APPENDIX 1: DRAWINGS

The guidance drawings listed below are typical layout and construction details deemed to satisfy SPEN’s functional civil and building requirements for Secondary Substations.

Constructors shall note that where provided such typical details may be generic and may not reflect exact on-site requirements on a project/site-specific basis.

Where applicable and considered appropriate by SPEN, additional typical deemed to satisfy construction detail drawings may be issued on a project-specific basis.

Variations or changes to the ‘deemed to satisfy guidance drawings’ shall be submitted to SPEN for audit and agreement prior to any work starting on-site.

<table>
<thead>
<tr>
<th>Drawing No.</th>
<th>Drawing Title</th>
<th>Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP2022244</td>
<td>Typical 11kV GRP Plinth (No Metering)</td>
<td>5</td>
</tr>
<tr>
<td>SP2103445</td>
<td>Typical 11kV GRP Plinth (With Metering)</td>
<td>5</td>
</tr>
<tr>
<td>SP2142493</td>
<td>Typical 11kV RMU GRP Plinth (With Metering)</td>
<td>5</td>
</tr>
<tr>
<td>SP3020357</td>
<td>Typical 11kV Brick Built Substation (Close Coupled Gear)</td>
<td>6</td>
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<tr>
<td>SP4000542</td>
<td>Typical Z Vent Louvered Ventilation Unit For Brick Built Substation</td>
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<td>SP4000543</td>
<td>Typical Hardwood Doors for 11kV Substations</td>
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<tr>
<td>SP4000545</td>
<td>Typical 11kV Brick Built Substation (X or Y Type Separate Gear)</td>
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<td>SP4008870</td>
<td>Typical 11kV Brick Built Substation (3 Panel Board With Metering)</td>
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<td>SP4049060</td>
<td>Typical 11kV Brick Built Substation (D or G Type RMU With Metering)</td>
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<tr>
<td>SP4053389</td>
<td>Typical 11kV Brick Built Substation (Double Side by Side)</td>
<td>3</td>
</tr>
<tr>
<td>SP4058664</td>
<td>Typical 11kV Brick Built Substation (Double Square)</td>
<td>3</td>
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<tr>
<td>SP4102117</td>
<td>Typical 11kV GRP Plinth D Type RMU with MU Single Plinth</td>
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<tr>
<td>SP4105959</td>
<td>Typical 11kV Brick Built (LV Generation Substation)</td>
<td>3</td>
</tr>
<tr>
<td>SP4132847</td>
<td>Typical 11kV GRP Plinth G or D Type RMU (indoor Kit)</td>
<td>2</td>
</tr>
</tbody>
</table>
NOTE: The drawing is to be read in conjunction with document SP08-03-017 General Specification for the Civil Engineering and Building Design and Construction of Primary Substations. It is the constructor's responsibility to confirm, before construction, that the details on this drawing are correct as per SUB-03-017.

This is a generic guidance drawing that is deemed suitable for construction. However the construction should consider all site specific risk that will affect the design and operation of the substation. Proposed substation details are to be submitted for acceptance before installation.

Details shown on this drawing are typical for this type of substation building but may not be suitable for substations housing alternative equipment. The constructor shall verify themselves that the appropriate details shown are correct depending on the type of substation being constructed.

Concrete

The concrete shall be in accordance with the specification and attain the relevant cut crushing strength at 28-days.

Foundations (Concrete 40N/mm² 28-Day Cube Strength)

Foundations are to be set on undisturbed in-situ concrete that provide the required minimum design safe ground bearing capacity. Minimum bearing capacity to be 75kN/m².

Floor (Concrete 40N/mm² 28-Day Cube Strength)

A flat, level and smooth floor surface is essential for installation of plant. Tolerances to finished level expressed as a maximum permissible deviation beneath a straight edge with feet placed anywhere on the floor shall not exceed 3mm in 2m or 3mm in 3m. Floors to be cured, prepared & painted with 2 No. Coats of non-slip floor paint on completion.

Brickwork

All brickwork below D.C. to be H.D. category 1. min. 75N/mm² mean compressive strength and max 7% M.A. and durability designation F3 3r (Ex Engineering Brickwork Class E) in English bond except for exposed facs.

External facing brickwork to be H.D. category 1. min. 100N/mm² mean compressive strength and max 12% M.A. and durability designation F1 5r or better. Internal facing brickwork to be Fair faced smooth textured solid concrete bricks, sized to match external facing bricks and with a mean compressive strength of not less than 70N/mm². Class I mortar.

Walls

Walls shall be 215mm English garden wall bond on Collar jointed stretcher bond. Leaves of collar jointed double stretcher walls to be tied together by means of type 3 or type 2 stainless steel ties laid at each 215mm centres and set back 30mm from outer face, ties are to be staggered.

Walls

General

All proposed details are subject to additional or specified materials.

Concrete

All Reinforcement to be of minimum 4.8mm B.D. bars in all reinforcement concrete and be in accordance with the relevant national code of practice. Max 235mm spacing. Wherever practicable, roofs should be clad in self-weatherproof concrete with a smooth finish. 1.5% to 3% of all reinforcement (by volume) shall be designed to act as corrosion protection. Internal / External faces of concrete to be fair faced. All external finishes to be cured, primed and finished with a two coat high performance (Aliphatic) polyurethane waterproofing system (flat roof grade) with glass fibre mat reinforcement to initial coat, e.g.

Concrete

Foundation

Concrete foundation slab to be minimum 150mm thk. with 1.0% steel reinforcement to be min. 100mm bearing. Concrete floor to be min. 150mm thk. cured bed joint, 125mm cover over cable slots.

Foundation

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Concrete foundation slab to be min. 150mm thk. with 1.0% steel reinforcement to be min. 100mm bearing. Concrete floor to be min. 150mm thk. cured bed joint, 125mm cover over cable slots.

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Foundation
VENTILATION SHOWN IS TYPICAL FOR A 132/110kV TRANSFORMER. VENTILATION UNIT OPENING SIZES FOR 132kV TRANSFORMERS SHALL BE A MINIMUM 1000 x 1000mm. TYPICAL VENTILATION REQUIRED MAY NOT BE ADEQUATE IN CIVIL ENGINEERING AND BUILDING DESIGN AND CONSTRUCTION OF SECONDARY SUBSTATIONS, WHICH WERE REQUIRE ADDITIONAL OR ALTERNATIVE VENTILATION ARRANGEMENTS.

NOTES:

1. NOT APPLICABLE TO MV SWITCHING STATIONS.

2. DRAWING TO BE READ IN CONJUNCTION WITH SP4000945, SP4000956, SP4002338 & SP4008664. TYPICAL TRADITIONAL BUILDING DETAILS FOR SECONDARY SUBSTATIONS (NOT APPLICABLE TO MV SWITCHING STATIONS).

3. THIS DRAWING TO BE READ IN CONJUNCTION WITH SUB-03-017 "GENERAL SPECIFICATION FOR THE CIVIL ENGINEERING AND BUILDING DESIGN AND CONSTRUCTION OF SECONDARY SUBSTATIONS".

ADEQUATE NATURAL VENTILATION SHALL BE PROVIDED TO DESIGNE DEGREE DEPENDENT BY TRANSFORMER AND TO PREVENT CONDENSATION. DESIGNERS SHOULD REFER TO SUB-03-005 ("SECONDARY SUBSTATION INTEGRATION AND COORDINATION SPECIFICATION") FOR TYPICAL TRANSFORMER HEAT GENERATION VALUES.

VENTILATION UNITS SHALL BE OF ROBUST MATERIAL, CORROSION RESISTANT CONSTRUCTION, OFFERING THE SPECIFIED DEGREE OF PROTECTION FROM WATER INGRESS AND LONG OBJECTS WHICH MAY BECOME THE POTENTIAL TO IMPAIR ELECTRICAL SAFETY.

INFRARED VENTILATION UNITS SHALL BE PROVIDED WHERE SEPARATION IN THE EVENT OF FIRE IS REQUIRED.

VENTILATORS MANUFACTURED FROM MIN. 18 GAUGE, (0.5mm) GALVANIZED. ALL PARTS TO BE CORROSION RESISTANT ACCORDING TO THE SPECIFICATION BEFORE ASSEMBLY.

ALL DIMENSIONS ON THIS DRAWING ARE IN METERS UNLESS OTHERWISE STATED.
Details shown on this drawing are typical for this type of substation building but may not be suitable for substations housing alternative equipment. The contractor shall verify that all the appropriate details shown are correct, depending on the type of substation being constructed.

Foundations

- The foundation shall be in accordance with the specification and shall be made from concrete with a minimum compressive strength of 24 MPa.
- Foundations are to be set on undisturbed inorganic strata that provide the required minimum shear strength at 28 days.
- The foundation shall be designed to support the weight of the substation and any additional loads as specified.

Walls

- Walls shall be 215mm English garden wall bond or Collar jointed stretcher bond.
- The concrete shall be in accordance with the specification and attain the relevant crushing strength at 28 days.
- The walls shall be designed to resist wind loads and seismic forces as applicable.

Roofs

- Floors of substations housing indoor switchgear shall have a visqueen damp proof membrane & LPL Decothane.
- The concrete shall be in accordance with the specification and attain the relevant crushing strength at 28 days.
- The concrete shall be in accordance with the specification and attain the relevant crushing strength at 28 days.

General

- The contractor shall consider all site specific risk that will affect the design and operation of the substation. Proposed substation details are to be submitted for acceptance before installation.
- Wherever practicable, roofs should be cast in situ reinforced concrete construction with a 150mm thick concrete slab over a visqueen membrane.
- Foundations and walls shall be corrosion resistant and the Constructor's proposals for screening or tagging for earthing purposes shall be expressly agreed with SPEN prior to construction.

**NOTES**

- Foundation details shown are typical for a single 500kVA transformer substation. The foundation details shown may not be applicable to various supply conditions which might require additional or alternative ventilation arrangements.
- The foundation detail shown is typical for a single 500kVA transformer substation. The foundation detail shown may not be applicable to various supply conditions which might require additional or alternative ventilation arrangements.

**Sp Power Systems Ltd.**
- System Design, Drawing Office
- Preston Way, Preston, CH60 2EB
- Telephone: 0151 603 2491

**TYPICAL TRADITIONAL BUILDING DETAILS FOR 11kV BRICKBUILT SUBSTATION (X OR Y TYPE SEPARATE SWITCHGEAR)**

**Rev.**

**A.J.R.**

**Location**

**Date**

**L.A.**

**Title**

**Drg. No.**

**Size**

**Status**

**ISUED**

**Approved**

**Checked**

**Drawn**

**Telephone**  0151 6092491
GENERAL UPDATES TO REFLECT CHANGES TO ENGLAND & WALES

Substations housing indoor switchgear require insulation. U values for wall and roof shall meet those detailed in the table below:

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>U Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulated</td>
<td>0.25 W/m²K</td>
</tr>
<tr>
<td>Non-Insulated</td>
<td>0.35 W/m²K</td>
</tr>
</tbody>
</table>

Roofs shall provide a minimum standard thermal insulation values as detailed in the table below:

<table>
<thead>
<tr>
<th>Roof Type</th>
<th>U Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulated</td>
<td>0.2 W/m²K</td>
</tr>
<tr>
<td>Non-Insulated</td>
<td>0.3 W/m²K</td>
</tr>
</tbody>
</table>

General

Brickwork

Class iii mortar.

Internal facing brickwork to fair faced smooth textured solid concrete bricks, sized to match external exposed faces.

7% M.A. and durability designation F2 S2 (Ex Engineering Brickwork Class B) in English bond except for the first course at 375mm centres and set back 38mm from outer face, ties are to be staggered.

Leaves of walls to be tied together by means of type 1 or type 2 stainless steel ties laid in every fourth plumb and smooth to the interior.

Walls

External walls to enclosures housing Indoor Equipment shall be cavity construction that provides, as a minimum, standard thermal insulation core in accordance with the table below. The external wall lining shall be solid brickwork minimum 215mm overall thickness. Walls shall be fair-faced exposed faces.

Walls

Brickwork

No. Coats of non-slip floor paint on completion.

Floors of substations housing indoor switchgear shall have a visqueen damp proof membrane installed & depicted. The floor shall not exceed 1mm in 1m or 3mm in 3m. Floors to be cured, prepared & painted with 2 coats of non-slip floor paint as compliant.

Foundations are to be set on undisturbed inorganic strata that provide the required minimum design strength at 28 days.

The concrete shall be in accordance with the specification and attain the relevant cub crushing strength at 28 days. This is a generic guidance drawing that is deemed suitable for construction. However the constructor shall confirm, before construction, that the details on this drawing are correct as per the above.

Proposed substation details are to be submitted for acceptance before installation. This drawing is to be read in conjunction with document SUB-03-017 General Specification for the Civil Engineering and Building Works and Construction of Secondary Substations. It is the constructor's responsibility to confirm, before construction, that the details on this drawing are correct as per the above.
NOTES

This is a generic guidance drawing that is deemed suitable for construction. However the constructor should consult the site specific information that will affect the design and operation of the substation. The constructor’s responsibility to confirm, before construction, that the drawing is correct as per SUB-03-017.

The constructor should consider all site specific risk that will affect the design and operation of the substation. Proposed substation details are to be submitted for acceptance before installation.

Details shown on this drawing are typical for the type of installation but may not be suitable for all applications.

1. Foundations shall be in accordance with the specification and shall be set at the relevant substation subgrade strength at 28 days.

2. All brickwork is to be laid using a D40 slump concrete or a manufacturer’s equivalent with a minimum of 31.5 N/mm² at 28 days.

3. Ties are to be staggered. SHS windposts shall be installed on the front and rear wall panels. Leaves of collar jointed double stretcher walls to be tied together by means of type 1 or type 2 stainless steel ties laid in every fourth course at 375mm centres and set back 38mm from outer face, ties are to be staggered.

4. Walls shall be 215mm English garden wall bond or Collar jointed stretcher bond. All finishes are to be in accordance with the manufacturer’s recommendations.

5. Beet of sand/cement screed over a visqueen membrane (top to be level with FFL).

6. All steelwork is to be hot dipped galvanised in accordance with the specification and shall provide additional or alternative ventilation arrangements.

7. These shall be corrosion resistant and the Constructor’s proposals for screening or tagging for earthing purposes shall be expressly agreed with SPEN prior to construction.


9. All steelwork is to be hot dipped galvanised in accordance with the specification and shall provide additional or alternative ventilation arrangements.

10. These shall be corrosion resistant and the Constructor’s proposals for screening or tagging for earthing purposes shall be expressly agreed with SPEN prior to construction.

11. Ventilation indicated may not be adequate in certain supply conditions which might require additional or alternative ventilation arrangements.

12. Walls of substations housing indoor switchgear shall have a visqueen damp proof membrane (top to be level with FFL). Foundations are to be set on undisturbed inorganic strata that provide the required minimum strength at 28 days.

13. All steelwork is to be hot dipped galvanised in accordance with the specification and shall provide additional or alternative ventilation arrangements.

14. These shall be corrosion resistant and the Constructor’s proposals for screening or tagging for earthing purposes shall be expressly agreed with SPEN prior to construction.

15. Foundations of double square type.

16. All steelwork is to be hot dipped galvanised in accordance with the specification and shall provide additional or alternative ventilation arrangements.

17. These shall be corrosion resistant and the Constructor’s proposals for screening or tagging for earthing purposes shall be expressly agreed with SPEN prior to construction.

18. Foundations of double square type.

19. All steelwork is to be hot dipped galvanised in accordance with the specification and shall provide additional or alternative ventilation arrangements.

20. These shall be corrosion resistant and the Constructor’s proposals for screening or tagging for earthing purposes shall be expressly agreed with SPEN prior to construction.


22. All steelwork is to be hot dipped galvanised in accordance with the specification and shall provide additional or alternative ventilation arrangements.

23. These shall be corrosion resistant and the Constructor’s proposals for screening or tagging for earthing purposes shall be expressly agreed with SPEN prior to construction.
**Journal**: SP4105959

**SP PowerSystems Ltd**

System Design, Drawing Office, Gateway House, Old Hall Drive, Bromborough, CH62 3NX.

Tel: 0141 614 7143.

TYPICAL TRADITIONAL BUILDING DETAIL FOR 11kV BRICK MULLION AND TRANSFORMER SUBSTATION (LV GENERATOR)

**11kV SUBSTATIONS**

Laps to be min. 400mm

- 210mm Engineering brick built face (F.P.)
- Concrete: min. 150mm thk.
- Ventilation shown is typical for a single 500kVA transformer substation.
- The typical ventilation indicated may not be adequate in certain supply conditions.
- Proprietary corrosion resistant (or similar approved) ventilation systems are available.
- Wherever practicable, roofs should be cast in situ reinforced concrete construction with a minimum 150mm thk. roof slab.

**Concrete**

- All finishes are to be in accordance with the specification and attain the relevant cub.
- Details shown on this drawing are typical for this type of substation building but may not be suitable for substations housing alternative equipment. The constructor shall satisfy themselves that the appropriate details shown are correct depending on the type of substation being constructed.

**Brickwork**

- All brickwork below D.F.C. to be H. D. C. 100, min. 75psf/m² (or similar approved) compressive strength and max. 70 M.P.A. and durability designation F2 S2 (Ex Engineering Brickwork Class B) in English bond except for egress façades.
- Brickwork should be of the same manufacturer and type.

**Walls**

- Walls shall be 125mm thickness to be of Colar joined internal brickwork or solid concrete blocks, used to match external facing brick and with a mean compressive strength of not less than 200psf/m².
- Class I mortar.
- Walls shall be 125mm thickness wall lined as Colar joined member.

**Foundations**

- Foundations are to be set on undisturbed inorganic strata that provide the required minimum design safe bearing capacity. Minimum bearing capacity to be 750kN/m².

**Steel Spur Box**

- The concrete shall be in accordance with the specification and attain the relevant cub.
- Foundations (Concrete 40mm/38 Day Cube Strength). Foundations are to be on undisturbed natural strata. Concretes that provide the required minimum design safe bearing capacity. Maximum bearing capacity to be 750kN/m².

- (Concrete 40mm/38 Day Cube Strength) 1:50 A2 PLANT LAYOUT Scale 1:10

**Foundation Section**

- Additional foundation and general ground improvement works to be designed to suit specific conditions.

**General**

- To be read in conjunction with document SUB-03-017 General Specification for the Civil Engineering and Building Design and Construction of Substation Buildings. It is the constructor’s responsibility to confirm, before construction, that the details on this drawing are correct as per SUB-03-017.

- This is a generic guidance drawing that is deemed suitable for construction. However, the constructor should consider all site specific risks that will affect the design and operation of the substation. Proposed substation details are to be submitted for acceptance before installation.

- Details shown on this drawing are typical for this type of substation building but may not be suitable for substations housing alternative equipment. The constructor shall satisfy themselves that the appropriate details shown are correct depending on the type of substation being constructed.