1. SCOPE

This specification details the Company's requirements for the LVAC electrical wiring installation within Grid, Primary and Secondary substation buildings that are not part of the **System** as defined in EM/APP/001.

The design and installation of the electrical building supply wiring at both new and refurbished substation sites shall comply with the requirements of this specification.

The serviceability of the LVAC electrical installation at an existing substation site shall be judged on its condition and suitability for current purpose rather than compliance with this specification.

2. ISSUE RECORD

This is a Reference document. The current version is held on the EN Document Library.

It is your responsibility to ensure you work to the current version.

Issue Date	Issue No.	Author	Amendment Details
June 2013	1	Lee Speakman	Original Issue
19/12/2018	2	Gordon MacKenzie	General review, in line with industry guidance document updates.
01/11/2025	3	Terry Cochrane	General review – minor updates

3. ISSUE AUTHORITY

Author	Owner	Issue Authority
Name: Terry Cochrane Title: Lead Engineer Engineering Design & Standards	Name: Jon Ruiz De Aguirre Title: Substation Manager Engineering Design and Standards	Name: Fraser Ainslie Title: Head of Engineering Design & Standards Fraser Ainslie ..... Digitally signed by Fraser Ainslie Date: 2025.12.22 10:56:11 Z Date: .....

4. REVIEW

This is a Reference document which has a 5 year retention period after which a reminder will be issued to review and extend retention or archive.

5. DISTRIBUTION

This document is part of the Construction Virtual Manual maintained by Document Control but does not have a maintained distribution list. It is published on the SP Energy Networks website.

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7. REFERENCE DOCUMENTS

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

Health and Safety at Work Act 1974.

Electricity at Work Regulations 1989.

Provision and Use of Work Equipment Regulations 1992.

BS 7671:2018	IET Requirements for Electrical Installations,
ENA TS 50-18	Application of ancillary electrical equipment.
BS EN 61439-3	Low-voltage switchgear and control gear assemblies. Distribution boards intended to be operated by ordinary persons (DBO).
IEC 60479-1	Effects of current on human beings and livestock.
BS EN 60947-3	Low-voltage switchgear and controlgear . Switches, disconnectors, switch-disconnectors and fuse-combination units.
BS 5266-1: 2025	Emergency lighting. Code of practice for the emergency lighting of premises.
BS EN IEC 60079-0	Explosive atmospheres. Equipment. General requirements.
BS EN 50200	Method of test for resistance to fire of unprotected small cables for use in emergency circuits.
CAB-03-036	Technical specification for General Wiring Cables.
EM/APP/001	Business specific application of the Safety Rules procedure
SUB-01-013	Embedded and Underground Substations.
ESQCR 2002	SI 2002 No. 2665 The Electricity Safety, Quality and Continuity Regulations 2002 Guidance on The Electricity Safety, Quality and Continuity Regulations 2002
ESQCR 2006	SI 2006 No. 1521 The Electricity Safety, Quality and Continuity (Amendment) Regulations 2006 Guidance on The Electricity Safety, Quality and Continuity Regulations (Amended) 2006
Health & Safety	Guidance HSG 38 Document (Lighting at Work)

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8. DEFINITIONS

For the purpose of this specification, the following shall apply:

The Company	Refers to SP Distribution plc, SP Transmission plc, SP Manweb plc
SP Distribution plc.	The Distribution Licence Holder for the distribution service area formally known as ScottishPower.
SP Transmission plc.	The Transmission Licence Holder for the distribution service area formally known as ScottishPower.
SP Manweb plc	The Distribution Licence holder for the distribution service area formally known as Manweb
SP Energy Networks (SPEN)	The brand name of the division of the ScottishPower group of Companies that encompasses SP Distribution Ltd, SP Transmission Ltd, SP Manweb plc.
The Engineer	The Company's representative having authority over technical matters contained within this specification.
Approved	Equipment approved in accordance with The Company's Equipment approval procedure, and which is considered suitable for installation on the Company's networks. Engineering installation designs considered suitable for installation within the Company's property and/or connected to the Company's network.
Essential Substation Supplies	Supplies to Tap Changers, Circuit Breaker (raise/lower motors) etc.

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9. INTRODUCTION

Electrical installation schemes shall be entirely suitable to the intended purpose of each room within the substation building, including the LVAC supply distribution board, and if applicable, the design to satisfy requirements for use in potentially explosive environments in Battery Rooms with unsealed batteries. These schemes shall conform in all respects to the requirements of the relevant BS/BS EN Standards and the Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers (IET) or its successor organisation.

The Contractor should submit his proposals to SPEN, six weeks in advance of the proposed commencement of work, including loading calculations to verify the design for all aspects of the works.

The Contractor shall supply a valid electrical test certificate for the completed works in accordance with the current IET regulations and shall be recorded in the company's corporate IT system, including where applicable, incorporation within CDM H&S File handover to SPEN.

The Contractor shall provide SPEN with 'As-Installed' schematic and layout drawings showing the installed LVAC distribution system. (As per Appendix 2.)

Internal cabling shall be run through surface-mounted trunking and/or conduit (MICC if requested, shall be clipped to surface).

Small power

Substations shall incorporate complete electrical installations for small power schemes including 400V, 230V and 110V outlet sockets as required by SPEN.

All LVAC wiring installations shall normally be supplied from the local distribution network, typically a 230V single phase supply (secondary substation) or 400V three phase and neutral (Grid/Primary Substation) A.C. supply, via a 100A SP&N cut out.

Where there is no available supply from the local distribution network, the supply may be taken from the substation L.V. Board utilising a safe system of work authorised by SPEN.

Three phase equipment shall be supplied via a suitably rated switch disconnector to a three phase 400V distribution board.

Loads shall be balanced across all three phases, where applicable.

Internal lighting

Internal lighting shall be designed to allow safe movement of personnel and safe operation of equipment, and shall be operated by wall mounted switches, positioned adjacent to doorways, including outside at the entrance to rooms, and/or at more than one doorway if appropriate.

Internal lighting schemes generally shall be designed such that the positions of all light fittings and associated switches etc. take due cognisance of the locations of, and access to all equipment within the building.

Emergency lighting shall also be provided in Primary substations, and where appropriate, in Secondary substations (embedded locations, where the door does not exit directly to the open air).

A key test wall switch shall be installed adjacent to the entrance door.

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Electro-mechanical heating & ventilation

Where provided, electrical installations for heating and ventilation schemes to buildings shall incorporate suitable control and instrumentation, and cabling systems necessary to maintain appropriate operational conditions.

System fault level

The low voltage system fault level at the point of connection to the incoming power cable shall be considered to be a minimum of 16kA, unless otherwise advised by the Engineer.

10. GENERAL INSTALLATION WIRING REQUIREMENTS

The design proposal shall include adequate information to prove that the performance of the specified cabling and associated equipment, in particular the rating of any specified circuit fuses or miniature circuit breakers shall be adequate to interrupt the stated fault level current.

At existing substations which are to have their electrical wiring installation rewired, all redundant wiring, associated equipment, circuit breakers, switchgear and fuse gear etc., shall be removed, unless approved and detailed in the design proposal.

Any required interruption/disconnection/reconnection of "**Essential Substation Supplies**" shall only be completed after agreement with the Engineer.

No design or installation non-conformances other than those specifically referred to in this document shall be accepted.

The design proposal document shall include, but not be limited to, the following information:

(a) Suitability of installed equipment for system fault level.
(b) Circuit fault disconnection time.
(c) Proposed circuit protection method (i.e. cartridge fuse, MCB, MCCB, RCD, RCBO etc.)
(d) Design earth loop impedance at each outlet and load connection point.
(e) Voltage drop to each outlet and load connection point.
(f) Rise of earth potential under fault conditions.
(g) Scheme for, and design of, metal work bonding.
(h) Main earthing conductor rating.
(i) Circuit cable current rating and maximum design loading.
(j) Circuit cable insulation type.
(k) Circuit cable mechanical protection.

10.1 Common substation electrical installation requirements

(a) All socket-outlets, spur outlets, switches and mounting boxes shall be metal clad, and be of an approved corrosion resistant finish.
(b) Where entry to a room must first be gained, before the light switch can be operated, the light switch shall be fitted with neon indication.
(c) Lighting circuits, socket-outlets and spur outlets shall have RCD protection with a rated residual operating current not exceeding 30mA and a maximum operating time of 40ms at 5 times the rated current, or protection achieved by equivalent rated RCBO.
(d) Battery charging systems shall be connected using a fused, **un-switched** spur that is **not** supplied from a circuit with RCD/RCBO protection.
(e) All wiring shall be in Low Smoke Zero Halogen (LSOH) cable. Where LSOH cabling is installed in substations within basements, or similarly restricted access/egress sites, or substations contained within regularly populated buildings, the mechanical protection by trunking and/or conduit, shall either be non-combustible, or proven to pass the specified fire resistance tests specified in BS EN 50200.
(f) 400V installations shall be fully segregated from all communications and control circuits.

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(g) All circuits shall be clearly identified by permanent labelling.
(h) A permanent warning label shall be applied on, or adjacent to equipment, where it can be seen before gaining access to live parts, where the voltage exceeds 230V.
(i) Socket and spur outlets shall not be supplied from different phases in the same room.

10.2 Grid & Primary specific installation requirements.

The specific electrical installation requirements of newly constructed Grid & Primary substations shall be as detailed on the relevant SPEN substation construction drawing, or substation construction specification.

The electrical installation requirements of existing primary substations undergoing a scheme of re-wiring as part of a renovation programme shall meet the requirements of this document.

In both cases the design proposal referred to in section 10 above shall detail the exact type and position of all wiring and wiring accessories, and shall be subject to approval in writing prior to the commencement of the works.

(a) Primary substation control rooms & switchrooms containing “Indoor Switchgear”, shall be fitted with a lighting system designed to provide the minimum required lighting level (200 lux average illuminance, and 100 lux minimum measured at 1m above floor level), to provide effective, economic, low glare lighting suitable for the tasks to be undertaken in each room, and achieved using (low energy) double tube fluorescent fittings with an IP rating of IP65. These minimum lux levels apply to the operating areas of the rooms, i.e. front of switchgear and control panels. Slightly lower levels will be acceptable to the rear of control and switchgear, but there must be no obvious significant change in light levels throughout each individual room. Other rooms, corridors etc. shall be fitted with a lighting system designed to provide the minimum required lighting level as detailed in HSG 38, achieved using fluorescent fittings with an IP rating of IP65 and/or pendant/batten type lighting fittings, fitted with low energy lamps.

    The supply to the fittings shall be across the three phases, and arranged over the fittings such that the entire switch-room has a usable level of illumination when only two phases are live. (see10.1 (h) for labelling requirements)

    Lighting shall generally be switched for each individual room, although there are some existing sites with interconnected switchrooms, where it may be beneficial to control all switchroom lights from one point.

(b) Emergency lighting shall be provided by bulkhead type, IP65 8-watt, 3-hour non-maintained emergency exit fittings, complete with “legend” signage, installed as required within the building.

(c) Lighting fittings installed within any room specifically and solely used to house unsealed battery systems, including all Plant type batteries shall be ‘intrinsically safe’ and conform to the requirements of BS EN 60079-11.
    The light switches for battery rooms shall be wall mounted externally from the room, and in such a position that it is not practically possible for one to operate the light switch whilst holding open the battery room door.

(d) Grid & Primary substations with an access driveway of greater than 15m in length, within ScottishPower owned land, shall be fitted with a 150W metal Halide floodlight, complete with integral PIR detector located above the main access/egress door.
    The PIR shall have a minimum detection range of 12m and a minimum detection angle of 110deg. An internal override switch shall be wall mounted internally adjacent to the door.

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(e) Primary substations control rooms & switchrooms containing “Indoor Switchgear”, shall be fitted with an approved heating scheme having a minimum rating of 60W/m^3 and shall be achieved using appropriate wall mounted heaters, fitted with protective guards.

An assessment of the ‘U’ value of the building shall be made by the Contractor, who shall provide a calculated assessment to ensure the rating of the heating scheme ensures that water vapour condensation does not occur on the switchgear within the High Voltage switchroom, when the external ambient temperature is -10ºC, and the ambient external RH is 80%. The assessment calculation of this shall be submitted in the design proposal, and shall be approved in writing prior to commencement by the Engineer.
The scheme shall be fitted with a thermostatic control with a concealed setting preventing change without the use of tools with an adjustable range of 5 to 30ºC and set at 15ºC.

(f) Battery rooms containing vented cells may be present on some existing sites and require only background heating to prevent deterioration of the battery and building structure.

This shall be achieved by providing:

- Wall mounted convection heaters for use in **‘**hazardous areas’ sized to provide a nominal temperature of 10°C for each room. When sizing the heaters allowance must be made for any existing natural ventilation within the room.
- Wall mounted tamperproof thermostat suitable for use in ‘hazardous areas’ to control the tubular heaters, one thermostat per room. Set to 17°C.

(g) Heating is not required in non-operational areas, i.e. corridors etc.

(h) Humidity control by dehumidification (See Appendix 3.)

(i) Grid & Primary substations shall have provision within the protective distribution unit for a supply to a sump water pump installed in each primary power transformer oil containment bund area. The supply shall have appropriately rated over-current protection and shall have RCD protection with a rated residual operating current not exceeding 30mA a maximum operating time of 40ms at 5 times the rated current, or protection achieved by equivalent rated RCBO. The cabling to the sump pump local control equipment shall have steel wire armour, and shall be of a type approved in writing prior to the commencement of the works by the Engineer.

(j) Grid & Primary substations shall have provision on the protective distribution unit for a three-phase 16A supply to the tap change motor fitted to each primary power transformer.
This supply shall be fitted with over current protection.
The arrangement at the protective distribution unit shall be such that it is possible to either fully remove fuse carriers, or to establish a locked point of isolation for this circuit using a padlock with a hasp of up to 7mm diameter, without denying access to all other circuit protection devices within the protective distribution unit.

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10.3 Secondary substation specific installation requirements

(a) Secondary substations where required, shall be fitted with a lighting system designed to provide the minimum required lighting level as detailed in HSG 38, generally achieved using pendant/batten type lighting fittings, fitted with low energy lamps.
(b) There may be occasions, specifically in basement or embedded secondary substations, where there may be a requirement to install emergency lighting. Where necessary, a bulkhead type, IP65 8watt, 3-hour non-maintained emergency exit fittings, complete with "legend" signage, shall be installed as required.
(c) Secondary substations with more than one access/egress door shall be fitted with a two-way light switching arrangement, and have a second light switch wall mounted and adjacent to the additional doorway.
(d) Secondary substations housing a transformer do not require supplementary heating.
(e) Where "Indoor" rated equipment is installed in a secondary substation that does not have a secondary transformer, a heating scheme, fully compliant with section (e) of clause 10.2 above, shall be installed.
(f) IDNO Substations require small power supplies for SPEN auxiliary equipment (RTU's). A suitable installation shall be provided for SPEN consisting of a minimum 10A single phase protected supply.

10.4 Solkor Ring Test installation requirements

Solkor is a legacy installation arrangement which is part of 'the System' and not in line with BS7671:2018. This section is for reference only.

The Solkor ring test arrangement where a LV supply is used to determine if there are open points on strings of interconnected 11kV/6.6kV circuits and to test if the pilot cable is faulted to earth. This supply is also used for intertripping of legacy Solkor A installations.

Until such time as the function modernised on all connected sites (on same strings of 11kV/6.6kV circuits), the arrangement will need to be retained when existing primary and secondary substations are re-wired or when secondary substations are added looped into existing 11kV/6.6kV circuits which has the arrangement.

The "Solkor ring test" circuit requires supply from a designated 16A way off the L2 phase of the distribution board at primary substation. This supply is taken to a current limiting resistor which then connects to pilot cables. The ring test indications and pilot faulty indications are shown on lamps connected in circuit via test switches in the protection cubicle of associated circuit bay at primary substations and associated Solkor protection panel as secondary substations. Typical arrangements can be found in Appendix 4

11. PERIODIC INSPECTION & TESTING

All substation LVAC wiring installations require inspection, testing and certification. Good practice is detailed in BS 7671:2018, Guidance note 3,

The Contractor shall supply a valid electrical test certificate for the works, and results shall be recorded by the company.

Where an LVAC wiring installation provides a supply to Plant or Apparatus forming part of the System as defined in EM/APP/001 (e.g. battery charger), then the limit of the LVAC wiring installation for the purposes of testing shall be the incoming terminals of the nearest point of isolation external to the Plant or Apparatus concerned.

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12. APPENDIX 1 – SCHEDULE OF WORK

The following Schedule illustrates the most commonly used items, installed in both Primary and Secondary substations and should be used as a template for the Tender, and returned along with the design proposal drawings.

Schedule of Rates for Electrical Installation Works

Substation Name: **Date:**

This is a Design and Build Contract.
The Contractor shall complete the following Schedule of Rates.
Installation, when stated in the rates, is to include all fixtures, fittings, spacers, screws, plugs, anchors etc that will be required to fix in place (install)
All works are to be undertaken to the latest SPEN Standards and Specifications and / or the latest Industry Standards and Specifications.
All of the testing & commissioning that is required to make the plant and equipment ready in all respects for connection to the System and subsequent

Item	DESCRIPTION	UNITS	MAT COST	LAB COST	ACTIVITY COST
	SUBSTATION LIGHTING & SMALL POWER				
1	Internal wiring, 1.5 mm2, LSOH installed in conduit / trunking	m			
2	Internal wiring, 2.5 mm2, LSOH installed in conduit / trunking	m			
3	Internal wiring, 4 mm2, LSOH installed in conduit / trunking	m			
4	Internal wiring, 6 mm2, LSOH installed in conduit / trunking	m			
5	Internal wiring, 10 mm2, LSOH installed in conduit / trunking	m			
6	Internal wiring, 16 mm2, LSOH installed in conduit / trunking	m			
7	Fused Switch, 100A, DP, wall mounted, supply and install	each			
8	Fused Switch, 100A, 3P, wall mounted, supply and install	each			
9	Isolator, 100A, DP, wall mounted, supply and install	each			
10	DB, 1ph, 4 way, wall mounted, supply and install	each			
11	DB, 1ph, 6 way, wall mounted, supply and install	each			
12	DB, 3ph, 12 way, wall mounted, supply and install	each			
13	MCB, 1ph, 6A, type A to D, supply and install	each			
14	MCB, 1ph, 10A, type A to D, supply and install	each			
15	MCB, 1ph, 16A, type A to D, supply and install	each			
16	MCB, 1ph, 20A, type A to D, supply and install	each			
17	MCB, 1ph, 32A, type A to D, supply and install	each			
18	MCB, 1ph, 50A, type A to D, supply and install	each			
19	RCBO, 1ph, 6A, supply and install	each			
20	RCBO, 1ph, 16A, supply and install	each			
21	RCBO, 1ph, 32A, supply and install	each			
22	MCB, 3ph, 6A, type A to D, supply and install	each			
23	MCB, 3ph, 32A, type A to D, supply and install	each			
24	20 mm plastic conduit, supply and install	m			
25	25 mm plastic conduit, supply and install	m			
26	32 mm plastic conduit, supply and install	m			
27	20 mm galvanised conduit, supply and install	m			
28	25 mm galvanised conduit, supply and install	m			
29	32 mm galvanised conduit, supply and install	m			
30	20 mm plastic conduit bends and boxes, supply and install	m			
31	25 mm plastic conduit bends and boxes, supply and install	m			
32	32 mm plastic conduit bends and boxes, supply and install	m			
33	20 mm galvanised conduit bends and boxes, supply and install	m			
34	25 mm galvanised conduit bends and boxes, supply and install	m			
35	32 mm galvanised conduit bends and boxes, supply and install	m			
36	15 x 15 mm plastic trunking c/w lid, supply and install	m			
37	25 x 25 mm plastic trunking c/w lid, supply and install	m			
38	50 x 50 mm plastic trunking c/w lid, supply and install	m			
39	50 x 75 mm plastic trunking c/w lid, supply and install	m			
40	50 x 50 mm galvanised trunking c/w lid, supply and install	m			
41	50 x 75 mm galvanised trunking c/w lid, supply and install	m			
42	41 x 41 mm galvanised channel, supply and install	m			
43	fixings and brackets including flat joint pieces, channel nuts and screws for 41 x 41 channel, supply and install	m			
45	base plate for 41 x 41 channel, supply and install	each			
46	Tubular heater, 2 kW, supply and install	each			
47	Room thermostat for use with the tubular heater, supply and install	each			
48	Metalclad surface mounted switchsocket outlet 2 gang, c/w back box, supply and install	each			
49	Metalclad surface mounted connection unit DP switched, fused with neon, c/w back box, supply and install	each			
50	Metalclad surface mounted connection unit DP switched, fused with flex outlet and neon c/w back box, supply and install	each			

12.1 Schedule of Work (Cont.)

Schedule of Rates for Electrical Installation Works (Cont.)

Substation Name: **Date:**

This is a Design and Build Contract.
The Contractor shall complete the following Schedule of Rates.
Installation, when stated in the rates, is to include all fixtures, fittings, spacers, screws, plugs, anchors etc that will be required to fix in place (install)
All works are to be undertaken to the latest SPEN Standards and Specifications and / or the latest Industry Standards and Specifications.
All of the testing & commissioning that is required to make the plant and equipment ready in all respects for connection to the System and subsequent

Item	DESCRIPTION	UNITS	MAT COST	LAB COST	ACTIVITY COST
	SUBSTATION LIGHTING & SMALL POWER				
51	Metalclad surface mounted switch, 1 gang SP, 2 way, c/w back box, supply and install	each			
52	Metalclad surface mounted switch, 1 gang SP, 2 way with Neon, c/w back box, supply and install	each			
53	Metalclad surface mounted switch, 1 gang SP, Intrinsically Safe, BSEN 60079-112 , c/w back box, supply and install	each			
54	Metalclad surface mounted switch, 2 gang SP, 2 way, c/w back box, supply and install	each			
55	Metalclad surface mounted switch module, key operated for emergency lighting, c/w front plate and back box, supply and install	each			
56	Metalclad surface mounted data module, telephone outlet master, c/w front plate and back box, supply and install	each			
57	Light, Fluorescent, impact resistant, IP65, 1 x 58W, HF, c/w conduit box mounting kit, supply and install	each			
58	Light, Fluorescent, impact resistant, IP65, 2 x 58W, HF, c/w conduit box mounting kit, supply and install	each			
59	Light, Fluorescent, impact resistant, IP65, 1 x 58W, HF, 3 hour non-maintained emergency, c/w conduit box mounting kit, supply and install	each			
60	Light, Fluorescent, impact resistant, IP65, 2 x 58W, HF, 3 hour non-maintained emergency, c/w conduit box mounting kit, supply and install	each			
61	Light, Fluorescent, Bulkhead type, IP65, 2 x 11W, supply and install	each			
62	Light, Fluorescent, Bulkhead type, IP65, 8W, 3 hour non-maintained exit light, c/w legend panels, down, left or right, supply and install	each			
63	Light, Intrinsically Safe, BSEN 60079-11, unit,supply and install	each			
64	Room thermostat for use with the tubular heater, Intrinsically Safe, BSEN 60079-11, unit,supply and install	each			
65	Light, Pendant/Batten unit,supply and install	each			
66	Light, area flood, wall mounted, IP54, 150W halogen, c/w PIR sensor and timer, supply and install	each			
67	Dehumidifier, EBAC CD30E (or approved equal), supply and install	each			
68	Isolator, 32A, 3P, wall mounted, padlockable, supply and install	each			
69	Undertake periodic inspection test to BS7671	sum			
70	Test and commission the installation on completion	sum			
71	Misc:				
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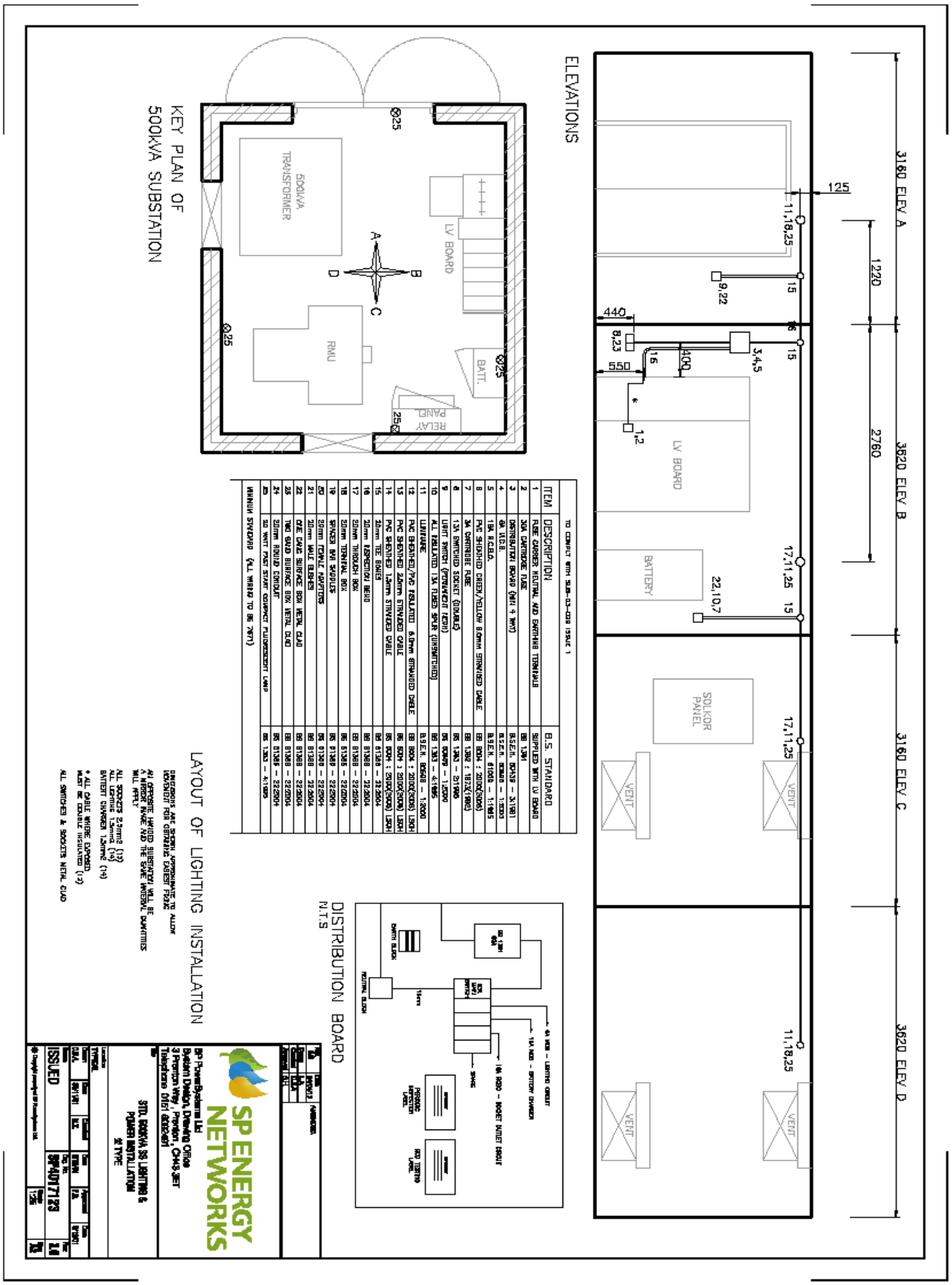
13. APPENDIX 2

13.1 Example of 500kVA substation electrical layout drawing



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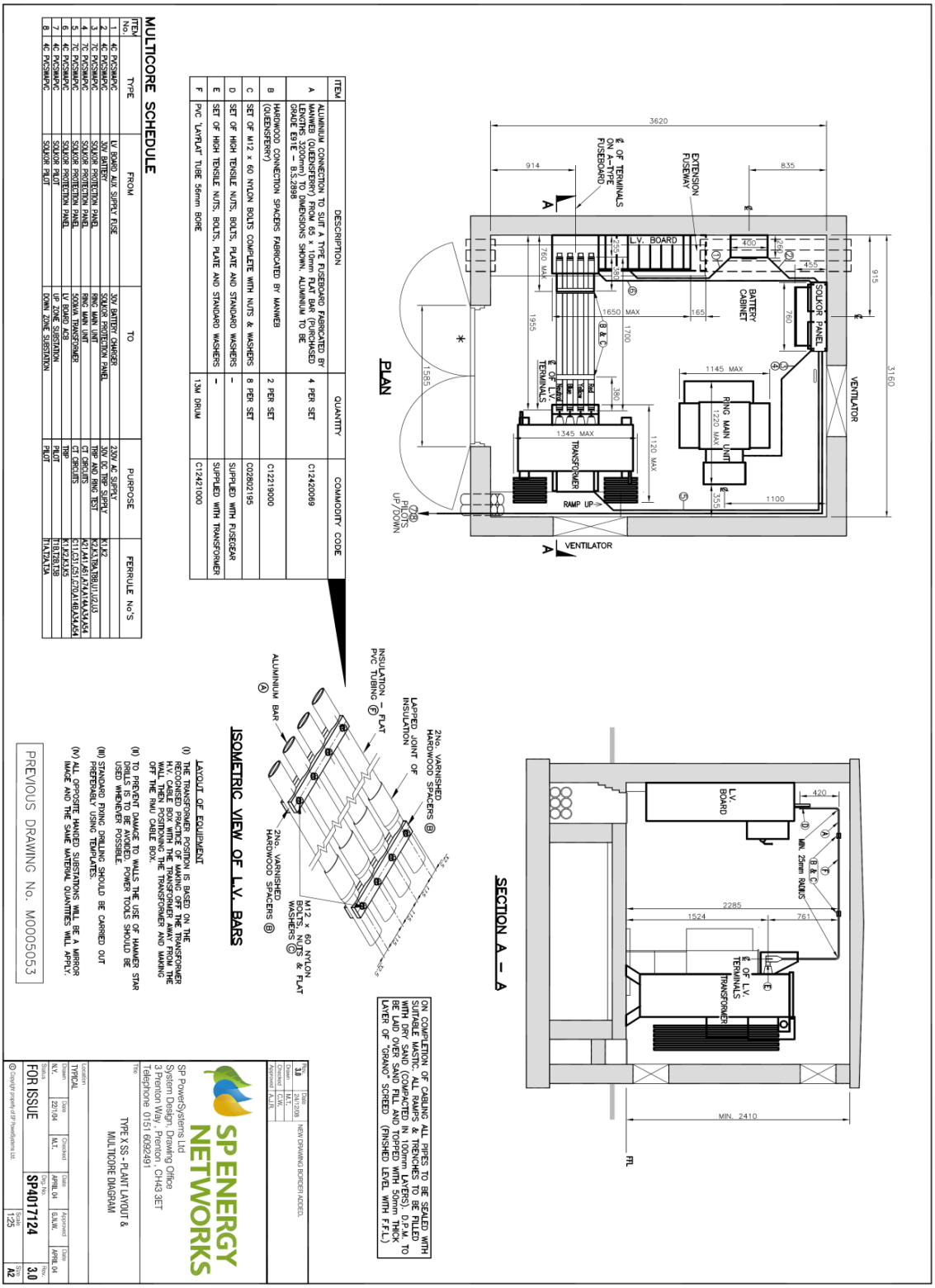
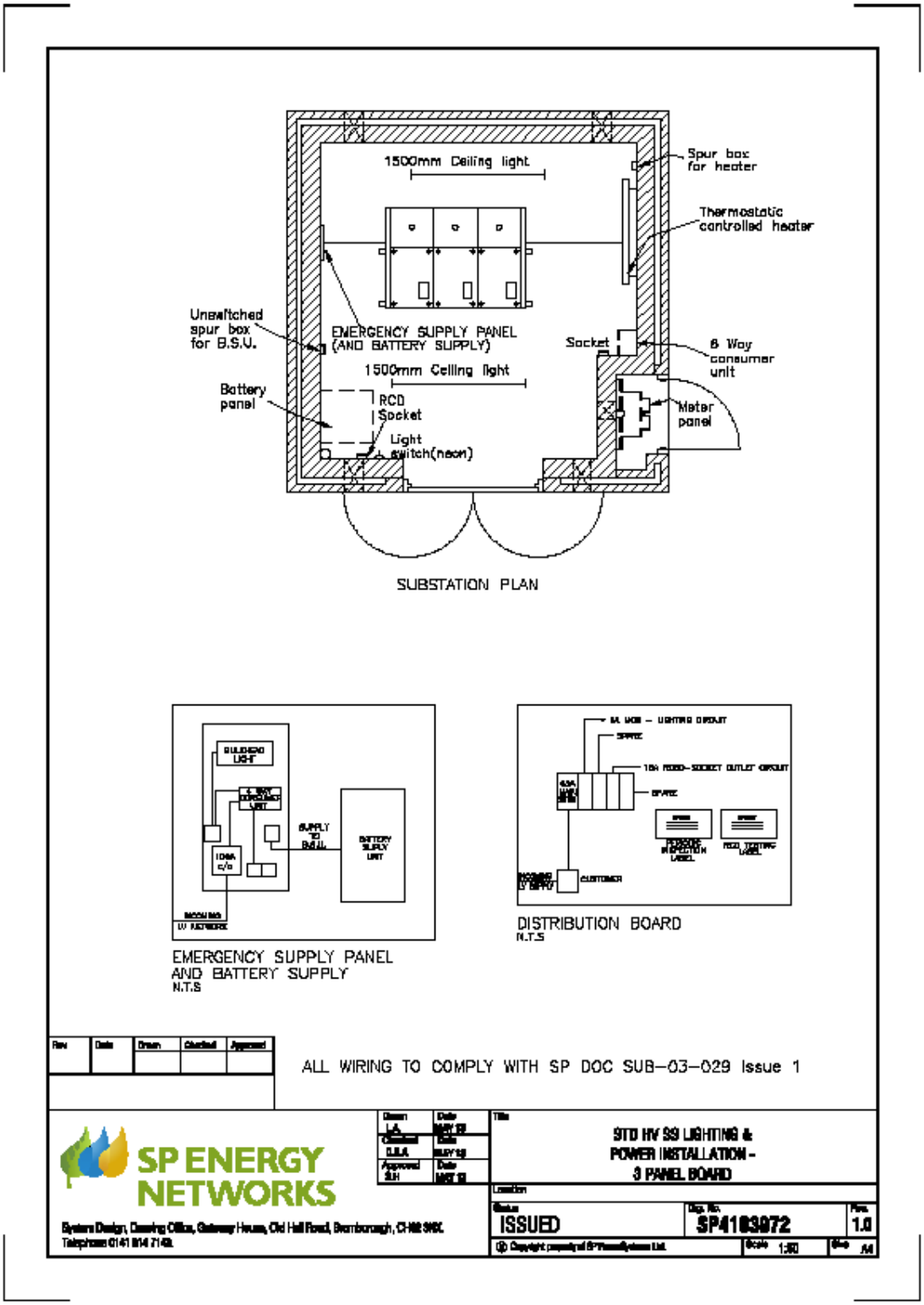

PLAN
SECTION A – A
ISOMETRIC VIEW OF L.V. BARS
MULTICORE SCHEDULE
SP ENERGY NETWORKS
FOR ISSUE
SP4017124
PREVIOUS DRAWING No. M0005053

13.2 Example of HV substation electrical layout drawing



14. APPENDIX 3

When requested by the Engineer, a dehumidification system shall be installed in addition to the heating scheme.

The design proposal shall detail the make, type and rating of the installed dehumidifier, and shall indicate its installed position and the minimum water extraction rate that the dehumidifier is capable of.

The dehumidification scheme shall be subject to approval in writing by the Engineer.

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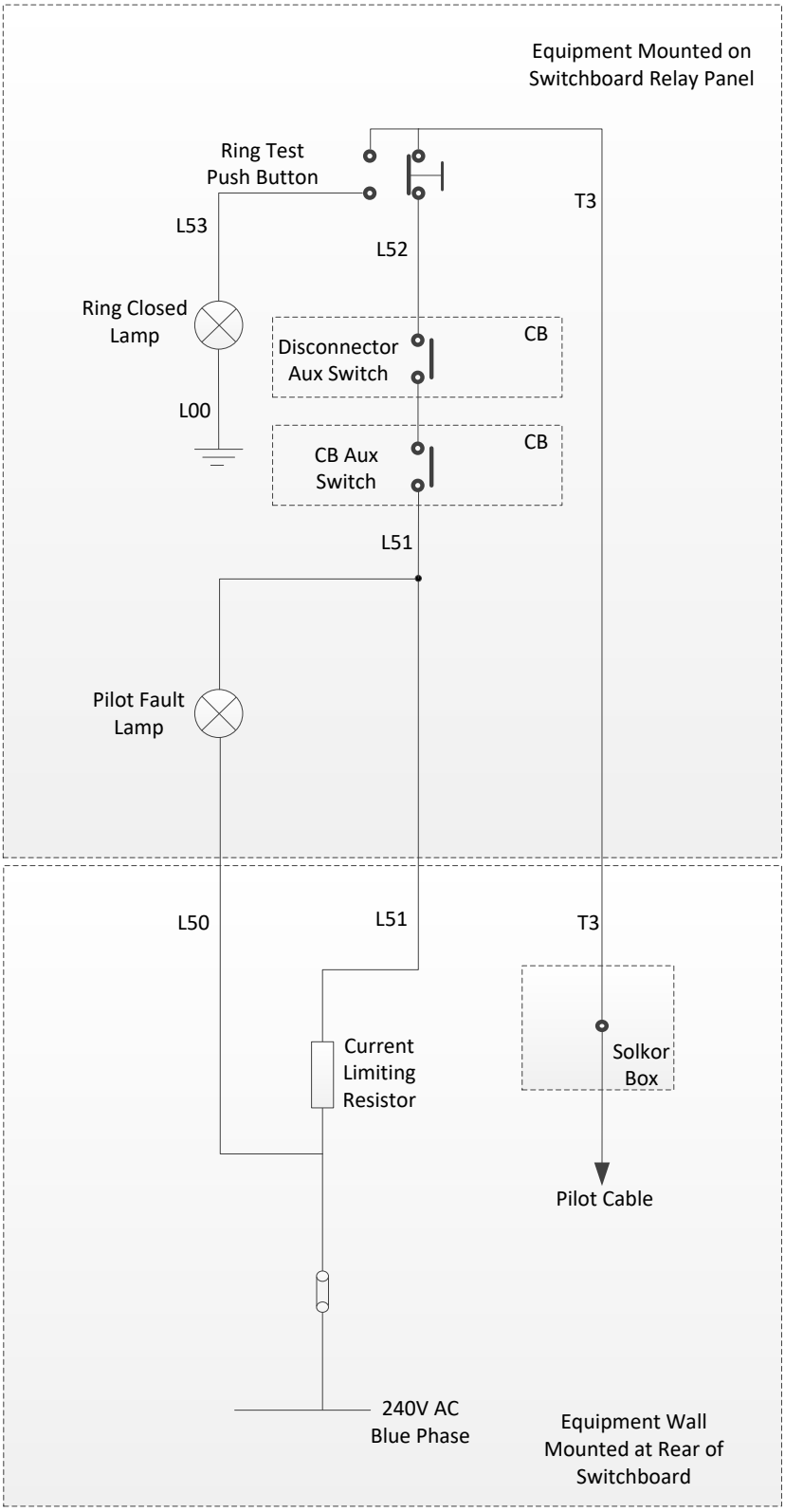
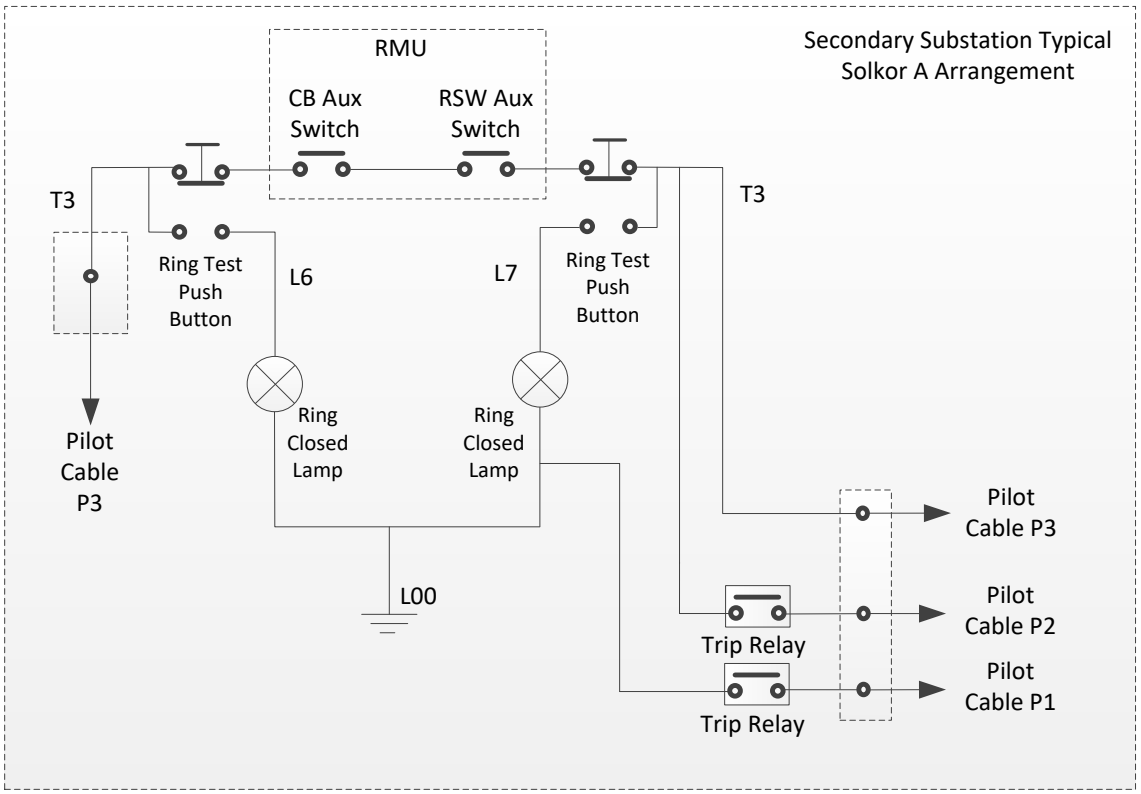
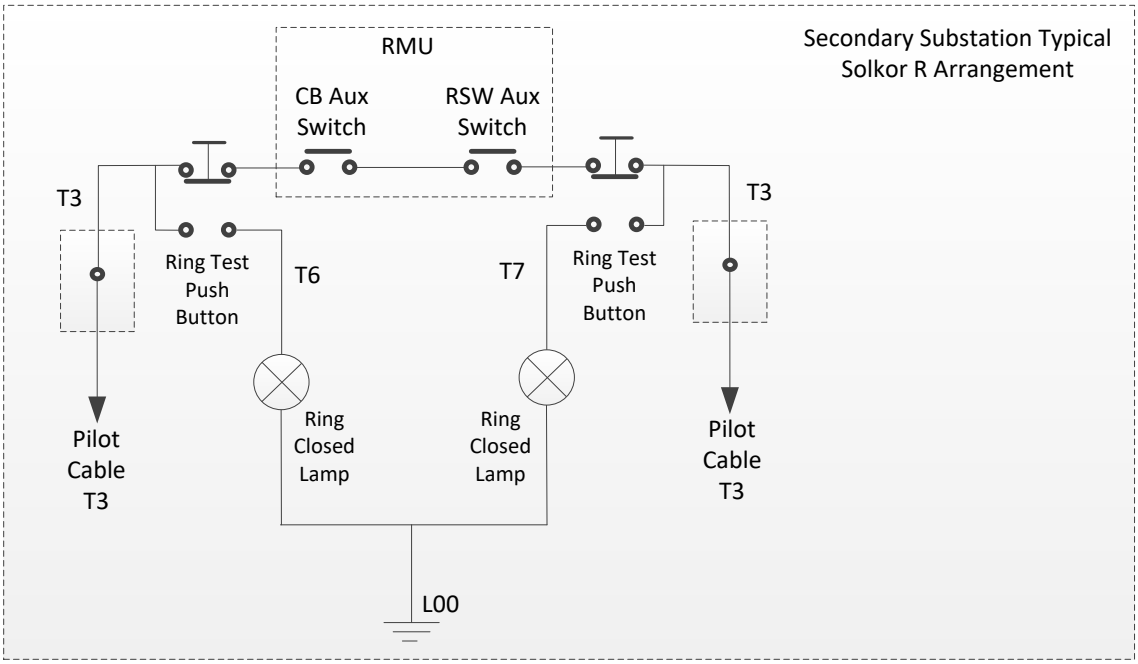
15. APPENDIX 4

15.1 Primary Substation Solkor Ring Test Function Typical Arrangement



15.2 Secondary Substation Solkor Ring Test Function Typical Arrangement





Internal Use