

ENGINEERING STANDARD

GE-CIC-ES-0118

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1. GENERAL

This document applies to standalone distribution substations (HV/LV), where HV refers to voltages greater than 1kV up to and including 22kV.

It is incumbent upon the Constructor to comply with all relevant legislation, including future updates and publications in keeping with good industry practice.

Civil and building fabric in its entirety shall be constructed in accordance with the provisions of current, relevant and applicable, BS EN documents, British Standard Specifications and British Codes of Practice.

The Constructor shall ensure that civil engineering and building contractors engaged to carry out works are competent, qualified and experienced with respect to the nature of electricity substation construction.

Civil and building contractors should hold appropriate membership of the National Federation of Builders, Federation of Master Builders, Civil Engineering Contractors Association or similar professional trade body.

Operatives should hold appropriate Construction Skills Certification Scheme (CSCS) Cards or National Vocational Qualifications (NVQs).

The standard of workmanship shall be in keeping with best industry practices and not less than that specified by BS 8000.

The Constructor shall ensure that civil engineering and building contractors engaged to carry out works under this Specification take all reasonable precautions to ensure the safety of all parties concerned with or affected by operations associated with substation construction works.

The safety or operation of any existing utility plant must not be prejudiced; records of buried services must be obtained from all utilities and safe-digging practices must be adopted, including the use of a cable-locating tool.

The Constructor shall notify GTC prior to commencement of substation construction works.

Substation construction shall be such that no sprinkler systems, gas, water, drainage or other third-party service pipes, cables or heating and ventilation ducts or are built within, through or under substations, both existing and proposed.

Construction to be completed in line with GTC standard prior to energisation of new equipment. No equipment/ switchgear is to be delivered to site unless the substation is secure.

Unless variation has been agreed in writing by GTC prior to construction, a delay in plant installation or energisation could result if works are not in accordance with these drawings:

For the purposes of this document “Electricity Network Manager” refers to:

- Electricity Networks Director
- Head of Electricity Asset Management
- Head of Electricity Operations
- Electricity Asset Manager

- Electricity Policy & Standards Manager

GTC List of Standard Substations Drawing Titles and Reference Numbers

- | | | |
|--|--------------------------|---------------|
| • Close coupled | Side gabled roof detail | GTC-E-SS-0010 |
| • Close coupled | Front gabled roof detail | GTC-E-SS-0011 |
| • Close coupled | Pyramid roof detail | GTC-E-SS-0012 |
| • Close coupled | GRP Kiosk detail | GTC-E-SS-0002 |
| • Close coupled | Flat roof detail | GTC-E-SS-0014 |
| • Double close coupled distribution substation with side gabled roof | | GTC-E-SS-0022 |
| • Close coupled with OSCP | Side gabled roof detail | GTC-E-SS-0023 |

GTC List of Specialised Substations Drawing Titles and Reference Numbers

- | | | |
|---|------------------------------------|----------------|
| • Dual HV intake substation with adjoining close coupled substation | | GTC-E-SS-0005 |
| • 20kV cable connected | Side gabled roof detail (for ABB) | GTC-E-SS-0009A |
| • 20kV cable connected | Side gabled roof detail (for Lucy) | GTC-E-SS-0009B |
| • 11kV HV metered intake | Side gabled roof detail | GTC-E-SS-0015 |
| • 11kV HV metered intake | Front gabled roof detail | GTC-E-SS-0016 |
| • 11kV HV metered intake | Pyramid roof detail | GTC-E-SS-0017 |
| • Integral to building arrangements | Foundation detail only | GTC-E-SS-0018 |
| • HV Switch Room for Extensible Panel | | GTC-E-SS-0019 |
| • 11kV metered single intake with close coupled GTC substation | | GTC-E-SS-0021 |
| • Dual close coupled substation | Side gabled roof detail | GTC-E-SS-0022 |
| • HV Dual intake with adjoining unit substation and integral OSCP | | GTC-E-SS-0024 |
| • Triple HV intake substation with adjoining close coupled substation | | GTC-E-SS-0025 |
| • Close coupled | GRP Kiosk detail – ENWL region | GTC-E-SS-0027 |

GTC List of Earthing Drawing Titles and Reference Numbers

- | | |
|---|---------------|
| • Substation Earthing Layout | GTC-E-EA-0001 |
| • Internal Substation Earthing Layout | GTC-E-EA-0002 |
| • Reinforcement Earth Bar Connection | GTC-E-EA-0003 |
| • Substation with OSCP Earth Layout (for use with GTC-E-SS-0023 only) | GTC-E-EA-0004 |

2. AS-BUILT INFORMATION

Any deviation from this standard, agreed with an Electric Network Manager, will require as built information to be submitted to GTC in an approved electronic format no later than '30' days of the site being commissioned.

Where applicable, Operating Manuals and CDM Health & Safety Files shall be submitted to GTC in an approved electronic format no later than '30' days of the site being commissioned.

3. QUALITY ASSURANCE

All materials shall be of good quality, suitable for purpose, designed and manufactured such that they provide safe and continuous service and are capable of withstanding the various stresses and onerous conditions to which they may be subjected on the site of installation without suffering any undue deterioration. GTC shall have the right to inspect any aspect of the construction process. The Constructor shall ensure that all testing results are available for audit inspection by GTC.

This Clause shall not grant any right to the Constructor to vary the requirements of these drawings, nor shall it detract in any way from GTC's rights.

Any deviation requests should be submitted to GTC prior to the work being carried out, with details on the reason for deviation and evidence that the minimum requirements within our standards will have still be met. GTC will assess requests but reserves the right to refuse any deviations.

4. PRE-ENGINEERING SITE INVESTIGATIONS

The Constructor shall carry out adequate appropriate desktop and site-based studies to provide the information necessary to ensure safe transfer of design loadings to ground and compliance with respect to waste handling and disposal.

Site investigation study records and reports shall be available for audit inspection by GTC, including confirmation that the substation operation would not be adversely affected during 1 in 100-year flood conditions. An environmental, security and fire risk assessment will be completed by the designer for all substations.

The developer will be responsible for obtaining all planning consents and building regulation approvals before construction work commences.

5. SITE LAYOUT / ACCESS

Constructors shall note the requirement for unrestricted 24-hour access for GTC operatives to the substation enclosure; standard Company suited lock(s) must control this.

Constructors shall note that pedestrian safety barriers may be required where the site layout is such that emergency egress from the substation is towards a vehicular traffic route, and that these barriers would be required to be demountable if this were also a plant access route for the substation.

Constructors shall note that vehicular crash barrier protection may be required external to the substation where the site layout is such that there is a risk of impact from vehicular traffic.

Access to the substation should be step free hard standing capable of installing the substation equipment by landing in front of the substation and rolling in. Any gradient on this should be kept to a minimum and not impede the ability to replace equipment and comply with section 8 (Drainage). Examples of suitable hard standing – tarmac, concrete and grasscrete, although all should be capable of landing the equipment which has an approx. weight of 5000kg.

Constructors shall note that any gates, fences or barriers on an access route would need to be fitted with standard Company suited lock(s) and should be sufficient to allow 24-hour access for GTC operatives and vehicles.

Brick built substations should be sited a minimum of 3m from the nearest property due to potential for noise/ vibration from the substation to cause disturbance to adjacent residents or workers, or other parties. GRP enclosures provide less noise attenuation and therefore require a greater clearance, the substation should be sited a minimum of 7m from any residential premises (housing to premise wall distance). This distance applies to all EcoDesign Tier 2 transformer sizes up to 1MVA. For transformers greater than 1MVA, early consultation should be made with an Electricity Network Manager.

Consideration on the substation position should be given to the door opening requirements as specified in section 14.1.

6. SETTING OUT

It is essential that substations be set out in accordance with Land Acquisition drawings where the Company has or will subsequently take freehold or leasehold possession of the land on completion. Any amendment to the location must be identified to GTC at the earliest opportunity to allow for timely update of relevant land acquisition drawings.

7. EARTHWORKS

All foundations shall be set on undisturbed inorganic strata that provide the required minimum design safe ground bearing capacity. The design presented on these drawings is based on a safe allowable bearing capacity of 50kN/m². In the event that such a bearing capacity cannot be achieved, the foundations may require piling. It is the principal constructor's responsibility to design the piling system and submit to GTC for advance approval, prior to commencement of any work on site.

The bottom of excavated areas shall be trimmed, levelled or graded and well rammed or otherwise compacted. The construction sequence shall be such that undue exposure of the formation level to excavations is avoided. Excavations shall be kept free from all water from whatever source.

The levels of foundations are not to be founded within non-engineered fill.

Weaker or more compressible ground at depth below the foundation that may impair the stability of the structure is to be removed.

In clay soils subject to volume change, foundations shall be taken to a depth where anticipated ground movements, caused by vegetation and trees, will not impair the stability of the structure.

An adopted active soil drainage system will be installed where the water table can rise to within 250mm of the level of substation plinth.

8. DRAINAGE

Roof gutters to be GRP 100mm diameter half round or equivalent 'square section'.

Roof downpipes are to be 63mm diameter or equivalent 'square section' GRP.

All gutters, downpipes and fixings to be black, unless required otherwise to match adjacent buildings.

The discharge from the roof downpipes will be collected by an adopted surface water drainage system. The drainage systems shall meet the requirements of, and be approved by, relevant local authorities, utility companies and environment agencies as applicable.

The Constructor will ensure the hard-standing access to the front of the enclosures is designed to ensure surface water drains away from the door threshold. If this cannot be achieved a heavy-duty linear drainage channel will be installed for the full width of the door threshold. The linear drainage channel will discharge to an adopted surface water drainage system.

Consideration should be given to drainage conditions during the construction phase on sites where the final drainage solution may not be installed initially. Substations should not be sited at the lowest point of site to avoid flooding issues, including from surface run off.

9. CONCRETE

9.1 General

Reinforced concrete forms will be constructed from RC28/35 concrete mix with a minimum strength class of C28/35, consistence class of S3, water cement ratio of 0.6 and a minimum cement content of 280kg/m³.

Where the ground investigation report identifies the presence of sulphates or other aggressive chemicals in the groundwater, the ground or any adjacent material the Constructor will be responsible for selecting the appropriate mix to suit the site conditions.

Specified characteristic strength shall be verified by concrete cube tests.

The standard of concrete finish shall not be less than that indicated below:

All concrete forms will be cast against undisturbed ground. Where this is not possible the finish to all formed surfaces shall be F2. Forms will be designed to produce a dense smooth finish free from voids greater than 10mm diameter. Minor defects will be made good as specified.

Pit walls shall be at least 200mm thick, constructed in situ concrete.

Base slab shall be 300mm in situ concrete on 1 layer of 1000 gauge polythene sheeting.

All in situ concrete shall be grade RC28/35, reinforced with 1 layer of A393 steel mesh to each face in walls and top and bottom faces in slabs.

Finish to exposed worked surfaces, such as floors and plinths will be W2 / W3. A steel or power float shall be used when the concrete has stiffened sufficiently to be properly worked to produce a smooth even finish free from float marks and abrupt irregularities.

Constructors shall note that sufficient time should be allowed for concrete curing before any equipment is landed, taking into account factors such as temperature conditions and concrete mix.

The finish to all surfaces, other than the rebate which is cast to accept a GRP or Steel grating covering the cable pit which must be square to remove any potential trip hazard, will otherwise be flat, level with smooth surface finishes to the floor and plinth as this is essential for the installation of plant. Tolerances are expressed as a maximum permissible deviation under a straight edge with feet placed anywhere on the surface of floors and plinths shall not be more than 1mm over 1m or 3mm over 3m. Exposed rises to plinths shall be chamfered. Rises to ramp transitions onto floors, vertical corners within cable trenches and the like over or around which cables could pass shall be rounded.

The pit shall be covered using 38mm or 50mm thick GRP gratings with an anti-slip top surface. The gratings should not be protruding out of socket to cause trip or fall.

The gratings shall be installed on completion of the floor construction – any cable cut-outs will be formed later following cable installation. Individual gratings may be no larger than 1.0 square metre.

Unless drawings show otherwise, all cable ducts shall be 150mm ID (178mm OD). twin wall HDPE.

All ducts must be sealed (at the time of installation) at the external end using a purpose made stop end seals. Seals used must be acceptable to both DNO and GTC. GTC approves the use of following sealing system on their asset only:

- Roxtec Ltd
- Hauff-Technik UK Ltd
- CSD sealing systems

The use of rags, newspaper, timber boards and rayflate seals etc to seal the ducts is not acceptable.

Draw ropes will be required for ducts runs > 3.0m in length.

Ducts shall be surrounded by 100mm of 10mm gravel. Compacted granular fill shall be used to fill the space between the duct surround and the underside of the foundation slab. Mass concrete may be used in place of granular fill.

The cable pit is designed to act as a holding sump, in case of oil leakage from the transformer. It is essential therefore that all of the cable ducts be effectively sealed on completion of the cable installations, as specified in GTC's Substation Flood and Pollution Prevention – Contingency Planning Procedure GE-EPR-OP-0042.

Where the use of expanding polyurethane foam is permitted by the above procedure, this shall be used to fill the pit end of the ducts, to a depth of 300mm. Where cables are present, these are to be centred in the duct before the foam is applied; measurements shall be taken to ensure that the cables are held in this position until the foam has cured sufficient to carry the weight of the cable.

Before all the cable ducts are sealed ensure any earth wires that GTC needs to install are in position.

9.2 Re-inforcing Bar

Re-inforcing bar and or mesh used within the concrete base **Shall** be welded by the installer to ensure earth continuity throughout the foundation and approved methods of welding would include, Gas, Arc or Cadweld techniques. The use of twisted wire connections is not suitable and therefore **Not Approved** by GTC, as earth continuity cannot be assured and non-compliant installations will not be accepted. An inspection of this is work by GTC or our Approved Contractor is recommended before pouring concrete, but where this is not possible evidence in the form of photographs of the completed welded concrete reinforcement will be accepted.

An earth connection bar shall be welded to the floor reinforcement mesh and installed in the wall of the cable pit or trench accordance with the relevant construction drawings related to the substation and/or Drawing No. GTC-E-EA-0003 (reinforcement earth bar connection).

9.3 Low Carbon Precast Concrete Bases

We are currently undergoing a trial of low carbon precast concrete base, this section will be updated in due course.

10. SUBSTATION SECURITY

10.1 General

The substation shall be secure prior to any equipment installation, including the install or permanent doors and locking.

Risk assessments should be carried out by Designers of Distribution Substations to be ultimately adopted by GTC, in line with GTCs design policy and the Construction Design and Management Regulations 2015 (CDM). The assessment of the location of the substation on the risks associated, both during the construction stage and once a network has been fully constructed.

For sites in open areas: where it is highly likely that the area around the substation will be vacant for a considerable duration due to the developers proposed construction programme, consideration should be given to enhancing the security measures via temporary CCTV install or and Heras fencing with locked gates.

Construction Phase: Where a substation is installed early in the development programme the location is likely to have a different risk to that when development is completed for example:

- Adjacent to a heavy construction traffic route
- Adjacent to site material storage areas
- Heavy construction machinery being used in proximity.
- Consideration should be given to the installation of Heras fencing or any other suitable barrier around the substation at, at least 1m distance (dual locking on the gates as required).

Vehicular Impact: where a substation is installed in proximity to the carriageway, car parks, lorry yards, or any other area where vehicular impact can be reasonably foreseen, consideration should be given to mitigating such risk by:

- Relocation of the substation.
- Increasing the distance between the substation and carriageway.
- Installation of a kerb / separation between the carriageway and the substation.
- Within a lorry turning yard the installation of an Armco barrier or concrete bollards in front of the substation may be appropriate subject to agreement with the relevant highway authority or landowner.

10.2 Locks

GTC will supply appropriate padlocks for all completed substations, including dual-locking facility for the outer doors. During construction it is the responsibility of the Constructor to ensure the substation remains secure.

Euro profile key operated locks on outer doors are not acceptable to GTC.

11. MASONRY

All masonry to be in accordance with BS EN 1996-3:2006 and walls shall be fair-faced plumb and smooth to the interior.

Masonry materials shall be selected to maximise durability consistent with the architectural or planning requirements for the substation.

The walls shall comprise an outer skin of facing brickwork or coursed stone to match adjacent properties, and an inner skin of solid fair-faced concrete blocks. Bricks may be used for the inner skin.

The minimum acceptable standard for belowground masonry will be High Density (HD) Category I clay brickwork of minimum 75N/mm^2 mean compressive strength, 7.0% maximum moisture absorption and durability designation F2 S2 (ex 'Engineering Class B' quality or equivalent).

External masonry shall be clay-facing brickwork of minimum 9N/mm^2 mean compressive strength and a durability designation F1 S2 or better.

Internal masonry shall be light coloured solid smooth fair-faced concrete facing blockwork with a minimum compressive strength of 3.6N/mm^2 and a dry density: 600 kg/m^3 . Aerated concrete blocks are not acceptable.

For substation with adjoining room the internal dividing wall shall be built with high density concrete block with a minimum comprehensive strength of 30N/mm^2 .

Inner and outer skins shall both be laid in stretcher bond, and tied with stainless steel wall ties; minimum 4mm diameter 'double-triangle', vertical twist fishtail. Ties shall be evenly distributed at maximum 450mm centres vertically and 375mm horizontally, staggered in alternate courses with additional ties at openings.

For damp proofing, both internal and external wall skins, shall comprise 2 courses of Class-A blue engineering bricks having a comprehensive strength of min 125N/mm^2 and water absorption less than 4.5%..

Mortar shall be sand lime, mix 1:1:6, where required, the use of sulphate resisting cement (e.g. below ground) will be used.

External and internal mortar pointing to be 'bucket handle' finish. Other pointing styles, e.g. weather struck, recessed, etc may only be used where required to match adjacent buildings.

12. ROOF CONSTRUCTION

12.1 General

Roof materials shall be selected to maximise durability consistent with the architectural or planning requirements for the substation.

All timber to pitched roofs shall be vacuum process preservative treated.

The use of lead as part of waterproofing systems should be avoided unless essential.

All works to comply with current editions of manufacturer's technical literature for products selected.

Maximum permissible roof pitch to be 45 degrees.

Concrete roof for standalone substation building where GTC will own and maintain the building is not permitted.

Green living roofs are generally not approved and will be subject to individual approval by the Electricity Networks Manager.

12.2 Basic Workmanship

Carry out all tiling work in accordance with BS 5534:2014+A2:2018.

Set out to give true lines and regular appearance, fitting neatly at all edges, junctions and features.

Fix tiled roofing to make the whole sound and weather tight at the earliest opportunity.

Repair any defects as quickly as practicable to minimise damage and nuisance.

Keep gutters and pipes free of debris and clean out at completion.

12.3 Underlay

Handle carefully to prevent tears and punctures and repair with adhesive tape any which do occur.

Lay parallel to eaves, maintaining consistent tautness to minimise gaps.

Vertical laps not less than 150mm wide, coinciding with supports. Fix with galvanized steel extra large head felt nails.

Ensure that underlay does not obstruct roof ventilation.

12.4 Battens/Counter Battens

Sawn softwood, species to BS 5534:2014+A2:2018.

Grading: To BS 5534:2014+A2:2018:

Preservative treatment: Guidance is provided in BS 5534:2014+A2:2018

12.5 Battens on Timber Supports

To be in straight horizontal lines, aligned on adjacent areas, with no batten less than 1200mm long.

Joints to be square cut, butted centrally on supports and must not occur more than once in any group of four battens on any one support.

Provide an additional batten where an unsupported lap in the underlay occurs between battens.

Fix each batten to each support, splay nailing at ends.

12.6 Tiles and Tile Fixing

Lay each course straight bond with tails aligned.

Fix tiles as specified by Manufacturer, but in any case the last tile at the end of every course, and every tile in the course adjacent to both eaves and top edges must be fixed, using nailing and/or clipping as appropriate.

Nail tiles where specified using 80mm x 3.7 mm aluminium nails.

Clip tiles to gables using Manufactures clips and clip nails.

Roof tiles shall be concrete or slate pantiles, with the type used flexible to match local planning requirements and/ or aesthetics. Plastic roof tiles are not permitted.

12.7 Ventilated Eaves

Ensure that top of fascia board is at correct level.

Fascia ventilator grilles.

Fix to top of fascia board. Ensure rear air grilles are not restricted.

Fix eaves trays continuously to support underlay at eaves to prevent water retaining troughs.

Fix rafter ventilator trays continuously to ensure free passage of air above insulation at wall plate level.

Fix bird comb eaves filler units to top of fascia board.

Fix all tiles in eaves course with eaves clips.

Fix all tiles in eaves course with tails projecting 50mm over gutter.

12.8 Mortar Bedded Verge with Bedded Undercloak

Ensure that gable wall is brought up to correct level.

Ensure that rigid sarking terminates on final rafter.

Carry underlay 50mm onto outer leaf of gable wall.

Bed undercloak of 6 mm fibre cement sheet of approved colour, sloping away from and projecting not more than 50mm beyond face of wall on mortar identical to that used in gable walling, and point neatly.

Carry tiling battens over undercloak and finish 100mm from verge edge.

Use standard tiles on right hand verge and treble roll tiles on left hand verge.

Fix verge tiles to every tiling batten with verge clips.

Bed edge of verge tiles flush with undercloak on 75mm wide bed of mortar as clause 290, ensuring that mortar is not displaced or cracked by mechanical fixing of tiles.

12.9 Mortar Bedded Hip

Underlay from one side of the hip should overlap the underlay on the other side by not less than 150mm.

Hip irons: To BS 5534:2014+A2:2018, fixed to hip rafters with galvanized steel screws.

Cut tiles to fit closely at junction. Make weather-tight with edges and joints of hip tiles solidly bedded in mortar. Insert tile slips into solid bedding at butt joints.

Shape first hip tile neatly to align with corner of eaves and fill end with mortar and tile slips finished flush.

All hip tiles within 900mm of rigid masonry support or abutment walls must be mechanically fixed.

12.10 Mortar Bedded Ridge

Underlay from one side of the ridge should overlap the underlay on the other side by not less than 150mm.

Make weather tight with edges and joints of ridge tiles solidly bedded in mortar as clause 290. Insert tile slips into solid bedding at butt joints.

Fill ends of ridges at gables with mortar and tile slips finished flush.

Bed dentil slips in each roof tile pan to form dentil course projecting a consistent approved dimension.

All ridge tiles within 900mm of rigid masonry support or abutment walls must be mechanically fixed.

Ridge terminals: Ensure roof timbers are trimmed around terminal positions. Cut and fit underlay neatly around terminals.

Roof space ventilators: Concealed air vent ridge fixed at not more than 2m centres.

12.11 Wall Plate

To be 50mm x 100mm softwood, spiked and strapped to inner skin of blockwork with 30mm x 5mm x 1200mm long galvanised mild steel straps at maximum 1200mm centres. Strap to be

twice bent over the wall plate and plugged & screwed to the blockwork with minimum 50mm penetration into the blockwork.

12.12 Lateral Support

At rafter/gable wall positions the end three rafters shall be strapped to the wall at both roof and ceiling level. Straps shall be 30mm x 5mm galvanized mild steel at max. 2m centres. Provide 100mm x 60mm S.W. strutting between trussed rafters to support straps. Note that a 50mm gap should be left between the end truss of any gable or separating wall.

12.13 Fire Resistance to Roof

Under line ceiling trusses with 12mm supalux or similar ceiling board, to give fire resistance.

12.14 GRP One-piece 'Lift Off' Roof

Where the substation design specifies a GRP roof this must be designed and built by an approved supplier. The following general notes apply to this type of roof:

- The roof shall comprise a one-piece structure.
- Unless otherwise specified by the manufacturer, the roof structure shall be secured to 100mm x 75mm softwood wall plates. The wall plates shall be connected to the masonry using 50mm x 3mm galvanised mild steel flats, with M6 x 50mm galvanised coach screw fixings 2, 4 & 6 courses down from top of wall. There shall be a minimum of 3no equally spaced flats per wall plate.
- The roof shall be fixed to the wall plate with an approved method such that 'explosion relief' ventilation with a retaining "limit-stop" mechanism is provided.
- External roof finish – as required to match adjacent buildings.
- Wall plate timber shall be pressure treated
- A minimum guarantee period of 20 years is required for each installation.

Note – Currently no standard specification exists for a GRP roof, therefore use would require a bespoke solution and costs may be prohibitive. Use of a GRP roof will require a bespoke design approval with an Electric Network Manager.

12.15 Flat Roof

Flat roof designs are not typically approved for use on GTC networks, however can be accepted where required for planning permission requirements. Prior GTC approval is required for each individual flat roof installation.

A Polyroof system is the preferred GTC option, further information is available on request or in reference to drawing GTC-E-SS-0014.

Information about the proposed roof system must be formally submitted to GTC and approved in writing prior to installation. A minimum guarantee of 20 years is required for each installation. Only fully trained and manufacturer approved roofing contractors to be used.

The roof system shall have a minimum fire rating of 1 hour and comply with local fire requirements. Roofing system must be BBA (British Board of Agrément) approved and approved by the local planning authority. A pitch from the front to the rear is preferred, with drainage from the roof managed.

13. WOODWORK

All timber should be sourced from plantations where accepted management systems are in operation that achieve sustainability of supply.

All structural timber in roof construction including trussed rafters, noggins and bracing should be preservative treated double vacuum method of preservative impregnation prior to delivery to site.

Prefabricated roof trusses described in substation drawings to GTC specs are acceptable.

14. DOORS

14.1 General

All substation doors must be approved by GTC. Approved suppliers are listed in the final section of this specification and on the relevant drawings.

NOTE: Wooden doors are NOT Approved for use on GTC substations

Depending on the assessed security risk and in accordance with Electricity, Safety, Quality and Continuity Regulations (ESQCR) 2002 (as amended) GTC may specify the use of steel doors. The Designer will specify use of steel doors if required under the site-specific substation risk assessment. Approved suppliers are shown in section 17.

Doors shall open outwards. Doors shall not open over public highway, including footways. Standard doors will require a minimum of 1.6m opening. Where space is restricted consideration could be given to use of bi-fold doors from an approved manufacturer.

External doors will be required to open through a minimum of 170° to facilitate the installation of plant and should be able to be fixed open. Doors shall be fully weather proofed including appropriate seals to the external perimeter of frames.

14.2 External GRP Doors

External GRP doors shall be proprietary units of reinforced construction and exposed surfaces that meet the requirements of Class 2 to BS 476 with respect to surface spread of flame.

Doors shall comprise double-skinned GRP leaves, pre-hung in a suitable robust frame. The active leaf shall be fitted with a two-point locking mechanism, suitable for padlock application.

Where timber is incorporated this shall be vacuum process preservative treated and fully encapsulated within GRP.

The doors shall have a finished colour 08B25 "Brown", however a different colour may be used if required to fit in with adjacent buildings.

Frames shall be built-in to all new work using galvanised fishtail or ragged right-angle lugs. Frames shall be built-in to existing work using proprietary corrosion resistant frame fixings. Frame/masonry joints shall be sealed using suitably coloured 1-part polyurethane gun applied mastic, minimum depth 20mm.

GRP Doors pre-hung in galvanised steel frame are only suitable for structural opening of 2710mm wide x 2560mm high and is not available in overpanel option.

14.3 External Aluminium Doors

Aluminium doors may be fitted in place of GRP doors for low security risk sites only.

14.4 External Steel Doors

Steel doors to GTC specifications will be fitted where there is a need for increased security. These doors are fully interchangeable with the GRP doors and will fit the same structural opening dimensions as specified on the drawings.

Anti-Graffiti finish can be factory applied to steel doors manufactured to GTC specification by our approved manufacturers and an extensive range of RAL and BS colours is available. GTC will accept any RAL colour from our approved manufacturers.

When installing steel doors considerations shall be given to corrosive environment and additional protection measures taken where applicable.

GTC's preferred steel door option is one with overpanel (plain or louvred) suitable for structural opening of 2710mm wide x 2560mm high. "No" overpanel option suitable for structural opening of 2710mm wide x 2145mm high can be explored where there is space constraint, however this must be agreed at the planning stage and approved by GTC Asset Manager before substation construction is commenced.

14.5 Earthing and Bonding of Steel Doors and Frames

When steel doors are fitted the door leaves must be bonded to the steel door frame using a (minimum) 16mm² flexible insulated copper bonding strap and the steel door frame connected to the substation earthing system using 70mm² green/yellow PVC insulated stranded copper earthing conductor, as detailed in Appendix 1, Sunray Engineering drawing No. SQD 1002-1.

14.6 Ventilators

Approved ventilation panels are incorporated at high and low level in each leaf of the approved doors. Each ventilator shall have an area of at least 0.25m². Additional ventilation will normally be provided by an approved louvered ventilator size 550mm wide by 750mm high in the rear wall of the substation as shown on the drawings. In some circumstances additional ventilation may be required and in restricted areas the position of the ventilation units may need to be altered to suit the locality or circumstances. Any variations from the standard drawings must be agreed at the planning stage and approved by GTC before substation construction is commenced.

All ventilation units shall be of a robust vandal and corrosion resistant construction, offering a degree of protection not less than that of IP24 to EN60529 i.e. protection against fingers or other object not greater than 80mm in length and 12mm in diameter and protection from splashed water. Approved ventilators are available from the approved suppliers detailed in the final section of this specification. Frame/masonry joints shall be sealed using suitably coloured 1-part polyurethane gun applied mastic, minimum depth 20mm.

A vent with a cable port shall be fitted as standard as shown on the relevant drawing, where it will be fitted on the LV side of the substation. Both ventilators must be bonded to the substation earthing using a (minimum) 16mm² flexible insulated conductor.

14.7 Door Furniture

The GTC approved doors, both GRP and Steel, are supplied complete with the approved door furniture and no variations from these agreed specifications are allowed unless approved in advance by GTC.

The following details specify the general requirements for door furniture:

Lock bracket or other mechanisms to receive padlocks shall be hardened galvanised or stainless-steel high-security, tamper resistant and non-removable without access into the substation. These shall be fitted with lock shrouds for additional security.

Doors shall be fitted with heavy duty galvanised or stainless-steel cabin hooks systems to restrain doors in the fully open position.

Hinges shall be stainless-steel construction.

2 No. 250mm barrel bolts to top and bottom of passive leaf, either stainless steel or hot dip galvanised

Both the active and fixed GRP door panels to include high and low level louvered vents, each with an area of not less than 0.25m². The ventilation units shall be of a robust vandal and corrosion resistant construction, offering a degree of protection not less than that of IP24 to EN60529, i.e. protection against fingers or other object not greater than 80mm in length and 12mm in diameter and protection from splashed water.

15. TECHNICAL REQUIREMENTS FOR EXTERNAL SITE FINISHES

Proposals for external site finishes shall be submitted to GTC for comment.

Concrete surfaces shall be avoided over cable entry areas unless appropriate adequate proposals for ducting beneath or cable covering through have been formally accepted in writing by GTC.

Grasscrete is GTC's preferred finish in front of substation, subject to safe touch and step potentials, to be checked with Designer at planning stage.

Note – some sites may require specific finishes around the substation due to site specific earthing conditions. If this is the case GTC designer will notify the developer.

16. ELECTRICAL INSTALLATION

16.1 Low Voltage Supply

The supply for substation power and lighting will be taken from the 32A transformer mounted fuse cabinet (TMFC) auxiliary fuse using 6mm² copper three core steel wire armour (SWA) PVC cable where the SWA protects the conductors.

For high voltage customer connections where no LV cabinet exists within the substation, using a 35mm² CNE service cable, the LV small power supply at cold sites will be taken from the customer.

16.2 Earthing

A HV earth shall be provided from the incoming LV small power supply where the earth core of SWA cable will terminate in the consumer unit. At the source end, the earth core of the SWA cable terminates at the DIN rail terminal H90 (preferably) or at the HV earth marshalling bar **below** HV-LV earth link. Thereby, the substation HV earth will be used as the earth electrode for the substation power and lighting. The armour of the SWA cable will only be connected to earth at the source end by the steel wire only being earthed via the steel body of the LV cabinet to avoid a second path for earth fault current.

16.3 Substation Consumer Unit

The consumer unit will be at least to IP56 specification, which provides adequate dust protection against unsatisfactory operation of the equipment. The consumer unit will have a minimum of four miniature circuit breaker (MCB) controlled ways where each of the outgoing ways will be labelled to identify the circuits as stated below:

- 2No 16A for Power
- 1No 6A for Lighting
- 1No 16A Spare Way

The spare outgoing way will be used for future special requirements (such as SCADA or Remote Actuator Unit) and should be blanked off for additional identification.

Plastic consumer units shall be used as a preference, as substation enclosures are not domestic dwellings. Metal consumer units shall not be used in HOT (segregated) earth sites (refer to section 16.6). Where plastic consumer units cannot be obtained, reference should be made to the Electricity Network Manager.

16.4 Joint OSCP Room Consumer Unit

This consumer unit will be at least to IP56 specification, which provides adequate dust protection against unsatisfactory operation of the equipment. The consumer unit will have a 100A RCD (30mA) protection and minimum of four miniature circuit breaker (MCB) controlled ways where each of the outgoing ways will be labelled to identify the circuits as stated below:

- 1No 32A for Power Sockets
- 1No 6A for Lighting
- 1No 63A for Commando socket
- 1No 32A Spare Way

The spare outgoing way will be used for future special requirements and should be blanked off for additional identification.

Plastic consumer units shall be used as a preference, as substation enclosures are not domestic dwellings. Where plastic consumer units cannot be obtained, reference should be made to the Electricity Network Manager.

Note: Joint OSCP room to substation is only allowed where substation is proven Cold and is not allowed where substation is Hot.

16.5 Electrical Fittings

All accessories and fittings will be high impact and sourced from a quality manufacture for example MEM or MK.

One 13A double socket outlet to IP56 specification fitted with 30mA RCD protection will be provided in a convenient location on the left-hand side of the substation. Plastic power sockets can be used in free standing substations as these substations are not domestic. However, for integral substations sited within domestic premises, socket made of ferrous metal or equivalent non-combustible material must be used where the socket's earth terminal is connected to the HV steelwork via the distribution board (consumer unit).

For substations in brick-built housing, three 17W LED bulkhead lights to at least IP56 specification will be fitted to the walls (one on either side of the door and one at the centre of the rear wall), and these lights will be controlled by a single lighting switch fitted 1350mm above the finished floor level on the wall adjacent to left or right of door opening, depending on which substation door can be opened first.

For joint OSCP room in brick-built housing, LED bulkhead lights to at least IP56 specification or equivalent fluorescent lights will be fitted, and these lights will be controlled by a lighting switch fitted 1350mm above the finished floor level on the wall adjacent to left or right of door opening, depending on which door can be opened first.

16.6 Wiring

The sockets are to be wired with a minimum of 2.5mm² copper cable and the lighting wired with a minimum of 1.5mm² copper cable.

All internal wiring (except SWA cable) to be contained in 20mm conduit. For standalone brick-built substations, high impact plastic trunking conduit will be used while for integral substations, HV earthed metallic conduit will be used.

16.7 Special Requirements for Hot Sites (Substations with Separate HV & LV Earths)

Care must be taken with lighting and socket supplies to avoid the possibility of making contact between the different earthing systems; at hot sites, the consumer unit, conduits, light fittings and switches must be non-metallic by using plastic insulation and to at least IP56 specification.

Supplies for lighting and auxiliary supplies e.g. RTU shall be provided via a minimum 500VA isolation transformer, LV isolation transformer to be installed within the LV transformer mounted fuse cabinet (before the installation of the LV way cables). The LV neutral of the secondary winding of the isolation transformer will be connected to HV earth using the HV earth marshalling bar avoiding the risk of touch potentials between neutral and earth. Isolation Transformer should be fitted as per 'Schneider Fitting instruction for ESHK15PMB' Doc reference DJ192D002.

13A power sockets should NOT be installed in the substation room.

13A socket fitted in transformer mounted LV cabinet shall be removed (refer to Schneider instruction DJ192D002).

16.8 Third party supplies from small power substation wiring

Where requests are received for third party equipment to be connected to the substation LV supply this can be reviewed on a site-specific basis with reference to the Electric Network Manager. For example, requests can be considered for defibrillator connections to a substation located in a public area, which can be registered as an unmetered supply with an unmetered network operator.

Where fitted an additional way may be required in the consumer unit to be installed to allow for connection of all equipment, as per section 16.3.

No application from small power substation wiring shall be entertained where substation is classed as HOT. This is because of the reason explained in section 16.7 & limited isolation transformer kVA capacity.

17. LIST OF APPROVED SUPPLIERS

Materials may be sourced from other suppliers, in which case full details must be submitted to GTC for technical approval prior to procurement.

Materials specified may be specified by the designer as part of the security risk assessment.

GRP Substation Doors, Gratings & Steel Ventilators:

Doors manufactured by Envico or Cubis procured via Utility Power Systems, Carrwood Road, Chesterfield Trading Estate, Chesterfield S41 9QB

Tel: 01246 262860

Fax: 01246 455915

E-mail: utilitypowersystems@wolseley.co.uk

Steel Substation Doors, Ventilators & Gratings:

Sunray Engineering Ltd, Kingsnorth Industrial Estate, Wotton Road, Ashford, Kent TN23 6LL

Tel: 01233 656648 – Main contact

Tel: 01233 656647 – Alternative contact

Fax: 01233 625137

E-mail: sales@sunraydoors.co.uk

Steel Substation Doors, Ventilators & Gratings:

Bradbury, Plot 6 Atkinsons Way, Foxhills Industrial Estate, Scunthorpe, DN15 8QJ

Tel: 01724 271999 – Main contact

Tel: 01233 656647 – Alternative contact

Fax: 01233 625137

E-mail: sales@bradburyuk.com

Aluminium Substation doors

TS Designs, Unit 5 The Gateway Centre, Cressex Business Park, High Wycombe, HP12 3SU

Tel: 01494 976976

Email: enquiries@ts-designs.com

Note – Ventilators and gratings will currently need to be sourced separately from this approved supplier list.

Cadweld & Earthing:

FM Sudafix LLP, 7 Farrington Way, Eastwood Link Business Park, Nottingham, NG16 3BF

Tel: 01773 767 450

Fax: 0115 9757606

GRP 'Lift-off' roof:

Storm King, Sandy Way, Amington Industrial Estate, Tamworth, Staffordshire, B77 4ED

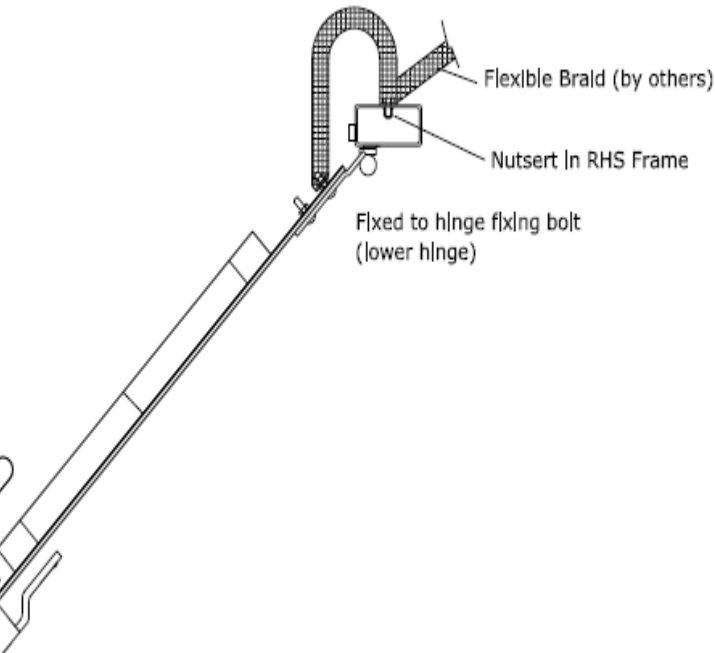
Tel: 01827 311100

Fax: 01827 311200

E-mail: contact@stormking.co.uk

Appendix 1

Sunray drawing no. SDQ 1002-1

	Client	Various
	Site	Various
	Quote no.	TBC
	Quantity	N/A
	Handing as viewed from the outside	Right
	Locking Active	3 Way lock with external padlockable handle
	Locking Passive	Drop Bolts top and bottom
	Finish	Powder Coated to BS 14 C 39 Matt
	Other Comments 3 Way Locking shown (Other Locks available)	
	Clients Approval Signature	
	Print Name	
	Approval Date	
	SUNRAY ENGINEERING LIMITED Kingsnorth Industrial Estate, Wotton Road Ashford, Kent, TN23 6LL Tel: 01233 639039 Fax: 01233 625137 Email: sales@sunraydoors.co.uk Website: www.sunraydoors.co.uk	
	Title Earth bond detail	
	Drawn	CRK
	Approved	
	Date	26th March 2009
	Sheet	1 of 1
	Drawing No.	SDQ - 1002 - 1



18. DOCUMENT HISTORY

Revision Number	Date	Reason For Amendment
Vn1.00	January 2022	Document Issued
Vn2.00	October 2023	Updated Section 9.1, 9.3, 10.1, 11, 13, 14.6 & 16.
Vn3.00	October 2024	Updated Sections 5, 9.1, 11 & 12.1.