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Code of Practice 351

Issue 5 January 2024

Civil Design Aspects of Primary Substations

Amendment Summary

ISSUE NO. DATE	DESCRIPTION
Issue 5 **January 2024**	Revision to Section 1: Remove reference to CP 74 Revision to Section 2: Remove reference to series of drawings. Revision to Section 3.1.4: Reference to CP998 added. Revision to Section 3.2: Remove reference to detailed drawings. Revision of Section 3.1.3: New section for Embodied Carbon Revision to Section 4.1: Changed title to Land Rights and Consents Revision to Section 4.2: Reference to articulated waggons for delivery removed. Revision to Section 4.3: Type of fence clarified. Revision to Section 5.1: Reference to EPD307 omitted. Revision to Section 5.2: Addition of pressure relief vents Revision to Section 5.8: Reference to ES366 Revision to Section 6.1: Oil Containment, risk-based approach. Revision to Section 7: Reference to ES400D5 Duct Seal Revision to Section 8: Fire Control. Revision to Section 8.3: Fire Extinguishers Revision to Section 8.4: Addition of Code of Practice Revision to Section 9.1: Addition of Code of Practice Revision to Section 9.4: Addition of Engineering Standard Revision to Section 9.5: Addition of Code of Practice Revision to Section 13.2: Addition of Engineering Standard Revision to Section 14: Amended references. Revision to Section 15: Additional Reference documents Revision to Appendix A. – Updated civil drawing. Prepared by: Kelvin Smith Approved by: Policy Approval Panel and signed on its behalf by Paul Turner, PAP Chairman

Contents

1 Scope

This Code of Practice covers the civil design aspects of primary substations in Electricity North West Limited. The document takes account of the requirements of the Electricity Safety, Quality and Continuity Regulations 2002.

The civil design aspects of Grid and BSP (Bulk Supply Point) substations is covered separately in CP355.

2 Introduction

This Code of Practice is intended to convey principles of the civil design criteria for incorporation in all primary substations.

A general arrangement drawing of a generic substation is appended to this Code of Practice to provide guidance to the preferred design when site conditions and electrical requirements permit.

It is not intended that this Code of Practice shall be retrospective in action in general but lays down an acceptable standard which shall be considered during any future replacement and refurbishment work.

Each construction project is specific: sometimes the work involves construction upon an operational site containing live equipment, with all the difficulties the site-specific operational requirements impose upon the construction process and sequence of work activities.

The designer shall always have due regard to simple value for money design objectives, constructing a substation that meets all current safety legislation and legal requirements, which is functional and fit for purpose with maximum security. In addition, action shall be taken regarding the impact upon third parties both environmentally and aesthetically. The completed design shall result in a building that:

(a) Meets the operational programme, with the appropriate impact upon the (complex) electrical network.

(b) Is low maintenance and has optimum lifespan.

(c) Meets the requirements “of "buildability", i.e., is easy to construct.

3 Substation Design

3.1 Design Criteria

From the Standards and Codes of Practice enforced upon the designer, the following design criteria shall be adopted:

3.1.1 Function

The primary function of a substation is to provide electricity to the local community in a safe, cost effective and environmentally friendly manner.

3.1.2 Environment

The substation shall provide a safe, clean, secure, and user-friendly environment for operatives and equipment.

Frequently, the substation will be sited adjacent to residential areas and must therefore be designed to minimise the effect on the visual and auditory amenity of the area, giving due consideration to legislation laid down by the Local Planning Authority. (Sound insulation etc).

3.1.3 Embodied Carbon

Designers should consider reducing the Embodied Carbon footprint on all projects, whilst considering all other factors of a suitable design, as outlined in this document. A calculation should be undertaken to assess the Embodied Carbon levels for all designs, in accordance with industry best practise and the RICS Professional Statement. The embodied carbon total for each design, should be expressed in terms of total kgCO2e. This is intended to assist with whole life carbon assessments and enhance consistency in outputs, in accordance with the guidance and methodology stipulated by EN 15978.

3.1.4 Legality

The substation design shall take full account of current legislation, including Health and Safety, Electricity Safety, Quality and Continuity Regulations, British Standards, Building Regulations, and accepted Codes of Practice currently in force.

3.1.5 Security

Site security is also imperative, to safeguard the building and its equipment from danger, theft and vandalism, and also to safeguard against unauthorised access to high voltage equipment. See CP998 Substation Security.

3.1.6 Site Restrictions

Where a substation is to be built within an existing operational site, due consideration shall be given to the potential hazards and risks associated with working on and around live operational equipment.

3.1.7 Life Span and Maintenance

A well-designed, good-quality value-for-money building, built in easily available, cost effective and environmentally sustainable safe materials will minimise the impact of COSHH requirements, help to minimise future maintenance requirements and ultimately optimise the life span of the building and its equipment (i.e., lifespan of building to match equipment - approximately 60 years).

3.1.8 Buildability & Programme

Where possible, the building design and materials used shall also take account of possible future expansion and upgrading of equipment. Considerable savings in the future will offset any additional costs associated with this forward planning.

3.1.9 Design

Whilst the design aspect should be done in accordance with the National Building Specification a design brief shall be issued detailing material, local authority and any third-party requirements for each substation.

3.1.10 Flood Protection

Where a proposed substation site is situated in a flood plain, the policy requirements of EPD355 shall be applied.

3.2 Current Substation Design

The drawing, within Appendix A, indicate typical layouts, elevations, and sections for a generic substation:

(a) 900190-00193: Typical Primary Layout

(b) In addition, a comprehensive specification is available) ES366 – Electrical Installations within Grid and Primary Substations.

Generally, the works comprise the combination of switch room and control room with a transformer bay(s) and security fencing. An access road, together with paved footpaths to pedestrian circulation areas and a general finish of limestone chippings externally. The design provides for small bore foul and surface water drainage, electrical and plumbing services.

The design in this example is not fixed but is an already proven low-cost standard solution. However, each project must be critically assessed to ensure the design is suitable and if necessary alternative construction techniques adopted (refer to Section 13).

The following sections provide an insight into the key elements of construction issues and parameters for consideration when designing a substation.

4 External Works

4.1 Land Rights and Consents

A substation site shall satisfy the following requirements:

(a) Provide sufficient space for the ultimate envisaged number, size and layout of plant and buildings.

(b) Provide adequate access for the largest indivisible loads envisaged, and adequate and safe personnel access and exit.

(c) Provide adequate space for the maximum envisaged number and size of overhead line and underground cable entries. Easements shall be negotiated via the Land Rights and Consents section.

(d) Shall be capable of complying with the detailed planning requirements of the Local Authority, including amenity aspects. At the same time, it shall not be so large, beyond the substation requirements, as to require expensive treatment of the unused portion of the land.

(e) Consideration shall be given to the environmental impact of developing each particular site.

4.2 Roadways

Construction shall be made to allow access for:

(a) Delivery, offloading and maintenance of transformers and switchgear should be taken into account when designing the layout of a substation. Co-ordination with haulage companies delivering transformers is recommended.

(b) Parking and turn around areas to be included for site staff vehicles.

4.3 Fencing

4.3.1 Application

Wherever possible the site shall be surrounded by fencing which presents a clear view of the enclosed space as a deterrent to unauthorised interference.

Where high voltage conductors are exposed in a substation, a security fence constructed to specification BS 1722, shall be installed.

Where a distribution substation is on the same site and is within the main security fence no additional security is required but fencing for demarcation purposes shall be installed.

Consideration shall be given to the use of removable panels in place of gates where access is only required for transit of fixed plant.

4.3.2 Amenity Fencing

Fencing provided to meet covenants or planning authorities' requirements shall:

(a) Be the minimum standard to meet those requirements, having due regard to maintenance costs,

(b) Provide minimum screening effects to discourage unauthorised interference, combined with reasonable resistance to vandalism. (Graffiti proof surfaces are preferable.)

In view of the varying requirements of planning authorities and the desirability of avoiding a clash of appearance with the surrounds no standard is set.

4.3.3 Security Fencing

The minimum acceptable specification shall be based on risk assessments of the proposed site in conjunction with CP998. Usually two alternatives are considered:

(a) Palisade security fencing.

(b) Weldmesh single skin 358 mesh.

Each site shall receive its own risk assessment during design to ascertain appropriate security fencing. This risk assessment shall be carried out in accordance with Appendix A of EPD301.

4.3.4 Gates

Entrance gates to access roads shall match the fencing.

Consideration for location of access and vision splays to Local Authority recommendations must be considered.

Gates to transformer compounds shall be positioned to provide convenient access for carrying out maintenance work, easy access shall be allowed from the parking area to the transformer tap changer.

4.3.5 Earthing

Fencing shall be earthed in accordance with Section 11 of this Code of Practice.

4.4 Drainage

(See also Section 6.1 regarding oil containment.)

Each substation site shall be considered on its own merits.

The selected site shall be thoroughly investigated to prove the presence of drains or otherwise.

Where drains exist, every effort shall be made to utilise same.

A system of land drainage may be installed adjacent to the building at an invert level below cable entry level and connected into the existing surface water drainage system.

In the absence of any form of drainage, or where existing drainage is unsuitable, the following courses shall be adopted:

(a) Surface water shall be collected into its own system and directed into a soakaway as far removed from buildings and structures, as the site will allow.

(b) Foul drainage shall be direct into a septic tank.

Where a site has a history of, or the potential for flooding, steps shall be taken to provide a system of land drainage. This drainage shall be gathered into a series of catch pits located within a French drain constructed on the perimeter of the site. The outfall from this drain shall be connected to either an existing surface water drainage system or a soakaway/convenient drainage ditch.

Reference shall also be made to the guidance contained in EPD355.

4.5 Transformer

Net transport weight of transformers can vary from 30t to 40 t. To cater for this load haulage vehicles of the articulated type up to 17.7m long are used, and access roads must be constructed accordingly. Co-ordination with the haulage companies is recommended.

Care shall be taken to ensure that the position of any overhead equipment near or over the access road does not impede the passage of the loaded haulage vehicle.

Consideration shall be made within the design to ensure plant and equipment can be installed in a safe and satisfactory manner. The designer is advised to seek advice from the plant manufacturer and installation company.

Transformer plinths are preferably sited alongside a road or temporary hardstanding. Where this is not possible the use of a crane should be considered. If this is not practical it may be necessary to provide permanent concrete skidways of sufficient bearing ability to carry the transformer in transit from the road to its plinth.

4.6 Switchgear

Delivery of switchgear may require off-loading, pulling, and landing platforms at the building entrance. Co-ordination with the electrical engineer to ascertain actual requirements is recommended.

4.7 Combined Services

Due to the extent of services located within a site, drainage, cables, earth mat, building services, multicores etc, it is imperative that the setting out of all underground services are co-ordinated and recorded as installed.

Where possible, services shall be routed away from areas that may be used for heavy equipment during the construction phase. If this is not possible suitable protection shall be provided.

5 Buildings

5.1 General

It is imperative that, before the plant and building layout is finally approved as a basis for detailed design work, agreement has been reached between the electrical design section on plant layouts, cable routes and overhead line supports inside the substation, and civil section on access roads, foundations, and structures.

Where possible the building volume shall be large enough to satisfy the requirements for internal arc relief. The designer is advised to seek advice from the plant manufacturer for the specific type of switchgear to be installed.

5.2 Walls

The general structures are normally brick/block cavity walls with approved rigid cavity insulation built in during construction, b other approved construction techniques can be considered. The design shall provide a robust barrier to withstand a disruptive failure from operational equipment, additional through wall vents will be required for flat roofed substations.

All internal walls must be suitable of supporting equipment up to a maximum weight of 100kg.

5.3 Roofs

The roof shall be of lightweight construction laid to a single cross fall with overhanging eaves to shed rainwater clear of the building. Gutters and drainpipes shall be provided and protected with an anti-climb guard.

A duo pitched roof may be used where the transformer compounds are not immediately adjacent to the combined switch room and control room.

In addition, flat roof construction can be used, although not preferred due to increased maintenance costs, unless used to house the transformers due to height restrictions. Pressure relief to be provided by through wall vents.

The soffit of the roof shall be protected with an approved fire-resistant material to provide a half-hour fire resistance. Access hatches must be incorporated to allow access to the roof void and to provide unrestricted pressure relief to the building in the event of a switchgear failure.

5.4 Doors

5.4.1 External Doors

The preferred construction shall be assessed to ensure that, as a minimum, all items within clause below are considered. Reference shall be made to ES326 for details on door construction.

External substation doors shall be constructed to provide a three-hour rating.

Reference shall be made to the following criteria:

(a) Escape from fire; provision of doors.

(b) Planning considerations (if applicable).

(c) Security of buildings.

(d) Emergency exit.

(e) Equipment installation

5.5 Floors

Full raised access floors shall be installed to all Control and battery rooms to facilitate bottom entry installation of all cabling.

All control panels and battery chargers must be supported on individual steel supports and must not bear onto the raised floor panels.

5.6 Thermal Insulation

Thermal insulation shall be incorporated to ensure minimum "U" values to satisfy current Building Regulation Approved Document Part L,

5.7 Toilets/Welfare

Toilet amenities are to comply with the current Health and Safety Welfare regulations.

Toilets are to be built into all new substations where this is practical, to be accessed from outside the building. Mess rooms shall not be provided.

5.8 Environmental Control

The air within a substation shall be maintained at a combination of temperature and humidity that will ensure that equipment is maintained with a suitable operating range of temperature without risk of condensation,

with the minimum overall capital and running cost combination. It is also necessary to avoid a build-up of flammable gas.

(a) Preferred minimum temperature, combined switch room and control room: 15°C.

(b) Operating relative humidity: 50%.

These conditions may be obtained by a combination of heating and dehumidification.

Refer to ES366 – Heating, Lighting and Small Power Installations in Grid & Primary Substations for details.

5.8.1 Transformer and Cooler within Confined Space

(a) When it is necessary to install both the transformer and cooler within a confined space, then the following calculations shall be completed and presented to the client for approval:

- Anticipated peak summer space temperature based on one transformer only operating under emergency conditions (i.e., 65 °C rise (maximum) above ambient).
- Anticipated peak winter space temperature based on one transformer only operating under emergency conditions (i.e., 65 °C rise (maximum) above ambient).

(b) Should the anticipated space temperature exceed the maximum design ambient temperature of the transformer, then supplementary ventilation shall be provided.

5.9 Water and Sewerage Supplies

For firefighting water supplies see Section 8.

Unless the cost is unacceptable a mains sewer connection shall be provided for domestic use (toilet and washing facilities).

If a new water supply is needed, contact the Accommodation Team/Energy Team for the correct new connections form. Details of the meter location and number need to be passed back to the Accommodation/Energy Team post installation for recording in internal databases.

New water meter points will Ideally be located outside the substation compound, however in the event of design constraints the meter may be located inside the substation compound when the installation of outside cannot be achieved.

5.10 Lighting – Internal

The internal lighting system shall be designed to provide illuminance levels appropriate to the tasks to be performed. Luminaires shall be located to take into account the operational and maintenance needs of the switchgear and other equipment. ES366 is the standard specification for heating and lighting installations.

5.11 Lighting – External

Where appropriate floodlighting shall be installed to external switchgear compounds. Fittings shall be positioned to enable ease of lamp replacement and to give a general illuminance to the compound to enable safe access and egress.

Selected luminaires shall have an appropriate degree of vandal resistance, taking account of the particular environment.

Care shall be taken when designing external lighting to minimise overspill to adjacent properties.

5.12 Electrical Installation – General

The incoming LV supply for auxiliary and essential services shall have an MPAN and fitted with an appropriate and fully accessible cut-out and meter board. Contact the Accommodation Team/Energy Team during late planning stages so they can arrange for our Meter Operator (MoP) to fit a settlement meter during the construction phase.

The installation shall be in accordance with ES366. 13 Amp socket outlets shall be positioned clear of all furniture or other fixed obstructions and shall be sufficient in number to suit the requirements of the particular site.

5.13 Furniture

Sufficient space must be allocated for operational engineer's workstation to include:

1 x desk
1 x chair
1 x 2 drawer filing cabinet.

6 Fixed Oil Plant

6.1 Oil Containment

6.1.1 Scope

The Control of Pollution (Oil Storage) England Regulations 2001 states that: “It is an offence to cause or knowingly permit the discharge of poisonous, noxious or polluting matter into relevant waters or into any underground strata.”

ENA Engineering Recommendation S39 states that all primary and supply point transformers shall be bunded.

Bearing in mind the statutory requirements, this section lays down the practical steps which shall be taken.

6.1.2 Principles of Oil Containment

An assessment of oil containment shall be made of all oil filled equipment, including the decommissioning of existing and delivery of new, particularly if there is the risk of oil leakage into the ground or added protection is needed for local water courses.

The principle is that all plant containing oil with a volume in excess of 250 litres be contained within a completely bunded area where practically possible.

6.1.3 Measures for Containment of Oil

A continuous bund wall shall surround the majority of oil filled equipment, even where this is not required for the prevention of spread of fire. The area within the bund wall shall be sealed by means of an impervious base set at such a depth as to provide a free volume - allowing for any chippings - equal to the capacity of the

largest tank – including any oil coolers – envisaged at this position minus 15% absorption into the limestone. The chippings to be used shall be 10/20mm grading. Entries shall be ducted from a point outside the bunded area to a point inside it; the ducts shall be cast into the walls of the bunded area, and all ducts shall be sealed with proprietary inflatable seals, and heat shrink seals if required by site conditions. Where a transformer is in a noise enclosure and the turrets and bushings pierce the enclosure roof, the roof drainage shall discharge inside the bunded area. The bund shall include a surface water drainage sump fitted with an oil discriminator pump to remove rainwater and prevent removal of oil from the bund. **Oil bunds adjacent to environmentally sensitive areas such as SSI sited, and watercourses shall be individually assessed.**

6.2 Drainage

Bunded areas shall drain to a sump provided within the bunded area. The sump shall be provided with automatic pumping with a control that differentiates between oil and water.

7 Prevention of Gas Accumulation (From External Sources)

All sites shall be assessed prior to construction for gases. All cable ducts shall be sealed with in accordance with ES 400D5. Ducts entering buildings below ground must be made discontinuous immediately outside and large openings may be reduced to a more convenient size with properly mortared brickwork and then sealed with the approved inflatable sealing kit.

In special high-risk situations where the site is adjacent to a landfill site or ground where methane gas is present, additional guidance shall be obtained.

Where a risk is known to exist and ventilation is restricted, a gas detection system shall be considered.

Where underground chambers allow entry of personnel, consideration shall be given to the installation of a permanent gas alarm.

Where the substation contains SF_6 filled equipment consideration shall be given to the fitting of an alarm in any enclosed space where the SF_6 may collect in the event of a leak.

8 Fire Control

This section details some of the design points to be considered to control the effects of fire. Each site, however, is to receive its own fire risk assessment in accordance with CP357 during design to ascertain appropriate measures, bearing in mind that the new substation may be located within a third-party site.

8.1 Segregation of Plant

8.1.1 Transformers

Engineering Recommendation ENA S39 gives guidance on separation distances and barriers. Where the distance defined in this document between the transformer and other essential equipment or buildings cannot be achieved, a fire separation barrier shall be constructed.

Each site shall be assessed to determine the extent of works required regarding fire separation.

The height of a fire separation wall shall be at least equal to the height of the transformer tank.

Where a transformer is in a noise enclosure, the enclosure walls and roof shall have a minimum fire resistance of 1 hour.

Firewall construction can vary depending on specific requirements from:

(a) Brick.

(b) Cladding.

(c) Concrete.

8.1.2 Switchgear

Indoor switchgear does not contain oil or compound filled cable boxes. Segregation by walls is not required. Outdoor switchgear shall comply with 8.1.1 above regarding clearance from transformers.

It may be advantageous to allow for the installation of temporary barriers to provide protection between sections when an Operational Instruction is imposed. This could be in the form of brackets, hooks, etc. set into walls and roofs to allow for the easy and quick installation of a temporary screen.

8.2 Escape from Fire; Provision of Doors

8.2.1 Door Types

Switch room and control room doors shall be of three-hour fire resistance and open outwards to assist escape.

Doors opening to a public footway should be avoided but where essential the approval of the local authority must be obtained.

On the inside of the buildings the panic door shall be painted green
BS 4800: 1989 colour ref 14.E.53 to contrast with the walls and be fitted with panic exit furniture, PUSH labels and overhead door stays.

It shall be possible to open these doors from outside the hazard chamber for rescue purposes.

8.2.2 Provision of Doors

8.2.2.1 Combined Switch Room and Control Room

A minimum of 2 doors to open air shall be provided at opposite ends of the building to allow emergency egress. For switchrooms over 20m in length there shall be 3No doors.

8.2.2.2 Access to Outdoor Compounds

Access to compounds shall be by independent gates through compound fencing.

8.2.2.3 Toilets

These should preferably have an external door not requiring transit of the substation.

8.2.2.4 Transformer Housings (enclosed spaces)

(a) These shall be treated as hazard chambers with a minimum of two exits required at diagonally opposite corners.

(b) On the inside of the housings the panic door shall be painted green BS 4800:1989 colour ref 14.E.53 to contrast with the walls and be fitted with panic exit furniture, PUSH labels and overhead door stays.

8.3 Fire Extinguishers

8.3.1 Portable Extinguishers

Portable extinguishers will not be provided in substations.

Fixed fire suppression systems shall only be installed at the request of a third party. In order to ascertain the correct gas to be used, reference shall be made to current legislation and to the Policy and Implementation Manager.

8.4 Hazard from Confined Spaces

Hazards due to confined spaces within cable tunnels, shafts, basements, or trenches shall be assessed. If such hazards may occur then guidance shall be sought and, where there is doubt, treated as confined spaces and reference made to CP905 for access and emergency procedures etc.

8.5 Fire Hydrants

When considering the risk of fire, the local fire officer shall be consulted for advice on the availability of local fire hydrants.

9 Security

9.1 General

This section details some of the design points to be considered to prevent unauthorised access, each site however is to receive its own specific security risk assessment during design to ascertain appropriate security. Reference shall be made to EPD301 and CP998 when assessing the security classification.

9.2 Fences

(a) All bolts shall be secured to prevent unauthorised removal.

(b) Gap at bottom, of fence between sections, between fence and gate, or between fence and a building must not exceed 75mm.

(c) Stays, braces, locks, bolts, notices, or any other fittings should not provide a foothold. If necessary, an extra pale may be fitted.

(d) Hinges shall be of a type that does not allow gates to be lifted off.

(e) Gate bolts shall shoot through a post (or mating leaf of a double gate) for padlocking without relying on a drop bolt.

(f) Where possible there shall be a clear space outside the fence of 2m, i.e., no trees, bushes, mounds, or any other aid to surmounting the fence. Allowance must be made for growth of trees. Rising ground outside the fence must be cut back 1.5m and then sloped. No lower fences or walls may be allowed to directly meet the security fence without a graduated height section paled both sides.

(g) No plant shall be positioned within 3.0m of a fence or boundary wall.

(h) The fence shall be no less than 1.85m in height, except where there are exposed conductors then the height must be 2.4m.

9.3 Buildings

Outward opening doors with hasp, staple and padlock give greater security and shall be specified.

- Emergency doors with locks operating on top and bottom shoot bolts give greater security (by not relying on accurate mating of the two leaves which may be affected by shrinkage).
- For security, all doors to have three-hour fire resistance.

It may be necessary to reinforce the inside of doors near locks to prevent forcing by a jemmy.

Downpipes shall be covered or provided with anti-climbing guards, especially so if live conductors are above or near the roof, or the building is in the run of security fence. Downpipes shall not be positioned near the point where a security fence meets a building.

Ventilators, if fitted, shall be robust and shall be baffled internally.

Dehumidifier ducts should preferably terminate inside the security fence. If not, they shall be securely cowled, and mesh screened.

Projecting courses of brickwork must not be provided.

Windows must not be provided.

Roof lights must not be provided.

9.4 Locks on Access

Reference should be made to CP606 Procedure S16 regarding padlocking of switchgear and tap change switches. Substation doors and gates shall be locked in accordance with EPD603 & ES309 Locks for Substations

Locks shall be:

(a) Profile cylinder type external to panic bolts or

(b) Shouldered cylinder type padlocks.

The normal access door shall be provided with means of securing from the inside to ensure security while work is in progress out of sight of the door. Such restraint shall not impede the emergency exit if the door forms part of an escape route.

9.5 Security Alarm

Security alarms shall be fitted to all property.

The security alarm shall be designed and installed to prevailing British and Industry Standards. (The building entrances only shall be protected.) The security alarm shall be installed by a member of NACOSS or SAIB (Security Alarms Inspection Board) and shall be registered on the list of the local police force. This is to ensure that the police will respond to the alarm.

Installation to be in accordance with ES366.

10 Noise

10.1 Introduction

All transformers generate noise, the principal component being a continuous tone of 100Hz. Other sources of noise are forced cooling fans. Where these are designed to run only on the loss of one transformer it is accepted that there may be some nuisance during emergency conditions.

The more irritating rattles due to loose nameplates, loose valve locking pins, tap changes, etc should be easily eliminated.

Noise can only be airborne, but it must be remembered that ground-borne vibrations may be re-radiated as noise by some other structure.

It is current practice to design substations without noise reducing housings for electrical plant.

Each site shall be designed using equipment to Electricity North West Limited specifications. Where required, assessment of noise levels to be expected at the site boundary shall be calculated. Where required by Local Authority planning assessment at other positions shall also be calculated. If further noise control is required, as specified by the Local Authority, provision shall be made for a noise reducing housing for the transformer.

10.2 Vibration

Under special circumstances it may be necessary to fit antivibration pads to distribution or auxiliary transformers, due to unduly close proximity to occupied premises or where specific ground conditions lead to transmission to some re-radiating object.

10.3 Noise Reducing Housings

If after a risk analysis a noise reducing housing is required, consideration must be made to its construction. Typical construction method being either traditional built brickwork or a proprietary prefabricated acoustic enclosure.

Consideration must be given for the possibility of future transformer housing within the design if deemed necessary.

11 Earthing

For the design, installation, testing and maintenance of earthing systems in substations, reference shall be made to the current regulations (EPD332, EPD333, CP332 and CP335).

12 Health and Safety

12.1 The Designer's Role in Health and Safety throughout the Project

All designers shall undertake their duties in accordance with current Health and Safety legislation, including:

(a) Ensuring that they are competent and adequately resources to address the health and safety issues likely to be involved in the design.

(b) Making clients aware of their duties.

(b) Giving due regard to health and safety in the design work.

(c) Providing adequate information about the health and safety risk of the design to those who need it.

(d) Co-ordinating their work with others to improve the way in which risks are managed and controlled.

12.2 Designer's Risk Assessment

Site specific hazard risk assessments must be completed for all elements of design and included as part of the CDM documentation. Any residual risks to be highlighted in drawings and designs.

13 Alternative Construction Techniques

Where appropriate, alternative construction techniques should be considered, in particular the switch room and control room could be constructed using alternative construction techniques.

13.1 Cladded Portal Frame Building

Replace the brickwork traditional superstructure with a simple steel portal frame with cladded roof and walls.

Disadvantages are lack of security; durability; resistance to fire; life span; and not being environmentally friendly from a planner's perspective in certain areas.

However, if the correct environment and design philosophy is satisfactory, a cladded portal frame could be considered.

13.2 Pre-fabricated Structures

These come in many forms but mainly glass reinforced plastic or steel fabric containers.

These would probably be unsuitable in most urban sites (unless dressed to suit), but on rural sites where access is suitable, these could be considered.

All aspects of design criteria shall be considered including local environmental and planning issues. In addition, the design must be value for money, with consideration to lifespan, minimum maintenance, and future ownership requirements.

See Engineering Standard ES302 – Packaged Housings for 6.6k V 11kV.and 33kV Switchgear.

14 Notices and Nameplates

The following table gives details on the type and the position of notices and nameplates at primary substations.

Schedule of Notices to be applied at Substations with Various Security Classifications

ESQCR Background Risk Classification See EPD301	Site With Exposed Conductors		Site With Security Fencing but No Exposed Conductors		No Security Fence	
	Statutory	Other	Statutory	Other	Statutory	Other
1	A1, B	A2, C*	A1, B	A2	A1, B*	A2
2	A1, B	A2, C*	A1, B	A2	A1, B*	A2
3	A1, B	A2	A1, B	A2	A1, B*	A2
4	A1, B	A2	A1, B	A2	A1, B*	A2

A1 Property plate adjacent to principal access. ES356 - Table 1, Item 1 and 1A

A2 Property plate adjacent to other access points and points of approach. ES356 - Table 1, Item 1 and .1A

B Safety sign “Danger of Death - Keep Out”. To be placed so that a notice is clearly visible from any position outside the perimeter fence. ES356 - Table 1.

C Safety sign “Danger of Death - Keep Off”. To be placed on equipment. ES356 - Table 1, Item 17.

No smoking sign, to be placed in all substations,ES356- Table 1, Item 60

* It may be more appropriate to use adhesive notices on doors or equipment

These signs, when fitted, shall not act as a climbing aid.

Refer to CP998.

15 Documents Referenced

DOCUMENTS REFERENCED	
Electricity Safety, Quality and Continuity Regulations 2002	
Environmental Act, 1995 (for matters relating to site contamination)	
Water Resources Act, 1991 (for matters relating to rivers, lakes etc)	
Control of Substances Hazardous to Health (COSHH) Regulations 2002	
Construction Design & Management Regulations 2015 (CDM)	
Engineering Recommendation. S39	Limitation of Fire Risk in Substations at 132kV and below
BS1722	Fences
BS 4800	Schedule of paint colours for building purposes
EPD301	Inspection & Maintenance of Electrical Plant and Substation security
EPD307	Plant Approved for Use in Electricity North West Limited
EPD332	Customer Installation Earthing
EPD333	Supply System Earthing
EPD355	Substation Flood Protection
EPD603	Substation Locking
CP332	400/230V Service supplies and Applications of PME
CP335	Earthing Design for 132kV, 33kV & 33/11/6.6kV Substations and Equipment
ES326	Substation Security Doors
ES356	Notices and Nameplates
ES366	Heating and Lighting Installations in Primary Substations
CP357	Fire Risk Assessments for Operational Sites
CP998	Security of Substations
CP905	Confined Space Entry

ES400D5	Cable seal
ES309	Locks for Substations
ES302	Packaged Housings for 6.6k V 11kV.and 33k V Switchgear

16 Keywords

Design; Earthing; Housing; Lighting; Noise; Substation; Switchgear; Transformer.

Appendix A