any inconsistency between the terms of this Handover Agreement and the Agreement, insofar as any inconsistency exists, the Agreement shall prevail.
7. For the avoidance of doubt, this Handover Agreement shall terminate on the formalisation of the property transfer from the Customer to ESB in accordance with the Agreement.

Signed for and on behalf of [ ] (the "Customer")
In the presence of:-

Signed for and on behalf of
ESB Networks Ltd
In the presence of:-

Schedule 1

Single Line Diagram showing the Scheduled Contestable Components

Schedule 2

Snag List

Schedule 3

Form of Handover Certificate

To: [the Customer]
[Address]

It is hereby certified that the Handover of the Scheduled Contestable Components as defined in the Handover Agreement for [insert name of Windfarm] took place at am/pm on the [ ] day of 20 .

Signed for and on behalf of
ESB Networks Ltd
In the presence of:-

Appendix E: Customer Works Programme

Document Required	Submitted for review	As Builts
~ Works Programme	Initial Meeting; (20 Business Days before construction)	
~ Organisation Chart	Initial Meeting;	
~ Mobilisation Chart	Initial Meeting;	
~ National standards and codes proposed	Initial Meeting;	
Drawing/Document List	20 Business Days before project start up;	
Work package		
Design package		
~ DP001 Pre-Design Information	Flood Risk Assessment Report at least 40 Business Days prior to commencement on site;	
~ DP002 Project Schedule		
~ DP003 Single Line Diagram (SLD)		
~ DP004 IPP Scope of Works	Design Risk Assessment at least 15 Business Days prior to commencement of work on site;	
~ DP005 Civil Works	• Document entitled 'Design Criteria for Civil and Structural Works' summarising all design related parameters, at least 10 Business Days prior to commencement of detailed design; • Fire certificate submission at least 15 Business Days prior to submission; Prior to commencement on site the following: • Soils Investigation Report at least 40 Business Days; • Full planning submission documents at least 15 Business Days; • Structural calculations and drawings at least 40 Business Days. Note: drawings received without full calculations will be returned to the IPP; • Ground Risk Register at least 15 Business Days; • Construction drawings, steelwork fabrication drawings and cladding fabrication drawings at least 15 Business Days;	
~ DP006 Plan, Elevation and Section Physical Layouts		
~ DP007 Earthing and Lightning Protection Design		
~ DP008 ESB Control Building		
~ DP009 Primary Plant		
~ DP010 Secondary Electrical Systems		
~ DP011 Precommissioning		
~ DP012 AS BUILTS		
Ventilation design of the battery room	10 Business Days before works commence onsite	
Operation and Maintenance Instructions		
~ Draft copy, before erection of equipment	60 Business Days	
~ 3 Draft copy, before erection of equipment	20 Business Days	
~ 3 complete copies, before erection of equipment		
Training Plan		
~ Notification of the training course date	40 Business Days	
~ Notification before the commissioning of the plant	20 Business Days	
Testing		
~ Test and Inspection Plan	40 Business Days before testing commences	
~ Test Records	20 Business Days before testing commences	
~ Factory Acceptance Test	10 Business Days prior to FAT	
~ Earthing & Soil Resistivity Witnessing	20 Business Days before testing commences	
Handover Agreement	20 Business Days before energisation	
Safety File and As-Builts	At precommissioning stage	20 Business Days before energisation
A complete set of As-Built Drawings		
~ Two hard copies and one electronic copy Folders		20 Business Days before the works go into service
~ Two hard copies and one electronic copy	20 Business Days before the works go into service	
~ CAD version of all associated drawings		40 Business Days after energisation

Appendix F: Design Package

Design Package (DP) Information Requirements for Contestably built Stations;

Note: All Customer design submissions shall be submitted in the following format and sequence. Incomplete DP's shall not be accepted for review.

Pre-Design

DP001 Pre-Design Information

1.1 Planning Conditions;
1.2 NC5 Form;
1.3 Substation location map;
1.4 Flood Risk Assessment Report;
1.5 Buried Services Report;
1.6 Topographic Survey;
1.7 Appendix 1 requirement of Connection Agreement for sites;
1.8 Appendix 1 requirement of Connection Agreement for overhead line and underground cable routes;
1.9 List of Designers, Consultants & Contractors and PSDP;
1.10 Professional Designer Indemnity Insurance Details;
1.11 CT calculations;
1.12 Outline Programme;
1.13 All other additional information as outlined in Sections 11.6 and 21.20;

Project Construction

DP002 Project Schedule

2.1 List of all project milestones, activities and deliverables with intended start and finish dates;

DP003 Single Line Diagram (SLD)

3.1 Single Line Diagrams for both the ESB Networks and Customer compounds;
3.2 SLD requirements;

DP004 Customer Scope of Works

4.1 SoW requirements for ESB Networks Compound;
4.2 Connection details to the Distribution System;
4.3 DRA Electrical and Civils Requirements;

DP005 Civil Works

5.1 Planning Submission;
5.2 Disability access dispensation;
5.3 Fire certificate;
5.4 Soil investigation report & Ground risk register;
5.5 Basis of design document;
5.6 Civil/Structural design calculations;
5.7 Control building drawings and details
– foundations, floor slab, ducts, walls, doors, pit, sump, roof;
5.8 Compound drawings and details
– ducting, trenching, fence/gates;
5.9 Electrical bases and Transformer bund details;
5.10 Station and entrance roads;
5.11 Surface and foul water provisions;

DP006 Plan, Elevation and Section Physical Layouts

6.1 Standard Drawings;
6.2 Compound Layout – clearances, access, outdoor lighting, WC, lightning protection;
6.3 AIS Busbar and Bay/Cubicle Layouts – clearances, elevation, support steelwork, conductors, fittings;
6.4 Conductors and Connectors;
6.5 Loading calculations (static and dynamic);

DP007 Earthing and Lightning Protection Design

7.1 Earthing/GPR Study – design criteria, calculations, installation/civil works;
7.2 Soil resistivity report;
7.3 Lightning Protection Scheme (LPS) – design criteria/methodology;

DP008 ESB Networks Control Building

8.1 General Layout;
8.2 Civil Works;
8.3 Mechanical and Electrical services;

DP009 Primary Plant

9.1 Submission requirements – Technical schedules, drawings, test reports/certs;
9.2 Power Transformer;
9.3 House Transformer;
9.4 Switchgear;
9.5 FATs;
9.6 Spares;

DP010 Secondary Electrical Systems

10.1 Cabinet and Board Design;
10.2 Control and Protection Schemes;
10.3 220V DC & 24V DC Lead Acid Battery System;
10.4 24V DC Self-Contained System;
10.5 220V DC and 24V DC Distribution Boards;
10.6 LV Distribution Board;
10.7 Control & Protection Cabinet;
10.8 Signals Cabinet;
10.9 Mimic Cabinet;
10.10 Star Coupler;
10.11 110 kV Interface Cabinets and 38 kV Marshalling Box;
10.12 Control & Protection Schemes;
10.13 CT circuits;
10.14 VT circuits;
10.15 BSP and Revenue Metering requirements;
10.16 Protection;
10.17 EGIP, Busbar Protection, Check Synch Schemes;
10.18 Interlocking requirements;
10.19 Intertripping requirements;
10.20 Signals System;
10.21 SCADA (110 kV Stations);
10.22 SCADA (38 kV Substations);
10.23 DCC and NCC Requirements;
10.24 Fire and Intruder systems;

DP011 Pre-Commissioning

11.1 Checklists/Handover Certificates;
11.2 Red Line Site Folder;

DP012 Substation AS BUILTS

DP013 HV CABLES

13.1 Planning Submission
13.2 Route Selection Design Drawings with all crossing & Pinch Points
13.3 Duct Installation RAMS, duct proving RAMS
13.4 Cable & Termination Technical Schedules, Type Tests
13.5 Cable Rating Calculations for installation
13.6 Cable Pulling Calculations RAMS for cable pulling
13.7 Cable Testing
13.8 Cable As Builts

DP014 HV Overhead lines

14.1 Planning Submission
14.2 Route Selection & Design Sheet
14.3 Plan & Profile Drawings
14.4 Tower Drawings, Calculations & Type Tests
14.5 Foundation Drawings & Calculations
14.6 OHL Construction RAMS
14.7 OHL As Builts

Appendix G: Pre-commissioning Checklist

ESB International

Precommissioning Checklist Form

Enter Details			
Station Name:			
IPP Designer		**Contact Number**	
ESB Design Reviewer		**Contact Number**	
IPP Pre-Commissioner		**Contact Number**	
ESB COW		**Contact Number**	
Date of Handover			

Note: *All precommissioning documentation and checks below to be available and varified prior to handover to commissioners*

		Comments
1. Documentation		
1.1 2 x Clean copy of schematics and drawings include mark-ups of all changes	☐	
1.2 All test Certificates	☐	
1.3 All O & M manuals	☐	
1.4 Cable Schedule	☐	
1.5 Pre-commissioning Report Complete	☐	
1.6 Scope of commissioning document.	☐	
include bay, phase etc details		
2. Tests		
2.1 HVAC (heating, lighting and small power) - Certified	☐	
2.2 Battery Discharge Test	☐	
2.3 Include buildings services info reference.	☐	
3. Protection Relays and other integrated electronic devices		
3.1 All DC MCBs closed	☐	
3.2 All relevant electronic devices powered up and operational	☐	
4. Other		
4.1 All earthing checked	☐	
4.2 Battery system free from crossed supplies and earth faults	☐	
4.3 All electrical clearances checked	☐	
4.4 All Physical plant operational locally and remotely	☐	
4.5 Permanent AC Supply connected	☐	
5. Metering and Asset Management		
5.1 Commissioning of IPP Revenue Metering Installation.	☐	
6. Telecoms		
6.1 Telecoms signed off on DOPOR (Declaration of Proof of Readiness)	☐	

Appendix H: ATEX – Explosive Atmospheres Certification

COMPLETION CERTIFICATE NUMBER: _____

Client Details

Detailed inspection certificate for an electrical installation in a potentially explosive atmosphere (other than mines) issued in accordance with I.S. EN 60079 and ET105:2011.

1. **CLIENT DETAILS**
   Client: _____ **Address:** _____
   _____ _____

2. **INSTALLATION DETAILS** (if different from 1 above)
   Client: _____ **Address:** _____
   _____ _____

3. **INSTALLATION EXTENT COVERED BY THIS CERTIFICATE** (attach an additional sheet if required):
   _____
   _____
   _____

4. **CERTIFICATION PARTIES (attach an additional sheet if required)**
   Design & Selection (pg2) _____
   Installation (pg3) _____
   Inspection (pg4) _____

5. **ELECTRICAL EQUIPMENT INSTALLED:**
   Industry Sector (Tick all that apply):

Refinery ☐	**Pharmaceutical** ☐	**Manufacturing** ☐	**Processing** ☐
Storage ☐	**Distribution** ☐	**Power Generation** ☐	**Other** ☐

Comments:
_____

Nature of ignitable materials as per EPD: Gas/Vapour ☐ Mist ☐ Dust ☐

Zones (Gas):	**0**	☐		**1**	☐		**2**	☐
Gas Group:	**IIA**	☐		**IIB**	☐		**IIC**	☐
Zones (Dust):	**20**	☐		**21**	☐		**22**	☐
Dust Group:	**I**	☐		**II**	☐		**III**	☐

Temperature Class: **T1** ☐ **T2** ☐ **T3** ☐ **T4** ☐ **T5** ☐ **T6** ☐

Comments:
_____

6. **ATTACHED TO THIS CERTIFICATE:**

(i) Including Pages 2, 3 & 4 of this Certificate	☐	**Number of sheets attached:** Four
(ii) Index indicating design drawings and documentation	☐	**Number of sheets attached:** _____
(iii) Index indicating equipment selection and certification	☐	**Number of sheets attached:** _____
(iv) ETCI Test Record Sheets for Electrical installations	☐	**Number of sheets attached:** _____
(v) ETCI Test Record Sheets for non EEx 'i' installations	☐	**Number of sheets attached:** _____
(vi) ETCI Test Record Sheets for EEx 'i' installations	☐	**Number of sheets attached:** _____
(vii) Comment Sheets attached	☐	**Number of sheets attached:** _____
(viii) List of Test equipment used	☐	**Number of sheets attached:** _____
		Total Number of sheets attached: _____

COMPLETION CERTIFICATE NUMBER: _____

Design & Selection

1. DESIGN PARTICULARS (if more than one organisation, attach additional sheets as required)

Project Supervisor Design Process (PSDP): _____ Address: _____

Designer: _____ Address: _____

EPD referenced in the design of this installation: ☐

Design completed as indicated on drawings and documentation as per Index attachment(s) no: _____

We, being the persons responsible for the design of the electrical installation in a hazardous area (as indicated by our signatures below), particulars of which are described above, having exercised reasonable skill and care when carrying out the design, hereby certify that the design work for which we have been responsible is, to the best of our knowledge and belief in accordance with standard I.S. EN 60079-14, ET105:2011 National Rules for Electrical Installations in Potentially Explosive Atmospheres and current Irish Legislation, except for any departures, if any, detailed as follows (attach an additional sheet if required): _____

The extent of liability of the signatories is limited to the work described above as the subject of this certificate.

A. Signature: _____ Date: _____

Name in CAPITALS: _____ Affiliation (CEng / IEng / Other): _____
Design Engineer / Manager

B. Signature: _____ Date: _____

Name in CAPITALS: _____ Affiliation (CEng / IEng / Other): _____
Design Engineer / Manager

Company registration Number: _____

2. SELECTION PARTICULARS (if more than one organisation, attach additional sheets as required)

Company: Address:

Selection of equipment and components as per Registry / Index attachment no(s): _____

Equipment and component certificates of suitability as per Registry / Index no(s): _____

We, being the persons responsible for the design and/or selection of the electrical installation in a hazardous area (as indicated by our signatures below), particulars of which are described above, having exercised reasonable skill and care when carrying out the selection, hereby certify that the selection for which we have been responsible is, to the best of our knowledge and belief, in accordance with standard I.S. EN 60079-14, ET105:2011 National Rules for Electrical Installations in Potentially Explosive Atmospheres and current Irish Legislation, except for any departures, if any, detailed as follows (attach an additional sheet if required): _____

The extent of liability of the signatories is limited to the work described above as the subject of this certificate.

A. Name in CAPITALS: _____ Affiliation (CEng / IEng / Other): _____
Engineer / Manager / Senior Design Engineer

Signature: _____ Date: _____

B. Name in CAPITALS: _____ Affiliation (CEng / IEng / Other): _____
Engineer / Manager / Senior Design Engineer

Signature: _____ Date: _____

Company registration Number: _____

COMPLETION CERTIFICATE NUMBER: _____

Installation

1. **INSTALLATION PARTICULARS** (if more than one organisation, attach additional sheets as required)

Company: _____ **Address:** _____

_____ _____

Confirmation of general compliance to ET101:2008 ☐

_____

_____

We, being the persons responsible for the erection of the electrical installation in a hazardous area (as indicated by our signatures below), particulars of which are described above, having exercised reasonable skill and care when carrying out the installation, hereby certify that the installation for which we have been responsible is, to the best of our knowledge and belief, in accordance with standard I.S. EN 60079-14, ET105:2011 National Rules for Electrical Installations in Potentially Explosive Atmospheres and current Irish Legislation, except for any departures, if any, detailed as follows (attach an additional sheet if required):

_____

_____

The extent of liability of the signatories is limited to the work described above as the subject of this certificate.

A. Name in CAPITALS: _____ Affiliation (CEng / IEng / Other): _____
Site Engineer / Construction Manager / Electrical Supervisor

Signature: _____ Date: _____

B. Name in CAPITALS: _____ Affiliation (CEng / IEng / Other): _____
Site Engineer / Construction Manager / Electrical Supervisor

Signature: _____ Date: _____

Company registration Number: _____

2. **Drawings & Test Record Sheets**

Electrical Drawings (As built) completed as per Index no: _____

_____

Electrical Test Record sheets completed as per Index no: _____

_____

Descriptive System Documents (As built) completed as per Index no: _____

_____

EEx 'i' Test Record sheets completed as per Index no: _____

_____

COMPLETION CERTIFICATE NUMBER: _____

Inspection of completed installation for compliance

1. INSPECTION PARTICULARS (if more than one INSPECTOR, attach additional sheets as required)
Company: _____ Address: _____
_____ _____

We, being the persons responsible for the INSPECTION of the electrical installation in a hazardous area (as indicated by our signatures below), particulars of which are described above, having exercised reasonable skill and care when carrying out the INSPECTION, hereby certify that the referenced work in this report for which we have been responsible is, to the best of our knowledge and belief, in accordance with standard I.S. EN 60079-17, ET105:2011 National Rules for Electrical Installations in Potentially Explosive Atmospheres for Electrical Installations in Potentially Explosive Atmospheres and current Irish Legislation, except for any departures, if any, detailed as follows (attach an additional sheet if required):_____
_____
The extent of liability of the signatories is limited to the work described above as the subject of this certificate.

A. Signature: _____ Date: _____

Name in CAPITALS:_____INSPECTOR / REVIEWER Affiliation (CEng / IEng / Other): _____

B. Signature: _____ Date: _____

Name in CAPITALS: _____INSPECTOR / REVIEWER Affiliation (CEng / IEng / Other): _____

C. Signature: _____ Date: _____

Name in CAPITALS: _____ Optional if a Notified Body is engaged in the inspection: _____

2. VISUAL CONFIRMATION
Detailed inspection schedules in accordance with standard I.S. EN 60079-17, ET105:2011 National Rules for Electrical Installations in Potentially Explosive Atmospheres and current Irish Legislation for each system compiled and reviewed for completeness. If not list all deviations here (attach additional sheets as required): _____
_____

Visual confirmation ONLY of general compliance to ET101:2008	☐	Diagrams, warning notices and signage in place	☐
Single phase circuits (& RCD's) double pole	☐	Identification of isolating switches	☐
Identification of protective devices	☐	Test Equipment Calibration Certificates confirmed	☐
Test Record Sheets complete	☐		

Comments: _____

3. DOCUMENTATION/PROCEDURES
The inspector is required to confirm that all applicable and related referenced documents / drawings have been recorded and confirmed to be true copies of the final as installed installation prior to conducting any detailed inspection of the referenced works.

ET101:2008 Installation Certificate (reference ET101:2008 Part 6)	☐	Classification of hazardous areas	☐
Apparatus Group	☐	Temperature Class	☐
Records sufficient for maintenance purposes	☐	Equipment isolated prior to inspection	☐
(ATEX) CE mark and Declarations of Conformity	☐	Plant Modification procedure in place	☐
Personnel Assessed for Competency	☐	Plant Engineer Consulted	☐
Documentation available for EEx 'i' systems	☐	Permit To Work system in place	☐

Comments: _____

4. NEXT INSPECTION
The interval between periodic inspections shall be in line with the requirements of current Irish statutory legislation;

Next inspection shall be recorded and documented in an appropriate manner in the Clients engineering and Maintenance Program.

Appendix I: List of revisions from comprehensive review of document by ESB Networks and EMP January 2021

I. Sections Added

Layout updated to reflect new ESBI Template

Section 1 Terms and Acronyms Added (Every subsequent section pushed 1 number)

Section 6.6 Added Design proposed, Plants and materials"

Section 7.8 Added "Environmental Design and Hazardous Substances" – "Excavated Material"

References to "IPP" have been updated to "Customer"

Section 18.2 Updated to "Passageways and Platforms" from "Passageways"

Sections added as follows:

18.13 Fire separation clearances

18.14 110 kV Surge Arresters

18.15 Gas in Oil Monitors

18.16 HV Connectors

18.17 Noise

Sections added as follows:

19.10 Electricity Supplies for Auxiliary Plant

19.11 Drainage

19.12 Hazardous Areas

Section 21.5 Updated to "Electrolytic Corrosion" from "Corrosion Action"

In "Control and Protection Section 24" Sections added as follows:

25.21 General Electrical Requirements

25.22 Electrical Equipment enclosures

25.23 Anti-Condensation Heaters

25.24 Electromagnetic Compatibility

25.25 Control and Protection Cabinets

25.26 Remote Diagnostic Access

Section 27 "Equipment and Physical Layout", Sections added as follows:

27.14 GIS Room Fire Sealing

27.15 GIS SF6 Extraction system

Section 29 "Ratings" Added as follows:

29.1 Normal Current Ratings

29.2 Short Circuit Current Ratings

29.3 Nominal Voltage Ratings

II. Changes to Pre-existing Sections

Section 2. Scope

Reference to (i) Connection Agreement and (ii) Grid Code included.

Section 3.2 Safety File

Addition of:

"The file shall be live and shall be updated regularly and made available on site for inspection during the construction and design review." & "The risk assessment should cover design, construction and operation and maintenance stages."

Breakdown of sections required in the safety file included.

Section 4.2 Directives

93/465/EEC updated to 768/2008/EC

Section 6.1 Design Requirements

Addition of:

"Site design consideration for access and egress of emergency services

Updates to ESB Networks safety rules which may impact design"

Section 6.2 Confirmation of construction compliance with Design

Addition of:

"Due to the phasing of design and variety of engineering disciplines the customer shall provide evidence of ongoing design coordination between these disciplines, e.g. electrical designers verification of civil designs, with clear revision history details identifying modifications made to all designs."

Section 6.4 Design Review

"Data Sheets and manufacturers details for materials used in the construction where not identified in the design drawings submitted shall be provided in advance for approval by ESB Networks. This includes but not limited to primary plant connector details proving suitability to bus bar force calculations and earthing system materials and installation methods employed."

"Care shall be taken to identify where any changes have been made to a design shall be clearly recorded in the design revision history."

Section 6.5 Design Review Log

Addition of:

"Issues identified by ESB Networks during the Design Review Stage shall be logged as an Open item in the Design Review Log. All such issues shall be addressed by the Customer and re-submitted for review. All Open items shall be Closed prior to Pre-Commissioning stage. In any event all issues shall be closed before handover of the contestable assets. Open items critical to a particular phase in the design shall be closed before advancing to the next phase. Advancing the works where open items remain may be done so at the customers own risk and may delay the commissioning and handover phase of the project. Early communication shall be necessary to avoid such delays. Communication channels shall be advised at the project kick off meeting with ESB Networks."

Section 7.2 Planning Permission

Addition of:

"All documentation shall be submitted to ESB Networks prior to submission of the planning application."

Section 7.7 Disposal of Material Found to be Hazardous

"The Customer shall dispose all materials arising from excavations in compliance with current environmental legislation. Material, which may be agreed to be disposed as spoil, shall be removed to approved spoil dumps and copies of waste transfer documentation shall be provided to ESB Networks."

Section 8 Quality Assurance

Addition of the following in Quality Assurance list:

- Quality Inspections and Progress Reports.
- Project Programme.

Section 8.1 Audits

Addition of:

"Advanced notice shall be given to ESB Networks specifically where works shall be enclosed or buried, thus removing the ability to visually verify compliance with the specification and standards. The customer shall record and document using photographic evidence. Such works shall include a weekly quality report and shall be submitted to ESB Networks. ESB Networks may provide samples of such reports at request.

In the event of non-compliance, the Customer shall take the appropriate remedial action.

Requirement for Construction Monitoring is also outlined in Section 12.3."

Section 8.3 Disclosure of Defects found

Addition of:

"In the event of internal or external damage to any equipment, including support structures, during transit to site, the Customer shall inform ESB Networks immediately."

Section 9.2 Handover Certificate

Addition of:

"– Receipt by ESB Networks of Customer Operators details and contact information

– Receipt by ESB Networks acceptance of telecommunications method and provider"

Section 9.3 Energisation

Addition of:

"All outstanding review logs shall be closed prior to energisation.

The Contested assets shall fully comply with duties and programmes set out in the respective Grid Code"

Section 10.1 Operation of Assets to be Transferred

"According to the Electrical Safety Rules, apparatus shall be treated as if it were part of the system when it has reached a stage where the apparatus, or part of it, shall be capable of being connected to the system in an approved manner. Treating apparatus as part of the system requires full application of the electrical safety rules for further work to proceed which requires operation of the new equipment."

Section 10.3 Operation

Changed from:

Item	Requirements
Operations Procedure	Operations Procedure as per ESB Networks operating Policy.

To

Item	Requirements
Station Equipment when part of the system	ESB Networks Safety Rules, Operations and Work Procedures. New Equipment to the Electricity System and Training.

Addition of:

"ESB Networks require 24/7 access for the purpose of metering where meters shall be installed on customer side of compound. Access to be agreed and incorporated into deign where required using standard ESB Networks access facilities to ensure safety, security and access shall be delivered for both Customer and ESB Networks.

ESB Networks shall be notified in advance of any change to customer's Operator details and if ownership changes shall be due to occur to ensure continuity of service"

Section 10.4 Operation and Maintenance – Equipment and Tools

"Operational equipment such as Switching Rods and Voltage Detectors shall be subject to approval from ESB Networks.

All switching and safety equipment like earth leads and clamp shall be consistent with those utilised by ESB Networks operator staff, these shall be presented and approved in advance.

Digital clocks in the control room form part of the essential operating procedures and shall be supplied."

Section 10.6 ESB Networks Padlocks

Addition of:

"Multilock systems to be agreed with ESB Networks, please also refer to clause 16.5"

Section 10.7 Storage

Addition of:

"Building layout and M&E services design shall provide for safe access and operation off all systems within the control room to ensure all future personal may carry out their duties effectively.

Control cabinet room layouts shall be reviewed by ESB Network and agreed prior to completion of the civil control room design, this shall be essential where additional cabinets may be required for larger switch yards like looped substations."

Section 12.1.1.1 General

Addition of:

"Any modification shall follow PSDP procedures and be clearly documented in the design revision history"

"The Customers programme shall be submitted identifying expected design completion dates. Each submission shall include a documents transmittal register. This register shall serve as a record of submissions, revisions made and identify documents yet to be submitted. A master transmittal register

of all designs expected to be submitted shall be included in the initial submission along with the project programme. The master register shall then be updated per submission by the customer.

The functional specifications provided by ESB Networks shall be broken into design packs. DP001 etc. The submissions shall be broken into these packs. The design review logs shall reference the Design pack number and the associated customers documents/drawings number under review for clarity.

All submissions shall be presented to ESB Networks electronically and agreed at project Kick off Meeting."

"These submission dates shall be also identified in the Customers Project Programme."

Section 12.1.2 Drawings

Removal of:

"Each design submission to ESB Networks shall be serially numbered and dated and shall refer to one subject matter only. Each submission shall be accompanied by a summary sheet which lists the documents comprising the submission. Where a submission includes revisions of documents previously submitted the summary sheet shall include a reference to the original submission number."

Addition of:

"All drawings shall be dimensioned and where appropriate scaled to standard scales.

All drawings shall demonstrate alignment with quality management systems employed for verification and approval. Unapproved drawings shall be rejected.

Submitted initial in printed electronic format e.g. PDF and later in electronic working copy format as the deigns shall be handed over to the system operator for future modification to the design where required post energisation and handover.

Some designs may only be reviewed using working electronic formats and shall be provided when requested. This may be especially pertaining to the design of network system routes via overhead line and cable networks.

Evidence in drawings of design coordination between engineering disciplines shall be critical to satisfying the duties of the PSDP.

The Single Line Diagram and Electrical Substation layout review shall be critical and shall be reviewed in advance of the review of any further designs.

Once reviewed the electrical substation layout shall be the master substation layout for the project. All other designs shall be georeferenced and layered upon this layout.

Earthing, Ducting, Drainage, Foundation and all civil and electrical service layout drawings shall be referenced via a geolocated Xref onto this master substation layout. For clarity the individual layouts shall be submitted with the master layout. Layout designs cannot be reviewed in isolation. This ensures coordination between the design disciples and reduces the risk of conflict between the designs during construction."

"All drawings shall indicate the status and following QMS system employed."

"Eplan P8 & PLS CAD.bak files" added to list of drawings required.

Section 12.3 Design Package

Addition of:

"as part of the PSDP duties, this document shall be updated and submitted where changes to design have occurred. Evidence of coordination between designers shall be presented and a final residual risk register for all contested assets be made available prior to energisation."

Section 12.4 Site Document file

Addition of:

"The latest design revisions reviewed by ESB Networks shall match that of which shall be at the construction site and made available to ESB Networks for review at the construction site itself."

Section 12.6 Drawings and Information to be included with the Initial Submission

Addition of:

"i. Preliminary Safety & Health Plan;
j. Residual Risk Register;"

Section 12.7 Drawings and information to be Submitted at Initial Meeting

Addition of:

a. Preliminary Works Programme
d. Status of Design Documents outlined in Section 5,6,7 and 11 of this specification.
e. Coordinate map identifying Construction Site Office Entrance.

Section 12.8 Drawings and information to be submitted According to the Agreed Programme

Addition of:

d. GAR sheets completed and returned to ESB Networks (ARA).

Section 12.9 Drawings information to be submitted before Handover to ESB Networks

Addition of:

"All documentation outlined in the Safety file in accordance with the current Construction Regulations.

The contents of the Safety File are outlined in Section 2.2.

GAR sheets completed and returned to ESB Networks (ARA).

Full suite of Pre-commissioning mark ups, test results and issues encountered."

Section 12.10 Drawings and information to be submitted on Completion of Station Works

"e. Test Certificates general test results were carried out on Electrical and Civil and M&E design and equipment.
f. Summary of routine tests and special tests, with copies of the test reports for all plant.
g. General Asset Registration (GAR) Sheets in typed format for both installation phase and commissioning phase return to ESB Networks (ARA). Customer to confirm with ESB Networks on completion.

All test results shall be typed, signed and dated."

Section 12.11 Technical Records

Addition of:

"All test results shall be typed, signed and dated."

Section 15 Packing

Addition of:

"Plant sensitive to shipping and transport vibrations shall contain shock monitors for review by ESB Networks."

Section 16 Training

Addition of:

"Before any new HV station has reached a stage where the apparatus, or part of it, shall be capable of being connected to the system in an approved manner where some or all of the station equipment shall be introduced to that location for the first time, any staff who shall be engaged in the operation of the station, shall be provided with training in operation of the station equipment.

For contestable builds, ESB Networks project management shall involve the NTC (training), Operations Policy and Safety unit (switchgear) and Protection Section (relays) at an early stage to take delivery of the requirements set out for customers from an operations perspective. Enforcement of the provision of these requirements shall be completed by ESB Networks project management as part of the project delivery plan.

The Customer shall submit a Training Plan to ESB Networks and approved by ESB Networks Training Centre (NTC), which shall describe in detail how the Customer proposes to train ESB Networks staff. This plan shall be provided at least 4 months before the training course and at least 4 weeks before plant shall be made part of the system. The plan shall include requirements and responsibilities for:

a. Organise training of NTC staff or direct training from supplier.
b. Communicating with ESB Networks local management.
c. Identifying ESB Networks staff for training.
d. Requesting Training from NTC.
e. Delivery Methods."

"The courses shall cover operations training, practical operation of switchgear and systems, plant familiarisation, fault diagnosis and testing and all aspects of plant maintenance. Training instructors shall be knowledgeable and experienced in the manufacture, erection, testing and maintenance of the equipment and shall have good communications skills in the English language. The training shall be provided on site during the construction period.

Where new switchgear, control or protection systems are being introduced to the ESB Networks System then a minimum of nine months notification to ESB Networks shall be required to address aspects such as Risk Assessment, Documentation production, Training material production and Training delivery. This needs to be project managed by the delivery organisation responsible for the project.

As part of the hand-over process, the Commissioning Manager, shall be satisfied that training has been provided to all relevant parties, before any new station shall be allowed to connect to the system. To meet this requirement:

a. The CSS shall confirm in writing to the commissioning manager that all on-call operators have been trained.
b. The Stations Supervisor shall confirm in writing to the commissioning manager that a satisfactory number of operators have been trained to enable the business needs to deliver for that station into the future.

Operations Policy and Safety Unit shall be responsible for ensuring through certification and/or approval, that those engaged to deliver the training shall be competent to do so."

Section 17.8 Responsibility for Facilities and Sufficiency of Means Employed

"Any adjacent customer sites impacted by the provision for services above shall be managed by the customer and agreed directly with the customer."

"In particular the provision of a continuous 24/7 three phase AC electricity supply (minimum of 50kVA) from construction to energisation stage."

Section 18.1 Access Requirements

Addition of:

"The Customer shall install a compound fence at a minimum height of 2.6 metres and ensure that the entrance gates shall be operating correctly throughout the lifetime of the project. The Customer shall not compromise the integrity of the compound fence by placing any climbing aids against it."

Section 18.2 Passageways and Platforms

Addition of:

"Passageways required for operation including those in the control room shall have a minimum width of 1.2mor where otherwise specified in the Designated Work Area (DWA) requirements. Other passageways shall have a minimum width of 1 m.2 m.

The Customer shall supply and erect all access platforms, catwalks, stairways and ladders necessary for providing safe and easy access to plant items for operation and maintenance. The Customer shall ensure that the whole of the access system shall be of uniform design and pattern through-out the Works. The design of all access platforms, stairways etc. shall conform to requirements given in the individual product specifications."

Section 18.6 Phasing Arrangements

Addition of:

"Phasing shall use R, S, T designations.

This section shall be read in conjunction with the associated HV Substations – Labelling and Signage documentation provided in the functional package provided by ESB Networks."

Section 18.7 Bay coding

Addition of:

"This section shall be read in conjunction with the associated HV Substations – Labelling and Signage documentation provided in the functional package provided by ESB Networks."

Section 18.8 HV Layout

Addition of:

"This section shall be read in conjunction with the associated HV Substations – Labelling and Signage documentation provided in the functional package provided by ESB Networks."

Section 18.9 Clearance Requirements

"Nominal Voltage" changed to "Rated System"

Section 18.9.1.3 Vicinity Zone

Addition of:

"Busbar force calculations shall be provided to ensure clearances shall be maintained between primary plant during normal and fault operation."

Section 19.1.1.2 38 kV Substations

Option 1 split into Single connection, Multiple connections and Connections with MV Busbar.

Addition of:

"The primary LV supply shall be from a busbar. A backup supply with ACO located on the ESB Networks side shall be provided by the Customer."

Section 19.2.1.1 DSO Controlled 110 kV Stations

Addition of:

"Each battery shall be monitored by a Battery Supervision Unit."

Section 19.4.1.2 Indoor Lighting

Addition of:

"A lighting calculation shall be provided for both indoor and outdoor areas for ESB Networks review. The calculated results shall meet the requirements set out below."

"Battery room = 250 lux."

All battery room lighting systems shall be ATEX rated, suitable for use in an explosive environment."

Section 19.4.1.3 Outdoor Lighting

Addition of:

"Degree of protection for outdoor lighting shall be IP64.

The proposed outdoor fittings shall meet the requirements set out in 18080 and the warranties in the connection agreement. All Outdoor lighting columns shall be ground mounted and retractable to facilitate maintenance at ground level.

All external lighting systems shall be installed at least 2 meters from the electrical compound boundary."

Section 19.5 Power Facilities

Addition of:

"Power facility requirements for ESB Networks 38 kV single room substations are outlined in drawing PG406-D009-109. A three-phase socket outlet shall also be installed in this room.

Power facilities shall be in accordance to the National Rules for Electrical Installations, Fourth Edition ET101:2008 or with the I.S. 10101 when it becomes valid, with the exception that ring circuits shall not be permitted."

Section 19.6 Ventilation

Removal of:

4 Natural Air changes per hour.

Addition of:

"All areas in the buildings including the HV cable room shall be suitably ventilated to ensure that no area becomes a confined space (per HSA Code of Practice for Working in Confined Spaces) due to the presence or reasonably foreseeable presence of hazards or lack of oxygen."

17.6.1.1. Battery Room Ventilation

"Natural Air ventilation shall be in accordance with I.S. EN 62485-2:2018 section 7.3. A battery room ventilation calculation shall be submitted for review."

Section 19.8 Heating

"The heating system shall be deigned to maintain a room temperature inabove 15°C. Where sealed batteries are contained within the control room the room temperature shall be maintained to a minimum of 18°C.

The battery room shall be heated by heaters which shall be suitable for use in a possibly explosive atmosphere. They shall be controlled by a capillary mounted in the battery room and a thermostat mounted on door outside the battery room or a suitable ATEX rated system."

Section 19.9 Bunds and Bund Water Management Systems

Addition of:

"All bunds shall be designed to extinguish flammable liquids from their associated plant.

All primary plant bunds (Transformer, ASC etc) shall be designed to remove falls risks/requirement of fall arrests for future operators while also ensuring adequate freeboard and vehicular protection around the bund and associated primary plant plinth."

Section 20 Miscellaneous

Addition of:

"The clock shall be synchronised with Co-ordinated Universal Time (UTC). This synchronisation shall be based on a radio time code which shall be obtained from the GPS satellite system. An automatic daylight-saving time change facility shall be included.

The Customer shall install the clocks as per manufacturer's instructions.

The details of the clock proposed shall be submitted to the ESB Networks for review."

Section 20.1.1.1 General

Addition of:

"The Fire Detection System used in the substation shall be manufactured, designed and installed in accordance with ESB Networks Specification 16701.

The control room cabinet layout shall be designed to allow for free movement of an operator while cabinet doors shall be opened in the event of an emergency. Cabinet doors shall not inhibit exit from many areas within the control room."

"Where the Fire Detection System may be shared between the Customer and ESB Networks Rooms, the Customer shall maintain the system and associated records on a regular basis."

Section 20.1.1.2 Portable Fire Extinguishers

Addition of:

"Portable fire extinguishers shall also be mounted outdoors on the Control Building wall in a suitable, visible cabinet

The number and location of fire extinguishers shall form part of the overall design of the Fire Detection system."

Section 20.2 Intruder Detection

Addition of:

"The Customer shall supply the keypad engineering code for the Intruder Detection System with the Safety File.

A Certificate of Completion for the Intruder Detection System shall be provided in the Safety File."

Section 21.2 Application

Addition of:

"The screens of all SCADA cables shall be earthed only at the RTU."

"Spare glands shall be 'blanked off' as required to retain IP rating."

"The fabrication detail shall be in accordance with drawing ESB Networks drawing PG406-D010-097-001."

Section 21.3 Routing Arrangement

Addition of:

"Provision of cable ducts for future development works shall be installed at the initial development stage."

Section 21.4 Laying of Cables

Addition of:

The Earth Grid conductor shall not be run within the concrete trough.

Cable Tray shall be in accordance with IEC61084 BS 61537:2007. Cable Tray shall be heavy duty, hot-dipped, galvanized steel with perforated tray base suitable for fixing cables. Heavy duty gauge with returned flanges to BS 61537:2007 shall be utilised. Constructed from mild steel and hot dipped galvanised to BS EN 10346:2009.

Glass Reinforced Plastic (GRP) removable covers shall be considered for 38kV and MV single room substations.

21.6 Supports

Addition of:

"All accessories shall comply with ESB Networks Hot Dip Galvanising Specification 05030, including treatment of cut parts. Plastic Cable ties shall not to be used for support, and all plastic accessories shall be UV rated."

Section 22.5 Earth Grid Installation

Addition of:

"The earth grid installer shall consult the overall earth grid layout and earthing practice drawings to ensure that tails from the earth grid shall be directly connected to the final installed plant location avoiding earth tails running across the compound. The fault current path shall be as short and direct as possible from the plant down to the main earth electrode. The Customer shall ensure that connection surfaces shall be clean and free from contamination.

Any earth conductor exiting the ESB Networks compound shall have the capability of being broken by means of a removal 'link'. This 'link' shall be located in a chamber outside the ESB Networks outer fence and its GPS co-ordinates marked on the As-Built drawings. This shall also apply to any earth brought out from the ESB Networks Compound by the customer in order to reduce the fault current.

During the installation of the main earth grid the Customer shall produce high quality photographs of each individual joint and earth grid installation along with corresponding GPS co-ordinates including any earth rod installations prior to excavations being backfilled. A ductor test shall be carried out and results presented to prove continuity in circuits. Such works shall include a weekly quality report and shall be submitted to ESB Networks. ESB Networks may provide samples of such reports at request."

Section 22.6 General Earth Grid Requirements

Addition of:

"Customer substation may be directly adjacent to the ESB Networks substation, the two earthing schemes shall be directly connected by a number of accessible interconnection points with a suitable chamber to remove link."

"Earthing conductors in proximity to control cables, cable sheaths, compressed air pipes and other services, which may become conductive during earth faults, shall have adequate separation (at least 300 mm below) from these services and shall be run in PVC pipes."

Section 22.8.1.2 Connections and Joints

Addition of:

"The Customer shall ensure that all bonding connections shall be accessible and maintainable Adequate clearance shall be provided between earthing fitting and finished concrete capping level. Please refer to earthing practice drawings and palisade fence drawings provided in the specification."

"There shall be consistency between the two conductors where the two conductors shall be crimped together. This shall be to ensure a uniform adequate pressure shall be applied to both conductors during crimping. Bird caging of earth grid due to sharp bends in the copper conductor shall be unacceptable.

In order to provide mechanical protection and also allow visual inspection of the condition of the conductor, flexible connections shall have clear PVC insulation."

Section 22.8.1.3 Temporary Earthing facilities

Addition of:

"Fixed earthing points shall be installed on the same side of the associated plant as the overhead earthing stirrup. This shall be to ensure an operator may safely apply and remove portable earthing leads using an earthing rod."

Section 22.9 Earthing of High Voltage Equipment Structures

Addition of:

"Ducting to carry earth conductors shall be cast into the concrete plinths, existing the plinth only at the location required to avoid potential trip hazards and tampering with conductor. Final location of plant shall be closely coordinated between the civil and electrical designs."

Section 22.9.1.6 Surge Arresters

Addition of:

"Each sperate surge arrester earth conductor to have a double H-crimp connection onto the earth grid and have separation between each H-crimp."

"7. Each separate surge arrestor earth conductor to have a double H-crimp onto the earth grid and have separation between each H-crimp

Earthing ducts shall be designed and installed in all concrete plinths to allow the earthing conductor pass from equipment to earth grid without being exposed to alleviate security issues and trip hazards."

Section 22.9.1.7 Control/Marshalling Kiosks and Relay Panels

Addition of:

"All moveable parts (i.e. doors/lids) shall be earthed by a flexible earth."

"Doors shall also use flexible earths."

Section 22.10 Fences

Addition of:

"All earthing connections from main electrode to palisade fence require PVC conduit ducts where they transition through concrete capping. The earth connection shall be located on that side of the post facing the compound (protects against access to connection from outside the compound)."

"Third party properties to be highlighted and discussed with ESB Networks."

Section 22.17 Control Cable Sheath and Screens

Addition of:

"Please refer to associated cable and control wiring within ESB Networks Specification 16118.

SCADA cable screens are to be earthed on at the RTU cabinet in the control room."

Section 22.20.1.1 Before Installation of the Earth Grid

Addition of:

- "• Tool crimp certification/calibration pull & ductor test results for sample copper and accessories to be used;
- Installation program and installation methodology
- Proposed earth electrode conductor and bonding conductors"

Section 22.20.1.2 Before Handover and After Installation

Addition of:

- "• High quality photographs of each individual joint and earth grid installation along with corresponding GPS co-ordinates including any earth rod installations."

Section 24.2 Design Loads

Addition of:

"All pull tests on anchor bolts shall be carried out and certified by an independent Contractor."

Section 25.3 Circuit Breaker Close Circuit

Addition of:

"Text labels shall be fitted to the electrical Open/Close pushbuttons and shall be designated 'OPEN' or 'CLOSE'. The text shall be black lettering on a white background. The colour of the pushbuttons for 'Close' and 'Open' shall be black and white respectively."

Section 25.6 CT and VT Secondary Circuits

Addition of:

"To allow commissioning and future testing and maintenance, there shall be facilities at a sufficient number of locations for secondary injection of current/voltage along the CT and VT secondary circuits.

The design shall be so that future commissioning, maintenance and testing of CT and VT circuits shall be possible without the disconnection of any wiring. This shall be achieved through the use of terminals with test facilities."

Section 25.7 Protection

Addition of:

"Housings shall conform with ESB Networks specified IP rating."

Section 25.13 Alarms

Removal of:

"For 38 kV substations, alarms for NCC shall be provided for SCADA by means of a parallel connection. This requires each signal input to be routed via a diode terminal (Phoenix type UK 4-TG) to the DATAC 98-way alarm units. A parallel connection is then routed through the diode terminal to NCC."

Addition of:

"A serial cable shall be directly connected between the AAP Unit and the DCC RTU. Any signals between the AAP Unit and the NCC RTU shall be hardwired via the diode terminals."

Section 25.15 Star Couplers

Addition of:

"This design shall be in accordance with the relevant ESB Networks Drawing in the Works Package."

Section 25.16 ESB Networks Customer Interface Kiosk

Addition of:

"This kiosk shall be located on the dividing fence between the adjoining compounds. The kiosk shall be accessible from both compounds."

"The Kiosk design shall consider proximity of thermostat to the heating element i.e. not directly above.

A single-phase AC outlet with a suitable IP rating, shall be provided externally on the side of the kiosk for commissioning purposes."

Section 27.1 Battery Room Layout

Addition of:

b. Shall be impermeable, coated in chemically resistant paint (IS EN IEC 62485-2:2018 Section 9.2d) with anti- slip properties. The floor finish in all battery rooms and enclosures shall be slip-resistant and acid or alkali resistant as appropriate for the battery chemistry employed. The floor shall be given a protective coating of acid-resistant, non-skid ceramic floor tiles or an approved acid-resistant epoxy coating applied in accordance with the manufacturer's specifications.

d. The FFL shall be 20mm lower than the adjacent room floor. In order to eliminate the lip between the floor levels at the battery room doors, the floor slab shall be sloped to merge the two levels with a gradient not exceeding 1:50.

    g. Battery room door specifications:

    The door/s to be fitted with internal emergency mechanism (panic bars) and shall swing outwards from the battery room.

    Where a battery room may be fitted with more than one door then one door shall be designated as the main access door with requirements as above. The remaining door shall be equipped with an internal mechanism (Panic Bar) only.

The internal/external door shall be a minimum width of a door and a half for new build substations. Battery room door shall not be less than 800mm wide and 2000mm high and the inside surfaces of the door shall be protected by an approved light-coloured acid resistant paint.

The internal door shall be fire rated and fitted with automatic door closers.

h. The battery room shall have the following labels installed:

On the outside of the battery room door:

- Ex warning sign in compliance with the ATEX regulations
- Restricted Access
- Dangerous Voltage (DC. 60V)/Risk of electric shock
- Prohibition sign for fire, naked flames & smoking
- Warning sign indicating the presence of corrosive liquids
- Warning sign indicating slippery floor when wet

Battery bank & charger identification labels.

On the external wall of the battery room, between the two high level and the two low-level vents:

- 2 x Ex warning signs in compliance with the ATEX regulations and an additional note: "Zone 2 area extends to 500mm around the vents"

Ventilation of the battery room shall be natural having vents located on two external perpendicular walls to meet the required number of air changes per hour to ensure that the hydrogen concentration shall be maintained at a non-explosive level in accordance with IEC 62485-2: 2010-06 Section 7.1 & 7.2). The ventilation design of the battery room shall be submitted to ESB Networks for review 10 business days prior to any related works commencing on site.

To prevent the escape of hydrogen into adjacent rooms/ spaces:

- Ensure that all opes in the battery room that lead into adjacent rooms shall be sealed
- The battery room ceiling shall be gas tight. False ceilings shall NOT be installed in the battery room as it becomes an unvented space.

The light fittings shall not be installed directly over the battery, but rather in between the battery rows, oriented in parallel to the battery racks, as the area immediately above and surrounding battery (i.e. 0.5 Meters radius from every cell) shall be classified as Zone 1.

All fittings within the battery room shall be ATEX rated. Refer to section 18.12 – Hazardous Areas.

Battery stands and their support rails shall be insulated to 2 kV. They shall be treated with acid resistant coatings.

Earthing and bonding shall not be applied to the battery and the battery room equipment.

Please refer to ESB Networks Specification 16632 and associated Civil Specification.

Section 27.2 Control Room Layout

Addition of:

"Control room cabinet layout drawings shall be submitted to ESB Networks for review."

Section 27.4 Equipment and Materials

Addition of:

"All damage shall be notified to ESB Networks during construction."

Section 27.6 Labels, Plates and Signage

Addition of:

"Please refer to all labelling requirements set out in the specification pack. The Customer shall advise in advance where there may be ambiguity with regard to labelling. Prior to commissioning ESB Networks shall survey the installation to ensure labelling shall accurately allow for safe commencement of commissioning and energisation."

"Full details and locations of all plates shall be clearly shown on the drawings and shall be submitted for ESB Networks review."

Section 27.12 Welding

Addition of:

"All welds/cut parts shall be treated to retain required corrosion protection integrity."

Section 27.13 Oil and SF6 Gas

Addition of:

"Certificates of compliance for all oil and gas shall be provided to ESB Networks for review."

Section 28 Pre-commissioning and Commissioning

Addition of:

"Prerequisite (On site) to the commissioning phase:

- Single Line Diagram
- Signage and Labelling
- A2 Relay Elementaries
- Scada Database complete
- Live Comms
- RTU Wiring schedule
- Earthgrid Drawings/GPR Study and Results
- Control Room Earth Bonding details. (With Customer Control Room)
- Incoming HV Cable disconnected and insulated.
- Customer HV Cable disconnected and secure.
- Manual/Mechanical close removed from Customer incomer.
- 24/7 AC Supply available
- Permanent AC Supply neutralising point identified.
- Customer commissioner available for Interface Testing.
- Secure control room/heating, lighting, fire, small power complete.
- Control room fitout/ table, chair, filing cabinet, rubber mat etc.
- Welfare facilities.
- Safe Parking"

Section 28.1 Pre-Commissioning

Addition of:

- Pre-commissioning documents; for review (as per DP011):
  - Completed Pre-Commissioning checklists contained in Section 9 of Works Package
  - A 'red line' copy of all pre-commissioning schematics and drawings;

  - A 'CAD marked-up' copy of all pre-commissioning schematics and drawings;
- Copy of Safety File; (as per section 2.2);
- Independent cable test results;
- All labelling completed and satisfactory to ESB Networks requirements

The Commissioning Plan shall allow for a 10-day review period of pre-commissioning documentation prior to commencement of commissioning.

Documents to be made available on site prior to Commissioning stage include the following:

- Material certificates and test result sheets;
- Single Line Diagram (A2 format);
- Protection elementary drawings (A2 format);
- The 'red line' pre-commissioning schematics;
- Two 'CAD marked up' copies of the 'red line' pre-commissioning schematics;
- Earthing Installation Report (as per Section 21.5);
- Defects Log (and remedial action taken);
- Labelling of all plant and equipment shall be completed.
- All required tools for operating primary plant shall be available within the substation compound.
- An on-site meeting shall take place between the Pre-Commissioner, Design Project Manager (DPM) and the Commissioner, or their representative. The meeting shall be used to:
- Handover the pre-commissioning documentation.
- Confirm that pre-commissioning is complete and of good quality. It may not be feasible to confirm everything at this meeting, but spot checks shall be completed e.g. No earth faults present, visual inspection of the quality of work, labelling, operation of the CB and associated position indication.
- Pre-commissioning of some items may not be completed for acceptable reasons. This shall be detailed on the pre-commissioning handover certificate and agreed by all parties