NSP/007/003 – Guidance on Substation Design: Construction Details

1. Purpose

This document gives guidance on the civil engineering aspects of Primary and Supply Point substation design.

This document supersedes the following documents, all copies of which should be destroyed.

Reference	Version	Date	Title
NSP/007/003	2.0	Feb 2018	Guidance on Substation Design: Construction Details

2. Scope

This document applies to all Primary and Supply Point substations constructed or modified on the Northern Powergrid network.

2.1. Table of Contents

3. Construction Details

3.1. General

Substations generally comprise buildings to house indoor rated switchgear and protection equipment that require control of humidity and temperature. These buildings shall be arranged such that the switchgear is located within a separate room to the protection/control equipment. A WC and store room shall also be provided at each substation site. Where customers are metered at a substation a separate room shall be provided to house the metering equipment.

Transformers shall be located adjacent to the access road in oil retention bunds and where possible separated such that they do not need to be enclosed to restrict the spread of fire. In accordance with **NSP/007/022 Guidance on Substation Design – Oil Containment.**

Transformers may be enclosed if sufficient segregation is not achievable or to limit noise nuisance. Refer to **NSP/007/020 - Guidance on Substation Design**

Outdoor compounds containing switchgear, plant, transformers, coolers, neutral earthing resistors, arc suppression coils, fault throwing switches, bus bars, etc. shall be enclosed within a 2.4m unclimbable palisade fence (see section 3.6). Subject to a security risk assessment substations containing exposed conductors located in the open air will require enhanced security in the form of an electrified fence conforming to **BS1722 Part 17 and BSEN 60335-2.** See section 3.6.2.

Substations with open terminal connections shall be designed to allow safe access for pedestrians, operation and maintenance of all plant. Consideration should be made to provide access for mobile elevated work platforms.

Buildings shall be positioned to ensure that control and power cabling is kept to a minimum.

Subject to a site security risk assessment marker post shall be used to indicate the site boundary. These posts shall be located a minimum of 2m beyond the perimeter security fence.

3.1.1. Substation Buildings

Substation buildings shall be designed in accordance with British Standards, European Standards and Codes of Practice and in compliance with Building Regulations, with a minimum maintenance life of at least 40 years.

3.1.2. Foundations / Trenches

Buildings should be constructed from suitable foundations designed to suit the requirements of the prevailing ground conditions identified by the ground investigation survey. The design shall minimise below ground excavations / trench work. The substation building and site levels should be designed to prevent water ingress into the substation. Initial site surveys should be carried out to determine the water levels for the site. In an effort to prevent water ingress, the cable access should be located at or above the normal water table. Preventing water ingress through tanking below ground is a non-preferred option. The most effective method is to ensure that trench bases are at or above the mean water table.

In regions where tidal considerations are necessary then the substation building should, where practicable, be built above the high water mark. Where water within the substation building is envisaged that it will be a problem and the above criterion cannot economically be complied with, then an oil sensitive automatic pump, sump and drainage system should be installed. Details of the approved system or special building considerations should be referred to the design engineer.

Flood risk assessment shall be completed on every project. The recommendations shall be used to develop the substation design. The substation site should be designed so that the substation building finished floor level is at minimum 750mm above the surrounding existing ground level where there is no identified flood risk and comply with Northern Powergrid IMP/001/012 – Code of Practice for Flood Mitigation at Operational Premises where a flood risk has been identified.

On a sloping site this dimension should be taken on the side of the building where the 11kV cables leave the control/switchroom. Where necessary a cable berm principle shall be employed where a small embankment of selected earth or filling sand is placed to the side of the substation to ensure that the cables have a minimum of 600mm cover where they leave the building. Where a flood risk is identified site specific flood resilient building design shall be considered to meet the recommendations in the flood risk assessment.

All cable ducts within the substation site shall have a minimum of 600mm of cover to the finished level. Power cables shall be installed in accordance with Northern Powergrid **NSP/002 Policy for the Installation of Power Cables.**

3.1.3. External Walls

External Walls should be as first preference constructed of insulated masonry cavity walls, with outer skin facing brick to match the local area. The use of stone or rendered blockwork is acceptable by agreement if required by the local authority planning department. The inner skin to be minimum 100mm thick 7N/mm^2 paint grade concrete blockwork flush/bucket handle pointed. Masonry walls shall be designed to BS EN 1996, BS EN 196, BS EN 998-2. Where wind posts are required minimum clearances shall be considered. Walls shall be adequately protected from moisture by installing a damp proof course (dpc).

Where a steel frame / cladding permanent building has been agreed the external skin should be of plastisol coated galvanised steel (min 0.5mm thick external skin, 0.4mm thick internal skin) insulated composite panels. An inner skin of minimum 140mm thick 7N/mm2 paint grade blockwork flush/bucket handle pointed is required for security and electrical equipment fixing. The structural steel frame should be hot dipped galvanised, coated or clad as required for fire protection.

External walls to substation buildings shall achieve a U value as required by the current issue of the Building Regulations Approved Document L2A for new buildings other than dwellings.

3.1.4. Internal Walls

Internal walls dividing and creating rooms should be of minimum 140mm thick 7N/mm^2 paint grade concrete block work. Walls between switch room / control room shall be two skins of 140mm blockwork, flush/bucket handle pointed built up to the underside of the ceiling and fire stopped to the same rating as the wall. Walls creating a division to 3rd party ownership or operation should be built up to the underside of the roof membrane and fire stopped to same rating as the wall.

3.1.5. Roofs / Ceilings

Should be as first preference a 30^o pitched traditional roof, using treated timber trussed rafters in accordance with BS EN 595: and BS EN 1995-1-1. Widespan pre-stressed concrete units with concrete screed on top for structural stability and security forming the ceiling.

External covering to be lightweight steel granular coated profiled panels 0.9mm thick steel giving a traditional tile effect. Alternative coverings are acceptable by agreement if required by the local authority planning department.

A minimum 9mm thick external grade plywood sheet sarking is required to top of the trussed rafters for security if a concrete ceiling is not used.

Steel frame building roofs should be a minimum pitch of 10^o covered with plastisol coated galvanised steel insulated composite panels (min 0.5mm thick external skin, 0.4mm thick internal skin). Internal liner to be white polyester coated. The structural steel frame should be hot dipped galvanised, coated or clad as required for fire protection.

Flat concrete or timber roofs will only be accepted in exceptional circumstances, i.e. as a local authority planning requirement, in secure industrial zones to match or adjoining existing similar buildings.

Other methods of roof structure will be considered subject to site specific requirements maintaining security and design / structural compliance.

3.1.6. External Landings / Access and Balustrades

All steps shall be level with consistent rise and goings for each flight. Steps should be 1200mm clear width for access and 2000mm clear width where access with test equipment is required.

All nosings shall be made apparent by means of a permanently contrasting material, nominally 55mm wide on the tread. Colour to be high visibility Yellow or similar.

Landings are to be positioned and designed to be suitable for equipment delivery including loads imposed by equipment, designer is to consider lifting operations and plant usage when determining the location and arrangement.

Landings to be arranged so that it is not possible to walk from a door position on to the stairs without a change of direction.

Finished top level of landing to be 35mm below finished floor level of substation rooms.

Landings to be designed to shed water with a 1:80 cross fall or open floor system.

The landing is to have a minimum 500mm from a door opening to the edge of the landing, steps or handrail.

The landing is to have a minimum 900mm clear width from the edge of a door in the held open position to the perimeter handrail, to maintain a fire escape route when doors are open.

Galvanised steel handrail system is required to the perimeter of landings and adjacent stairs.

Landing handrails to be 1100mm high from landing level. Handrails adjacent stairs to be 900mm high from the pitch line of the stair nosings. An intermediate rail is required at all times.

All handrails to be easily removable with standard hand tools and to have no projecting bolts left in the landing where equipment is delivered. All handrails are to be earthed as required.

3.1.7. Ventilation

Sufficient natural background ventilation shall be provided to all rooms. Switch / Control rooms up to 30m^2 floor area should have a min 20,000mm^2 free ventilation (approx. 4 air grates), Switch / Control rooms between 30m^2 and 70m^2 floor area should have a min 40,000mm^2 min free ventilation (approx. 8 air grates). WC, Store & Metering Annexe rooms min 10,000mm^2 free ventilation.

Air grates should internal and external, be positioned high and low diagonally opposite and sleeved.

Switchgear trenches should be vented at each end to external air to avoid confined space issues. Mechanical forced ventilation should be avoided where possible.

Particular consideration shall be given to additional ventilation requirements associated with batteries in control rooms.

Where louvers are used they should be of vandal proof welded steel construction max 450mm square, colour to match doors and be backed with galvanised steel bird & vermin mesh 6mm x 6mm, 22 gauge wire.

3.1.8. Control Rooms

The substation control room shall be designed in accordance with BS EN IEC 61936-1:2021 to safely accommodate plant and equipment. HV switchgear shall not be located in the same room as the relay/control panels. HV switchgear shall be located in a separate room usually located within the same building. The control room shall have its own main entry double door which is accessed externally. When adjacent to a switch room an internal FD120 with vision panel single door opening into the switch room should be provided. This door should be able to resist any failure blast force created by equipment in the adjacent switchroom.

The control room must also have additional emergency fire/panic escape doors in accordance with BS EN IEC 61936-1:2021. Refer to section 3.3 for door specifications.

The control room floor shall be constructed with a smooth trowelled screed or reinforced concrete finish. Particular attention shall be made to the finished levels and tolerances and guidance shall be obtained from the proposed electrical equipment manufacturer as to the necessary levels and tolerances required for the finished floor to accept the equipment.

Cable trenches within control rooms shall be nominally 600mm deep, have reinforced concrete bottoms and reinforced concrete or masonry sides. They should be designed to prevent ground water ingress and where ever possible cable trench floors shall be above water table level. Cable trenches shall not be located in the vicinity of access doors. Cable trenches shall be interconnected by banks of ducts to prevent creating confined spaces under hollow floors. Upon completion of cable installation, all ducts shall be sealed to prevent fire spread between trenches.

Trenches to accept floor mounted equipment shall be designed such that all plant can be suitably fixed down and allow access for the installation and termination of multicore cables. Refer to clause 3.2 Trench steelwork, access and trench boards.

3.1.9. 11kV and 20kV Switch Rooms

The substation 11/20kV switch room shall be a separate room designed to accommodate the equipment in accordance with BS EN IEC 61936-1:2021.

The switch room shall have its own main entry double door which is accessed externally. When adjacent to a control room an internal FD120 with vision panel single door opening into the switch room should be provided. This door should be able to resist any failure blast force created by equipment in the switch room.

The switch room must also have additional emergency fire/panic escape doors in accordance with BS EN IEC 61936-1:2021. Refer to section 3.3 for door specifications.

Switch room design shall incorporate any over pressure arc venting requirements of the particular type of circuit breaker to be installed size and number of vents shall be as advised by the switchgear manufacturer. When required pressure relief high security ventilation louvers should be installed.

Switchgear shall be orientated so that when facing the front of the switchboard, the T1 section is on the left and T2 section is on the right. If economically practical, for single transformer substations half-switchboards should be orientated so that future extension to a full switchboard would result in T1 on the left and T2 on the right. It is important that the design of the switch room, including cable ducts and floor fixings, are such as to allow for future switchboard extension.

The switch room floor shall be constructed with a smooth trowelled screed or reinforced concrete finish. Particular attention shall be made to the finished levels and tolerances and guidance shall be obtained from the proposed electrical equipment manufacturer as to the necessary levels and tolerances required for the finished floor to accept the switchgear equipment.

Unistrut fixings shall be designed in accordance with the switchgear supplier's recommendations and fixed in position prior to the screeding of the substation floor. Unistrut fixings to be a nominal 2mm above the finished floor level and consultation with the switchgear supplier is recommended prior to screeding. Following screeding it is normal for the switchgear manufacturer to visit site to check that the Unistrut and floor are satisfactory before switchgear installation.

Where steelwork is used for supporting switch gear, fixing holes must be accurately positioned. The horizontal tolerance shall be less than +/- 1mm over each fixing and +/- 2mm over the entire length of the switchboard. The vertical tolerance of steel work with respect to the Unistrut shall be +/- 0.5mm over the entire length of the switchgear fixings.

For existing substations where replacement switchgear is to be installed, new Unistrut may be required which may be proud of the existing floor level. In such cases the floor should be made up to the correct

level using self–levelling epoxy screed. Care should be taken to ensure that small steps are not created between trench covers and the finished floor level.

3.1.10. 33kV Switch Rooms

The substation 33kV switch room shall be a separate room designed to accommodate plant and equipment in accordance with BS EN IEC 61936-1:2021. The switch room shall have its own main entry double door which is accessed externally. When adjacent to a control room an internal FD120 with vision panel single door opening into the switch room should be provided. This door should be able to resist any failure blast force created by equipment in the switch room.

The switch room must also have additional emergency fire/panic escape doors in accordance with BS EN IEC 61936-1:2021. Refer to section 3.3 for door specifications.

Switch room design shall incorporate any over pressure arc venting requirements of the particular type of circuit breaker to be installed as advised by the switchgear manufacturer. When required pressure relief high security ventilation louvres should be installed.

The switch room floor shall be constructed with a smooth trowelled screed or reinforced concrete finish. Particular attention shall be made to the finished levels and tolerances and guidance shall be obtained from the proposed electrical equipment manufacturer as to the necessary levels and tolerances required for the finished floor to accept the switchgear equipment.

Unistrut fixings shall be designed in accordance with the switchgear supplier's recommendations and fixed in position prior to the screeding of the substation floor. Unistrut fixings to be a nominally 2mm above the finished floor level and consultation with the switchgear supplier is recommended prior to screeding. Following screeding it is normal for the switchgear manufacturer to visit site to check that the Unistrut and floor are satisfactory before switchgear installation.

Where steelwork is used for supporting switch gear, fixing holes must be accurately positioned. The horizontal tolerance shall be less than +/- 1mm over each fixing and +/- 2mm over the entire length of the switchboard. The vertical tolerance of steel work with respect to switchgear fixings shall be +/- 0.5mm over the entire length of the switchboard.

For existing substations where replacement switchgear is to be installed, new Unistrut may be required which may be proud of the existing floor level. In such cases the floor should be made up to the correct level using self–levelling epoxy screed. Care should be taken to ensure that small steps are not created between the switchroom floor and trench covers.

3.1.11. WC

The substation WC shall be a separate room formed within or attached to the substation switch room building. It shall have its own entry door which shall be accessed externally as opposed to internally from within the substation building. This will allow the facilities to be used without the need for personnel to access the main substation building.

The floor shall be constructed with a smooth trowelled screed or reinforced concrete finish.

The floor shall be painted with a two pack epoxy floor paint system, colour light grey.

The final coat of floor paint shall be applied following completion of the installation. Prior to application the previously painted floor shall be thoroughly cleaned and prepared as required by the paint manufacturer.

The walls shall be flush/bucket handle pointed fair faced blockwork and for security the walls shall extend full height to the underside of the precast concrete roofing units. No separate low level ceiling shall be formed.

The walls shall be painted with magnolia smooth masonry paint. The final coat of paint shall be applied after the electrical plant and equipment have been installed. An adequate number of coats shall be applied to ensure full coverage of the blockwork is achieved.

The ceiling shall be formed by the soffit of the precast concrete roofing units.

The soffit of the precast concrete roofing units shall be painted with white emulsion paint. An adequate number of coats shall be applied to ensure full coverage of the precast concrete is achieved.

A white vitreous china close coupled toilet shall be provided complete with a matching white vitreous china 6 litre dual flush cistern. The toilet shall be complete with a white plastic seat and cover. The toilet and cistern shall be securely fixed to the floor and wall. White sanitary grade silicone sealant shall be used to bed and point the toilet.

A white vitreous china wall mounted wash hand basin 500mm x 420mm shall be provided complete with single tap hole, waste, plug, chain and stay. The wash hand basin shall be mounted on the recommended wall brackets with suitable fixings. White sanitary grade silicone sealant shall be used to point around the wash hand basin. One 13mm self-closing cold basin pillar tap shall be provided.

For hot water, a wall mounted oversink instantaneous electric water heater complete with chromed moveable rigid outlet pipe and spray head shall be provided to the wash hand basin.

A splash back shall be provided to the wall above the sink. This shall be formed from white glazed ceramic wall tiles 150mm x 150mm and shall extend 300mm beyond the width of the sink and a height of 300mm above the sink. Joints shall be white grouted.

A chromium plated combined hat and coat hook shall be provided, fixed to the blockwork wall.

A chromium plated toilet roll holder shall be provided, fixed to the blockwork wall adjacent the toilet.

Waste water pipework shall be provided from the wash hand basin and the toilet. The wash hand basin shall be complete with an anti-syphon trap and 32mm diameter solvent welded UPVC pipework. The toilet shall be complete with a connector and 110mm diameter ring seal joint UPVC pipework. The toilet and wash hand basin pipework shall be connected into a 110mm diameter ring seal joint UPVC pipework vertical stub stack. The stack shall be complete with a “Durgo” type automatic air admittance valve and sealed access door fitting. The stack shall then connect onto the vitrified clay riser from the underground riser running up through the substation floor void via a drainage pipe collar adaptor where it passes through the floor.

Pipe clips shall be provided to all waste pipework and shall be fixed to the walls at no more than the manufacturer’s recommended centres.

Pipe clips shall be provided to all waste pipework and shall be fixed to the walls at no more than the manufacturer’s recommended centres.

Supply pipework to the toilet cistern and the wash hand basin shall be in 15mm copper with capillary type fittings. The copper pipework shall be connected onto the incoming water supply pipe running up through the substation floor void via a connector where it passes through the floor. At this point a crutch head hand wheel stop valve shall be provided and also a crutch head hand wheel draw off cock. A draw off point shall be provided with the controlling tap inside the WC and the outlet on the exterior of the WC. This is to allow connection of temporary facilities etc.

Isolation valves shall be provided before the tap, water heater and toilet cistern to allow future maintenance/replacement of individual items without having to turn off the full system.

Pipe clips shall be provided to all supply pipework and shall be fixed to the walls at no more than the manufacturer’s recommended centres.

All water supply pipework shall be fitted with polyethylene tube type pipe insulation.

3.1.12. Store Room

The storeroom shall be a separate room formed within or attached to the main substation building. It shall have its own entry door which shall be accessed externally as opposed to internally from within the substation building. This will allow the storeroom to be used without the need for personnel to access the main substation building.

The storeroom floor shall be constructed with a smooth trowelled screed or reinforced concrete finish.

The floor shall be painted with a two pack epoxy anti slip floor paint system, colour light grey.

The final coat of floor paint shall be applied after any electrical plant and equipment have been installed. Prior to application the previously painted floor shall be thoroughly cleaned and prepared as required by the paint manufacturer.

The walls shall be flush/bucket handle pointed fair faced blockwork and for security the walls shall extend full height to the underside of the precast concrete roofing units. No separate low level ceiling shall be formed.

The walls shall be painted with magnolia smooth masonry paint. The final coat of paint shall be applied after any electrical plant and equipment have been installed. An adequate number of coats shall be applied to ensure full coverage of the blockwork is achieved.

The ceiling shall be formed by the soffit of the precast concrete roofing units.

The soffit of the precast concrete roofing units shall be painted with white emulsion paint. An adequate number of coats shall be applied to ensure full coverage of the precast concrete is achieved.

3.1.13. Metering Annexe

The substation metering annexe room shall be a separate room formed within or attached to the substation switchroom building. It shall have its own entry door which shall be accessed externally as opposed to internally from within the substation building. This will allow the metering annexe to be accessed without the need for personnel to access the main substation building.

The metering annexe room floor shall be constructed with a smooth trowelled screed or reinforced concrete finish.

The walls shall extend full height to the underside of the roof membrane. No separate low level ceiling shall be formed.

3.2. Internal Trench Support Steelwork, Access & Covers

3.2.1. Equipment & Cover Support Steelwork

Equipment support steelwork shall be appropriately designed to suit specific equipment and cover requirements in the approved primary design arrangement. The design shall consider the work activities expected to take place on the equipment, including installation, operation, maintenance and removal. All equipment and cover support steelwork shall be in accordance with the following criteria:

All steelwork shall be hot dipped galvanised in accordance with BS EN ISO 1461 (2022) to a minimum mean coating thickness of 85µm.

No steelwork surface or trench covers shall protrude above finished floor level to prevent any trip hazards.

Steelwork shall include drilled and tapped holes or lugs as required for earth connections.

Where removable trench cover supports are required they should be easily removable and handled by one person.

Where steelwork is to be drilled for fixings on site it is to be locally treated using a zinc rich cold galvanising coating, with the surface prepared and coating applied as per the treatment manufacturers recommendations.

Steelwork shall be arranged to provide:

Adequate means for equipment installation.

Suitable access for cable installation.

Consideration for future expansion or modification, where practical.

Steelwork shall be appropriately designed to accommodate:

Equipment loadings (manufacturer specific).

Installation loadings.

Pedestrian loadings.

Deflection limits (manufacturer specific however generally shall be ±1mm over 1000mm).

3.2.2. Trench Access

Trench access steps shall be provided for trench depths greater than 700mm. All trench access ways shall be stairs in accordance with criteria below. Companion way ladders and vertical ladders are not considered a suitable means of escape in the event of an emergency. Stairs should be located as a minimum at one end of a trench with unobstructed access to sub-station emergency escape routes. Access stairs to switchgear trenches with switchboards longer than 5m should have stairs at both ends of the trench.

All steps shall be level with consistent rise and goings for each flight of steps. Rise 150-190mm, Going 250-320mm. Where a going is less than 260mm or open risers are used the treads shall overlap 16-25mm.

Stair pitch preferably 30-38˚. Maximum 42˚ in exceptional circumstances.

Stairs should be a minimum 750mm clear width.

All nosings shall be made apparent by means of a permanently contrasting material, nominally 55mm wide on the tread. Colour to be high visibility Yellow or similar.

Tops of stairs shall receive a plastic highly visible chain guard placed across the stair entrance, to provide a visual barrier to prevent trips and falls when the trench covers are lifted.

Galvanised steel handrail system is required adjacent stairs and to guard openings for future equipment spaces. Stairs less than 1000mm wide can have a single handrail to one side. Top of handrails shall be 1100mm high from floor level. Handrails adjacent to stairs to be 900mm high from the pitch line of the stair nosings. All handrails to be easily removable with standard hand tools. All handrails are to be earthed as required.

3.2.3. Internal Trench Covers

All permanent trench openings shall be covered using trench covers as detailed below. Temporary openings for equipment shall be covered using appropriate boards until the equipment is installed. Each individual cover shall be a maximum 700mm wide x 1200mm long and shall incorporate two 35mm lifting holes to aid removal. All cover bearings shall be a minimum 50mm wide. Finished level of covers shall be flush with finished floor level to not create trip hazards.

Trench covers at the rear of the switchgear shall be provided with 50mm x 50mm battens fixed to the underside to prevent the boards slipping off their supports.

Permanent trench covers shall be:

25mm thick Finnish Birch faced plywood,

Grade II to BS EN635

Facing grade S/BB

Bonded Class 3 to BS EN 314-2

BS EN 13986 CE2+

All surfaces of timber trench covers to have 2 No. coats flame retardant paint to provide Class 1 surface spread of flame and class 0 fire propagation to BS 476 pt 6 & 7, standard colour: Dark Grey

Topside of trench covers shall receive clearly defined numbers and the covers shall be numbered in a logical sequence to allow ease of replacement after they have been lifted, a plan should be provided showing board locations.

3.2.4. Internal Finishes

Internal finishes to substation rooms shall be in accordance with the table and specification below.

Room	Floor	Walls	Ceiling
Switch	Light Grey Epoxy Paint	Magnolia Masonry Paint	White Emulsion Paint
Control	Light Grey Epoxy Paint	Magnolia Masonry Paint	White Emulsion Paint
WC	Light Grey Epoxy Paint	Magnolia Masonry Paint	White Emulsion Paint
Store	Light Grey Epoxy Paint	Magnolia Masonry Paint	White Emulsion Paint
Metering Annexe	Light Grey Epoxy Paint	Magnolia Masonry Paint	White Emulsion Paint

Concrete floors shall be painted with a two pack epoxy floor paint system anti slip, colour as table above.

The final coat of two part epoxy floor paint should be applied after the electrical plant and equipment has been installed. Prior to application, the previously painted floor shall be thoroughly cleaned and prepared as required by the paint manufacturer.

Masonry walls shall be flush/bucket handle pointed fair faced blockwork and shall be painted with smooth masonry paint, colour as table above. The final coat of paint will be applied after the electrical plant and equipment has been installed. An adequate number of coats shall be applied to ensure full coverage of the blockwork is achieved.

Ceilings shall be painted with matt emulsion paint, colour as table above. An adequate number of coats shall be applied to ensure full coverage of the ceiling material is achieved.

3.3. Doors

3.3.1. General

It is essential that Northern Powergrid personnel can access and properly secure on egress all doors at all times. Any door material/construction type that may bind, shrink, warp, wind, corrode or distort will not be acceptable. Materials and coatings have to be suitable for the local environment conditions i.e. corrosion in coastal areas.

Doors shall be of robust construction that offers a high degree of security against unauthorised entry.

Doors shall open outwards.

All external escape doors shall be fitted with an emergency exit push bar.

Doors shall not open over public highway (i.e. including footways).

Subject to site layout, external doors are required to open through 90 degrees to facilitate the installation of plant. When doors are in the open position 750mm minimum clear opening shall be achieved,

Doors shall be fully weathered including appropriate seals to the external perimeter of frames, cover plate to meeting styles. Concrete thresholds shall be rebated to form a 35mm deep steel weather bar.

Door Security should prevent intrusion as well as unauthorised entry in accordance with Building Research Establishment Loss Prevention Standard LPS 1175 issue 7 classifications. Doors supplied should be rated and certification provided to the relevant security level required for the site as identified. Refer to Northern Powergrid site security risk classification and door security matrix.

Standard drawing No. C1016982

3.3.2. External Metal Security Doors

Refer to Standard Substation Drawing, New Build Primary & Grid Substations, Door Details, Drawing No C1016982.

External metal security doors shall be proprietary steel units, proposed details of which shall be submitted to Northern Powergrid for approval during the design stage.

Metal security doors shall be bonded to the substation earth system by means of M10 studs to each frame jamb and fix 16mm2 flexible copper braid connections between the frame and each door leaf (high & low level, approximately 200mm in from top/bottom).

3.3.3. Internal Doors

Internal doors shall be proprietary timber or steel fire doors with vision panel, certified as having a fire resistance rating of at least 2 Hours and providing a means of emergency egress, see **drawing number C1072915**

3.3.4. Door Furniture

The Contractor is responsible for the supply and installation of all fixed door furniture, which shall be corrosion resistant and designed not to aid climbing.

Northern Powergrid will provide appropriately suited locks as described in **NSP/007/018 - Guidance on Substation Design: Substation Locking and Labelling & the Operational Practice Manual (AA1 – AA2.4)**

Lock brackets or other mechanisms to receive padlocks shall be hardened galvanised or stainless steel high-security lock-brackets, tamper resistant and non-removable without access into the substation.

Mechanisms for Standard and Emergency egress shall be operated by means of full width panic bars. If emergency escape mechanisms are fitted to access doors with external locking then the panic bars must operate when the doors are locked (single action operation).

Bolts to fixed leafs shall be solid heavy-duty 16mm square section bow handled galvanised steel or other similar robust corrosion resistant construction.

Doors shall be fitted with appropriate proprietary restraint stays to fix doors open at 90 degrees or, where access for plant installation is restricted, doors shall be fitted with heavy duty galvanised or stainless steel cabin hooks systems to restrain doors open at 90 degrees.

Hinges shall be stainless steel construction minimum four per leaf or piano hinges.

External anti tamper steel locking covers should be provided if identified required by the substation security risk classification. These should be side hung, not to extend over the adjacent door leaf or frame and be locked with a single Northern Powergrid suited Squire SS65 padlock without the use of removable sliding bars.

Refer to Standard Substation Drawing, New Build Primary & Grid Substations, Door Details, **Drawing No Y026S5361.**

Where necessary doors shall be fitted with property and danger of death signage in accordance with **NSP/007/018 - Guidance on Substation Design: Substation Locking and Labelling.**

3.4. Drainage

Drainage systems shall meet the requirements of the Building Regulations and shall be approved by the relevant local authorities, utility companies and the Environment Agency as applicable.

Drainage systems shall be designed and consist of the minimum number of components necessary to be functional and minimise ongoing maintenance. The use of rising mains and pumped systems should be avoided.

Drainage system design and installation shall take into account any imposed loadings from heavy vehicles, such as transformer delivery vehicles. Manholes etc. shall preferably be positioned so that their covers are in roadways or other paved areas. If covers are positioned in gravelled or landscaped areas, they should remain visible and accessible for maintenance and have adequate concrete surround for vehicular protection.

All covers within access roads and those which may be subject to vehicle or mobile elevated work platform (MEWP) traffic should be designed for relevant load conditions but as a minimum be C250 load rating. In all other locations covers should have the appropriate load rating as determined by the designer.

New drainage systems should not discharge directly into existing open ditches, water courses, streams or rivers, except in exceptional agreed circumstances with the appropriate permissions.

“As-built” Site Drainage Drawings shall be colour coded and noted accordingly and “Emergency Drainage Plan(s)” provided and wall mounted within the completed substation buildings.

The design of the drainage system shall take into consideration power and multicore cable routes around the site.

The design of the drainage system shall take into consideration any identified flood risk and appropriate measures taken to prevent back flow into the building.

For requirements of transformer bund discharge refer to **NSP/007/022** Guidance **on Substation Design: Oil Containment**

3.4.1. Water Supply

A permanent potable water supply shall be provided. Arrangements should be made with the local water supply company and charges payable for the connection and for the ongoing supply of water. An external isolation valve and water meter is required.

3.4.2. Surface Water Drainage

Surface water from building roofs shall be collected by an appropriate system of rainwater goods that shall positively discharge to existing surface water drainage systems where practicable.

Where connection to an existing surface water system is not reasonably practicable then the use of suitably designed soakaways is acceptable.

All rainwater gullies and rodding eyes shall have a minimum 150mm thick concrete bed and surround.

The drainage system shall consist of the minimum number of components necessary to be functional & have a low maintenance requirement.

3.4.3. Foul Water Drainage

All new substation sites shall be provided with toilet facilities and an associated foul drainage installation.

The foul drainage shall connect via gravity to the mains drainage system where practicably possible.

Where there is no suitable mains drainage system available, then a cess tank of not less than 10,000 litre capacity should be provided. It should be of sufficient strength to resist local ground water conditions and pressures. The cess tank should be fitted with a padlockable hinged cover and frame with an integral fall protection safety grill.

The cess tank shall incorporate a high level alarm system connected to the substation alarm and SCADA system. The cess tank shall also be vented and positioned in an area on site which allows easy access for tanker emptying without having to enter LIVE areas.

Ducts running between the tank and the substation shall be suitably sealed after alarm and power cable installation to prevent ground water entering the tank and gasses entering the substation building.

3.5. Substation Compounds

3.5.1. Design Criteria

Open terminal compounds shall be designed in accordance with Northern Powergrid preferred design clearances which are detailed in NSP/007/005 – Guidance on Substation Design: Electrical Design Clearances. The equipment and busbar configuration will normally be provided by Northern Powergrid.

3.5.2. Equipment Foundations

Equipment foundations shall be reinforced concrete designed to resist loads applied by the supporting structure and equipment (provided by the structure designer). Concrete should be specified to suit any prevailing ground conditions identified by the ground investigation survey. All reinforcement shall be positioned to avoid holding down bolts such that no damage occurs to the reinforcing bars during structure installation.

Bases for aluminium or steel structures, lighting columns and other equipment shall be set at substation datum level. The finished compound level (gravel level) should be 75mm below this datum.

All equipment foundation faces shall be cast against formwork to their full depth. They shall be to line and level, true and vertical. All faces of concrete shall have a fair faced finish. Top surfaces shall be level but with a steel trowelled finish, without low points to prevent standing water. On large bases where foot traffic can be possible a non-slip finish should be provided. All exposed top edges shall have a 25mm chamfer formed.

3.5.3. Equipment Support Structures

Equipment structures shall be designed in accordance with Northern Powergrid **NPS/003/033 Technical Specification for Substation Support Structures.**

Each structure shall be clearly marked with the structure reference number and location mark. The location mark is used to ensure that the structure is installed in the correct orientation on site.

3.5.4. Cable Ducts and Troughs

Where multicore cables within the site are laid in precast or cast in situ reinforced concrete trough, blockwork or brickwork shall not be used for trough walls. All in situ concrete trough walls shall be to line and level, true and vertical and all faces of concrete shall have a fair faced finish with top surfaces having a steel trowelled finish. Top edges of cast in situ troughs shall have a 25mm chamfer.

The trough shall be provided with slip resistant solid top GRP covers. Individual covers shall be sized for removal by one person and shall be complete with hand holes where necessary for ease of removal. Covers shall be sat fully into a rebate in the top of the trough walls and the trough walls shall extend above the level of the compound dressing by a minimum of 25mm.

Covers of cable troughs shall be so designed to carry the applied loadings. Where heavy loadings are anticipated (i.e. access roads, plant and MEWP crossing points) then heavy duty trench covers of either concrete or other proprietary system may be necessary. Where heavy duty covers are provided suitable

manufacturers matching lifting equipment shall be provided and left on site to facilitate their removal and replacement.

Additional suitably sized galvanised steel angle supports shall be provided to the covers at angles and intersections to support the otherwise free spanning edges of the covers. The trough and covers shall be designed and installed to minimize the risk of creating slipping and tripping hazards.

Cable trough shall be provided with adequate drainage holes/outlets and soakaways to prevent the build-up of surface water with slight falls to the base. Where required due to high water table levels or poor natural site drainage, the trough drainage outlet points shall be connected to the site surface water drainage system.

90 degree angles and intersections shall have any sharp vertical corners rounded off internally to prevent damage to cables.

Where cable trough passes under security palisade fence lines, secure walls or forms cable access into substation buildings then the trough shall either be suitably terminated and ducted through, or have lockable security type covers fitted so that the trough cannot be used to gain access into or out of buildings or secure areas.

Where cable trough is connected and converts to a bank of ducts/conduits a transition pit shall be created to ensure that the ducts can connect to the troughing and that they can therefore maintain the minimum depth of cover. This may require the troughing to be deepened or widened at the transition point to receive the ducts.

Generally all power, multicore cables and earthing under roadways shall be laid in suitable ducts. **Ducts shall be in accordance with NPS/002/003** - Technical specification for cable ducts, protective tiles and tile tape. Laid in accordance with the table below.

Voltage	**132kV**	**66kV**	**33kV**	**20kV, 11kV, LV & Multicore**
Minimum Cover	900mm	750mm	750mm	600mm

Northern Powergrid approved marker tape / cable stock boards shall be installed above multicore and power cable ducts in accordance with **NSP/002 – Policy for the Installation of Power Cables**

Ducts shall generally be laid direct. Where necessary for construction purposes, ducts may be laid with a concrete bedding and surround.

Where ducts are provided below equipment marshalling and mechanism boxes, the ducts should be finished with a 90 degree bend, the end of which should be at datum level directly under the glanding position of the equipment.

A minimum of two 6mm polypropylene draw ropes shall be installed in each duct along its length. The ends of the ducts shall be sealed after they have been installed and prior to backfilling.

Where ducts are provided under roadways, hard paved areas or other permanent structures consideration shall be given to providing additional ducts for possible future use.

Where ducts are installed through the walls of a building they shall be fitted with a removable mechanical plug at the time of installation to prevent water ingress during construction.

All ducts shall be suitably sealed following cable installation using a permanent, flexible, removable waterproof seal. Ducts that are not in use shall remain sealed using a removable mechanical plug.

Ducts under access roads shall extend a minimum of 300mm beyond the road edges.

3.5.5. Site Surfacing

Surfacing within live compounds and general site areas within the substation boundary shall be to a minimum thickness of 300mm. This shall comprise an approved clean dressing layer of new single sized 20mm angular carboniferous limestone chippings 150mm thick. Laid and levelled onto a well compacted "DOT Type 1" crushed limestone sub-base. To provide a minimum bearing capacity of 75kN / m^2. Existing surfaces should have existing vegetation and topsoil removed, be well compacted and treated with an approved herbicide prior to laying any new sub base.

Where existing topsoil is thicker than 300mm, the additional topsoil thickness should also be removed prior to compacting and additional "DOT Type 1" crushed limestone" should be laid to make up the levels.

Replacement of an existing compound surface where alteration or refurbishment works are carried out shall be a minimum thickness of 225mm. The construction shall comprise of an approved clean dressing layer of new single sized 20mm angular carboniferous limestone chippings, 150mm thick, laid and levelled onto a well compacted "DOT Type 1" crushed limestone" sub-base. Existing surfaces should be well compacted to provide a minimum bearing capacity of 75kN / m^2. and treated with an approved herbicide prior to laying any new sub base. Other similar types of chippings may be suitable subject to approval by Northern Powergrid.

These landscaped areas shall be designed to be low maintenance and to avoid future problems with branches and roots affecting overhead lines and buried services.

Site surfacing around a substation building shall generally be 75mm thick layer of 20mm Angular carboniferous chippings on a weed inhibiting membrane on minimum 150mm DOT type-1 stone. A 50mm thick pre-cast edging shall be provided to retain chippings.

3.5.6. Access Roads

Access roads shall be designed for use by transformer delivery vehicles including suitable access from the adopted local authority highway

The design and construction of road and pavement crossings to existing public footways will have to be approved by the local authority, including completion of all notifications, fees and interfaces. Consideration should be given to sight lines and space required for turning into/out of the access road.

Roads shall be designed to ensure changes in levels and gradients are kept to a minimum to prevent grounding by low loaders.

Main access roads for transformers shall be a minimum of 4.5m wide and the minimum road width in all other areas shall be 3.5m. changes in direction shall be a straight line taken from the ends of an arc with a minimum internal radius of 6m. Roads shall generally be laid to falls and cross falls so as to shed water to the sides and prevent water ponding. The maximum gradient shall be less than 1 in 12 and changes in gradient shall be designed to prevent low loaders grounding. Where provided, kerbs shall be flush with the finished top surface to allow surface water run off onto adjacent permeable areas.

Allowance should also be made for the positioning of cranes used during transformer and equipment delivery.

A turning area for vehicles should be provided on site to permit vehicles to safely turn around prior to leaving the site. This can be accommodated in the parking area detailed below.

A parking area of minimum size 10m wide x 4m shall be provided. This may be of standard road construction or of a suitable hardstanding material designed to accept vehicle wheel loading.

Road construction shall be designed to suit the requirements of the prevailing ground conditions identified by the ground investigation survey. As a minimum the road construction should be of reinforced air entrained concrete, 200mm minimum thick with two layers of A252 reinforcing mesh, laid on 1200 gauge polyethylene membrane. Top surfaces shall have a tamped and brushed finish with steel trowelled

edges. Expansion and contraction joints shall be provided as required. The sub-base shall be of minimum thickness 200mm DOT Type 1 crushed limestone.

Alternatively asphalt concrete with hot rolled asphalt or stone mastic asphalt surface course construction may be adopted with a typical overall thickness of 215mm comprising 40mm thick surface course, 50mm thick binder course and 115mm thick base course. The sub-base shall be of minimum thickness 350mm DOT Type 1" crushed limestone. Surface courses shall not be laid until all other works are finished on site to prevent damage during equipment deliveries.

It is essential to ensure that all new cable ducts and other services which are required to be laid under the substation roads are in position and completed before construction of the access road commences.

3.5.7. Paving

Paved areas shall comprise 600x600x50mm (max) precast concrete natural finish paving slabs on a combined minimum 225mm overall thickness of sand-cement bed and compacted graded DOT Type 1 crushed limestone sub-base.

Unless enhanced construction is otherwise necessary for equipment installation/removal, buildings shall incorporate a minimum 1.2m wide paving to facilitate personnel access and egress between doorways, access steps, roadways, etc. Other doors or steps should have a simple concrete pad or area of paving slabs. All paths and pads shall have a non-slip finish and should direct any rainwater away from the building

3.6. Fencing

3.6.1. 2.4m High Security Steel Palisade Fencing

Steel palisade fencing shall be designed and installed to comply with BS1722 Part 12 (2006) Security Grade Palisade Fencing, except where shown on drawings **Y037S1101 Details of 2.4m High Security Steel Fencing.**

All parts of steelwork shall be hot dipped galvanised to BS EN ISO 1461 (2009) to a minimum mean coating thickness of 85µm after cutting, drilling, shaping, etc. and before assembly or riveting together. Any sharp edges caused by the galvanising process shall be carefully removed whilst maintaining the galvanised finish. Where a decorative finish is required i.e. powder coating, etc, this shall be in addition to the galvanizing process and a suitable etch primer will be used to ensure correct adhesion of the coating to the galvanised surface.

Palisade fencing shall be 2.4m high and shall comply with the details shown on the drawings. The 2.4m height is measured from the top of the continuous concrete kerb to the top of the fence pales, as shown on the drawings. Climbing aids must be avoided so locks, latches, bolts and signage must be designed and installed to prevent them providing a foot or handhold which could help to gain access over the fence.

Spacing of fence posts shall be 2.75m centre to centre for typical panels. If non-standard length fence panels are required at corners or adjacent gates, etc., then the rails must be pre-fabricated and galvanised. Cutting or drilling of galvanised rails is not permitted.

Posts shall be 2780mm long 102 x 44 x 7.4kg/m rolled galvanised steel joists with 180 x 76 x 8mm thick galvanised mild steel gusset plates welded on to receive top and bottom angle rails. Top and bottom rails shall be 65 x 50 x 6mm galvanised steel.

Pales shall be 2370mm long 'W' section corrugated cold formed mild steel security pales with a minimum face to view width of 70mm. Minimum thickness before galvanising shall be 3mm. Other types of pale shall not be used.

The maximum permitted spacing between adjacent pales, and also between pales and posts is 85mm.

Pale to rail fastenings shall be 8mm diameter carbon steel zinc finished C6L Huckbolt pins and collars, reference C6LW R10 8G with collars, reference 3LC 2R 10G.

Rail to post fastenings shall be 12mm diameter galvanised, grade 8.8 square neck round headed bolts with grade 8.8, permacone shear nuts.

The rivet ends and any small areas of damage to galvanised coatings shall be treated with zinc rich paint to provide a zinc coating equal in thickness to the original layer.

Additional proprietary anti-climbing measures such as anti-climb spinners shall be provided to the security palisade fencing where this presents 'internal corners' to the outside of the fence, adjoins buildings or other external fences, or where there exists a potential climbing aid within 2m (externally or internally) of the security palisade fence. The use of barbed or razor wire in these instances is not acceptable.

Non-standard fence panels shall be kept to the minimum.

Where slopes are present the preference is to ensure that an even gradient is achieved. The effective minimum fence height must be achieved on sloping sites and for steep slopes a higher than standard fence height may be required rather than stepping the fence and kerb.

3.6.2. Electric Fence

The fence shall be as shown on **drawing Y037S1119 Details of 2.4m High Security Steel Fencing with electric fence.** The system shall conform to **BS1722 Part 17 and BSEN 61011,** and shall comprise, but not be limited to, an energiser producing high voltage pulses at regular intervals of approx. 1.2 seconds feeding into a wire fence, controlled by a unit which will detect an abnormality in the pulse pattern and trigger an alarm. The voltage of the pulses shall be approx. 8000 volts, and each pulse should last approx. 0.00001 seconds, with a maximum energy of 2.5 joules, measured into a 500 ohm load.

The control unit shall be capable of detecting any tampering with the electric fence, including a short circuit and open circuit, and the control panel shall be self-monitoring and also have an internal tamper alarm.

The control unit shall be located within the substation building and have independent pulse and alarm LED indicators for each zone. All alarm outputs should be in the form of a normally closed dry contact in order to easily interface with any standard intruder alarm panel or CCTV system.

The electric fence shall consist of high tensile galvanised steel wires spaced at approx. 100 mm to form a grid, strung horizontally between mounting posts, strain posts and insulated support posts as necessary to form an impenetrable barrier. The wires shall be kept at a tension of approx. 20kg each by means of permanent tighteners. The posts of the electric fence shall be secured to and supported by the existing 2.4 metre galvanised metallic perimeter/compound fence, with the gap between the fences not less than 100mm and not more than 200mm. The contractor shall provide any additional bracing required and ensure that there is adequate mechanical support in the fencing structures to support the electric fence installation. A minimum spacing of 2 metres is required between the electric fence and any adjacent buildings or equipment.

The electric fence system shall extend above the perimeter fence and gates by at least 1000mm and shall take into account variations in the fence contour, including step changes. Where overhead power lines cross over the perimeter fence design assistance shall be sought from Northern Powergrid to ensure sufficient clearances can be maintained from the top of the electric fence to the overhead power conductors.

The electric fence installation shall also incorporate an anti-tamper system to detect inadvertent parting of the fence wires and in such event trigger the system into alarm mode. The anti-tamper system shall be applied across the full height of the electric fence. All components used shall be rated to match the tension and strains of the electric wires and made of suitable materials to be compatible with the other parts of the system.

The insulators used for the support posts should be constructed of UV resistant plastic material and be in the form of a ring and fitted with a water barrier. The minimum distance from the support wire to any metal surface should be 30mm.

All end and corner insulators should be constructed of UV resistant material. The live wire must not overlap any earth wire or hook and a water barrier shall separate the live from the earth side.

All high voltage connecting cables shall be of galvanised steel wire with a UV resistant solid high-density black polythene insulation.

At gate positions additional provisions shall be made to reduce the risk of touching live conductors whilst locking/unlocking main and personnel gates. These provisions can include added insulation, increased clearances and metal screening. These additional provisions shall be installed without compromising gate security.

All gates shall be fitted with a high voltage gate contact that will give an alarm when the gate is opened. Placing a short circuit across the system when a gate is opened shall not compromise the integrity of the rest of the security system. Gate contacts shall be installed where possible in the centre of the gate, but not at head height to prevent injury to staff.

Where gate contacts are fitted to the main substation leaf gates, normally used for vehicle access, then a horizontal sliding bolt shall be installed in the centre of the gates to prevent excessive gate movement and possible intermittent problems with gate contacts.

Wire mesh screening shall be provided between the perimeter fence and the electric fence in all areas close to public thoroughfares. The screening shall provide sufficient protection against inadvertent contact with live conductors by members of the public, especially children. The mesh screening shall be secured to the perimeter fencing in sections between vertical supports and the lower horizontal rail and shall not be allowed to come into contact with the electric fence wires. The mesh screening shall be a minimum of 1.8 metres in height for a new or existing perimeter fence, the area below the horizontal rail shall also contain a mesh screening infill. The mesh screening shall be manufactured from galvanised steel weld mesh or equivalent.

Where necessary to ensure continuity of a security barrier the sides and roof edge of perimeter buildings shall be protected by an electric fence at least 1metre wide/high, of similar construction to the main electric fence.

The electric fence energiser control unit shall be located (wherever possible) within close proximity to the substation building security control panel and shall be Set and Unset from the building security keypad.

Should it be found more convenient to locate the electric fence energiser some distance from the building security control panel, then the interconnecting signalling cable shall be of a PVC SWA construction and comply with the IST standard having 20 pairs of 0.8mm cross section.

Where the substation pedestrian gate forms part of the entry / exit route for the security alarm system, the substation security keypad shall only be located external to the substation buildings where the entry / exit route to a keypad located inside the substation building shall produce an excessive time delay (> 2 minutes). Otherwise the security keypad shall always be situated inside the buildings at the entrance to the substation control room.

Where an external security alarm keypad is to be installed it shall be located in a Stainless Steel IP rated vandal resistant weatherproof housing and have the facility to be locked with an Northern Powergrid padlock. An entry/ exit loudspeaker shall be located inside the security keypad housing. Provision should also be made to locate a safety isolation switch in the housing.

Red and Green lights, clearly visible from the main entrance gate, shall provide indication of the status of the electric fence. The lighting assembly shall be in a dual modular black housing, it shall also have a vandal resistant clear perspex cover to protect the lens against airgun or similar attack. Traffic light indicators shall be in the form of red and green LED clusters.

The entry/exit time delay for the electric fence shall be provided by the building security alarm system.

Signalling of the electric fence alarm activations will be via the (existing) building security control system.

Suitable highly visible warning signs conforming to BS EN ISO 7010 shall be attached to the fence at 10 metre spacings and shall be installed at a suitable height and in a position appropriate to the line of sight.

3.6.3. Continuous Concrete Kerb Foundations

A continuous concrete kerb refer to standard fence drawing for concrete kerb dimensions foundations shall be provided along the line of the fence. These are the minimum dimensions, and the actual kerb size shall be designed to suit the prevailing ground conditions. Expansion joints should be provided at max 12m centres with dowel bars and slip sleeves cast in. Preformed pockets at fence post locations to be cast in and grouted up with a smooth finish to exposed face after fence posts are fixed.

The nominal spacing between the bottom of the pales and the top of the concrete kerb should be 30mm. Both faces of the concrete kerb shall be vertical and shall be “fair face” shuttered for their full depth (casting against ground will not be permitted). All top edges shall be finished off with a 25 x 25mm chamfer. Top surfaces shall have a smooth steel trowelled finish.

Fence post pockets shall be formed in the concrete kerb and shall be 150 x 130 x 380mm deep. These shall be fully grouted up on completion of the fence. Non-standard fence panels shall be kept to the minimum.

Notice shall be given to the above design with respect to site-specific ground conditions, levels, topography, etc. and the foundation design increased accordingly to achieve the required structural performance.

3.7. Gates

Steel palisade gates shall be designed and installed to comply with BS1722 Part 12 (2006) Security Grade Palisade Fencing except where shown on the following drawings:

Y037S1110 - Details of Double Gate for 2.4m High Security Fencing.

Y037S1120 - Details of Double Gate for 2.4m high Security Fence with Electric Fence

Y037S1112 – Hanging Details of Double Gate for 2.4m High Security fencing.

Y037S1113 – Details of Single Gate for 2.4m High Security Fencing.

All parts of steelwork shall be hot dipped galvanised to BS EN ISO 1461 (2009) after cutting, drilling, shaping, etc. and before assembly or riveting together. Any sharp edges caused by the galvanising process shall be carefully removed whilst maintaining the galvanised finish. Where a decorative finish is required i.e. powder coating, etc., this shall be in addition to the galvanizing process.

Gates shall be 2.4m high and shall comply with the details shown on the drawings. The 2.4m height should be measured from the top of the adjacent continuous concrete kerb to the top of the gate pales, as shown on the drawings. Climbing aids must be avoided so locks, latches, hinges, bolts and signage must be designed and installed to prevent them providing a foot or handhold which could help to gain access over the gates.

Pales shall be ‘W’ section corrugated cold formed mild steel security pales with a minimum face to view width of 70mm. Minimum thickness before galvanizing should be 3mm. Other types of pale shall not to be used.

The maximum permitted spacing between adjacent pales, and also between pales and posts shall be 85mm. The maximum distance between the bottom of the pales and the top of the access road shall not exceed 70mm when the gate is in the closed position.

Gates shall comprise galvanised steel hollow section framework with galvanised steel gusset plates, slam plates, drop bolts, fittings, wicket gates and pales. Gates shall be of fully welded construction including welded fixing of pales.

Double gates shall be complete with a ground mounted drop bolt locating plate and foundation in the closed position and 2Nr ground mounted galvanised steel gate hooks and foundations in the open position.

Any small areas of damage to galvanised coatings should be treated with zinc rich paint to provide a zinc coating equal in thickness to the original layer.

Additional proprietary anti-climb measures shall be provided to gates where there exists a potential climbing aid within 2 m (externally or internally) of the security palisade fence. The use of barbed wire in these instances is not acceptable.

3.7.1. Concrete Foundations

Double gate post concrete foundations shall be a minimum 900mm thick and shall be designed to suit the relevant overall gate width. Gate post pockets shall be formed in the concrete foundations and shall be a minimum of 600mm deep. These shall be fully grouted up on completion of the gate installation. Notice shall be given to the above design with respect to site-specific ground conditions, levels, topography, etc. and the foundation design increased accordingly to achieve the required structural performance.

4. References

4.1. External Documentation

Reference	Title
BS 1722 - 17	Specification for electric security fence design
BS 7354	Design of high voltage open terminal stations
BS EN 1995-1-1	Design of timber structures
BS EN 1996	Design of masonry structures
BS EN 595	Timber structures test methods
BS EN 61936-1	Power installations exceeding 1 kV a.c. Common rules
BS EN ISO 1461:1999	Hot dip galvanized coatings on fabricated iron and steel articles.
BS PAS24 2007	Enhanced security performance requirements for door sets and windows in the UK
BS1203 WPB	Specification for synthetic resin adhesives for plywood
BS1722 Part 12	Security Grade Palisade Fencing
ESQCR	The Electricity Safety, Quality and Continuity Regulations (2006)
LPS 1175	Building Research Establishment Loss Prevention Standard

4.2. Internal Documentation

Reference	Title
IMP/001/012	Code of Practice for Flood Mitigation at Operational Premises
NPS/002/003	Technical specification for Protective Tile, Protective Tape and Cable Ducting
NPS/003/033	Technical Specification for Substation Support Structures
NSP/002	Policy for the Installation of Power Cables
NSP/007/005	Guidance on Substation Design: Electrical Design Clearances
NSP/007/018	Guidance on Primary Substation Design: Substation Locking and Labelling (in draft)
NSP/007/020	Guidance on Substation Design - Transformer Noise
NSP/007/022	Guidance on Substation Design Oil Containment
OPM	Northern Powergrid Operational Practice Manual

4.3. Amendments from Previous Version

Reference	Title
3.1	References added regarding electric security fence
3.1.10	Reference to ENA Recommendation S2/4 replaced with BS EN IEC 61936-1 (2021)
3.1.2	Reference to ground conditions added, requirement for a flood risk assessment
3.1.3	Reference added
3.1.8	Reference to ENA Recommendation S2/4 replaced with BS EN IEC 61936-1 (2021)
3.1.9	Reference to ENA Recommendation S2/4 replaced with BS EN IEC 61936-1 (2021)
3.2	British and EU standards referred to.
3.2.1	BS Reference updated
3.4	Note referring to back flow added.
3.5.5	Surfacing around buildings added
3.6.2	Electric fence spec added
3.6.3	Kerb dimensions referred to standard drawings
3.7	Reference Electric fence drawings
Document	Conversion to new CDS template.

5. Definitions

Reference	Title
n/a	n/a

6. Authority for Issue

6.1. CDS Assurance

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

		Date
Liz Beat	Governance Administrator	28/02/2024

6.2. Author

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

Review Period - This document should be reviewed within the following time period.

Standard CDS review of 3 years	Non Standard Review Period & Reason	
Yes	Period: n/a	Reason: n/a
Should this document be displayed on the Northern Powergrid external website?		Yes

		Date
Mark Thompson	Specification and Design Manager	25/07/2024

6.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Date
Ben Wilson	Substation Design Engineer	29/07/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Dave Sillito	Head of Major Projects	21/03/2024