

Document Reference:-	NSP/007/001	Document Type:-	Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024	Page	1	of 13

NSP/007/001 – Guidance on Substation Design: Key Design Parameters

1. Purpose

This document lists the key parameters that shall be applied in the design of primary and supply point substations on the Northern Powergrid network.

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

Document Reference	Document Title	Version	Published Date
NSP/007/001	Guidance on Substation Design: Key Design Parameters	2.0	October 2017

2. Scope

This document applies to the design of all primary and supply point substations to be constructed for use on the Northern Powergrid network.

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024		Page	2	of	13

2.1. Table of Contents

1. Purpose	1
2. Scope	1
2.1. Table of Contents	2
3. Key Design Parameters	3
4. References	4
4.1. External Documentation	4
4.2. Internal Documentation	5
4.3. Amendments from Previous Version	6
5. Definitions	6
6. Authority for Issue	7
6.1. CDS Assurance	7
6.2. Author	7
6.3. Technical Assurance	7
6.4. Authorisation	7
Appendix 1 – Table of key design parameters	8

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024		Page	3	of	13

3. Key Design Parameters

CDM Regulations and the ESQC Regulations require that design is carried out in accordance with the hierarchy of risk control. Through this process designs should be produced that:

- Avoid risks to health and safety
- Comply with statutory environmental requirements
- Meet electrical and mechanical duty
- Allow operational and maintenance functions to be undertaken
- Maintain appropriate levels of system security

To achieve this, the design and planning process and the designer's risk assessment should take account of parameters applying to the different aspects of the design defined by:

- Statutory Regulations
- HSE Guidance notes
- National and International Standards
- Industry Standards
- Company Policy Documents, Codes of Practice, Specifications and Standards

To assist in this process Appendix 1 of this document contains a list of key design parameters that must be considered during the design process for primary and supply point substations undertaken on behalf of Northern Powergrid.

Document Reference:-	NSP/007/001	Document Type:-	Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024	Page	4	of 13

4. References

4.1. External Documentation

Reference	Title
Buildings	
BR 447	Building Research Establishment Building Report
British Standards	
BS 5228 - 1	Noise and vibration control on construction and open sites
BS 5395 - 3	Stairs, ladders and walkways (Part 3 - Code of practice for individual stairs, permanent ladders and walkways)
BS 6187	Code of Practice For Demolition
BS 7354	Open terminal substations
BS EN 61936-1	Power Installation exceeding 1kV AC
GBG 51	Building Research Establishment Good Building Guide
Health and Safety Executive Documents	
HSE ACOP L101	HSE ACOP L113
HSE ACOP L113	Lifting Operations and Equipment Regulations (LOLER)
HSE ACOP L122	The Pressure System Safety Regulations
HSE ACOP L23	Manual Handling Regulations
HSE G47	Avoidance of Danger from Underground Services
HSE GS6	Avoidance of Danger from Overhead Lines
HSE INDG 401	Working at height regulations: Industry Guide
Miscellaneous Regulations	
	The Control of Asbestos Regulations (2006)
	The Environmental Protection Act (1990)
	Regulatory Reform (Fire Safety) Order (2005)
CDM	Construction Design And Maintenance (2007) Regulations
CHSM	Construction Health and Safety Manual
COSHH	Control of Substances Hazardous to Health Regulations (2002)
ESQCR	The Electricity, Safety, Quality and Continuity Regulations (2006)
Engineering Recommendations	
E/R P2/6	Security of supply. (See also Eng. Tech Report ET 130 & 131)
E/R S2/4	Limitation of fire risk in substation at 132kV and below and in enclosed cable ways.
Statutory Instruments	
SI 2001 No 2954	Control of Pollution (Oil Storage) (England) Regulations (2001)
SI 2005 No 735	Working at Heights Regulations (2005)
SI 2005 No 5141	Regulatory Reform (Fire Safety) Order (2005)
Energy Networks Association Technical Specifications	(See also NPS documents covering ENATS specifications)
ENATS 41-24	Guidelines for the design installation, testing, and maintenance of main earthing systems in substations (See NPS 007 012)
ENATS 41-36	Distribution switchgear for service up to 36kV (Cable connected)
ENATS 41-37 Part 1	Switchgear for use on 66kV-132kV distribution system (Common terms)
ENATS 41-37 Part 2	GIS switchgear for use on 66kV-132kV distribution systems
ENATS 41-37 Part 3	Circuit breakers for use on 66kV - 132kV distribution systems
ENATS 41-37 Part 4	Disconnectors and earthing switches for use on 66kV - 132kV distribution networks.
ENATS 43 - 7	132kV Steel tower transmission lines

Document Reference:-	NSP/007/001	Document Type:-	Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024	Page	5	of 13

ENATS 43 – 8	Overhead line clearances
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4.2. Internal Documentation

Reference	Title
Distribution Network Standards	
DSS 002 122 (YE Legacy)	Guidance on Primary substation Construction – Assessment of Substation Sites for Transformer Noise Levels
DSS 015	Policy for Renewal of Outdoor HV Substations
DSS 031	Policy for Fire Mitigation at Operational Premises
Environmental Operational Control Procedures	
ENV/001/001	Management of Oil and SF6 containing assets
ENV/002/001	Management of Noise, Dust and Visual Impact
ENV/003/001	Management of Waste
ENV/006/001	Protection of Plants, Animals & Conservation
ENV/006/002	Network Design and Development
ENV/007/001	Environmental Incident Response
ENV/008/001	Management of Site Works & Contractors
Health and Safety Policy	
HAS/001	Occupational Health and Safety Management Manual
HAS/012	The Control of Asbestos
HAS/013	Confined Spaces and Excavations
HAS/014	Control of Substances
HAS/017	Fire and Explosion Prevention and Control
HAS/018	Dangerous Substances
HAS/024	Control of Noise at Work
HAS/028	Pressure Systems
HAS/033	Work Equipment and Lifting Equipment
HAS/034	Working at Height
Improve Network Documents	
IMP/001/012	CoP for Flood Mitigation at Operational Premises
IMP/001/909	CoP for Distribution System Parameters
IMP/001/911	CoP for Economic Development of the LV System
IMP/001/913	CoP for Economic Development of the EHV System
IMP/001/914	CoP for Economic Development of the 132kV System
IMP/002	Policy for Security Measures at Major Operational Sites
Investment Policy & Planning	
INV/001	Asset Management Policy
INV/002	Policy for Asset Information
Management of Network Assets	
MNT/002	Policy for Inspection and Maintenance of Underground Cable Systems
MNT/004	Policy for Inspection and Maintenance of Overhead Systems
MNT/005	Policy for Inspection and Maintenance of Ground Mounted Plant & Switchgear
Network Service Procedures	
NSP/004/011	Guidance on Overhead Line Clearances
NSP/007/005	Guidance on Substation Design: Electrical Design Clearance
NSP/007/010	Guidance on Substation Design: Fire Hazards and Precautions (in draft)
NSP/007/020	Guidance on Substation Design: Transformer Noise
NSP/007/026	Guidance on Substation Design: Confined Spaces
Procure Goods and Services	
PRC/200	Policy for the Review of Technical Specifications in Tender Documents

Document Reference:-	NSP/007/001	Document Type:-	Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024	Page	6	of 13

Safety Documents	(Refer to equivalent HAS documents)
SAF CONF 01	Confined Spaces Regulations (1997)
SAF CONS 05	Work at Heights Regulations (2005)
SAF COS 01	Control of Substances Hazardous to Health Regulations (2002)
SAF PRES 01	Pressure Systems, Safety Systems (2000)
Miscellaneous	
DSR	Distribution Safety Rules
NPS	Network Product Specifications
OPM	Operational Practice Manual

4.3. Amendments from Previous Version

Reference	Title
Document	Updated to CDS template. Information Classification added

5. Definitions

Reference	Title
n/a	

Document Reference:-	NSP/007/001	Document Type:-	Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024	Page	7	of 13

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	05/02/2024

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:	Reason:
Should this document be displayed on the Northern Powergrid external website?		Yes
		Date
David Johnson	Major Projects Specification & Engineer	16/05/2024

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
Mark Thompson	Major Projects Specification & Design Manager	01/05/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
David Sillito	Head of Major Projects	24/05/2024

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice			
Version:-	3.0	Date of Issue:-		May 2024	Page	8	of	13

Appendix 1 – Table of key design parameters

Design Issue	Aspect	Northern Powergrid Document	CDM Regulation	External Regulation
Site Selection	Existing water courses		4,5,6,11,18,35	GBG 51 BR 447
	Flood risk	IMP 001 012		
	Ground contamination	HAS 014	4,5,6,11,18,26	
	Geology		4,5,6,11,18,28	
	Third parties			
	Transport infrastructures			HSE GS6 HSE G47
	Services			
	Vegetation	ENV/006/001ENV/006/002		
	Vandalism	IMP 002 DSS 015		
Environment	Contamination risks	ENV/003/001ENV/006/002 ENV/001/001		CHSM Section 34
	Oil Containment	ENV/003/001		SI 2001 No 2954
	Noise (construction)	ENV/002/001HAS 024		BS 5228 Environmental Protection Act (1990)
	Noise (operation)	NSP 007 020		
	Dust	ENV/002/001		Control of Asbestos Regulations (2006)
	Archaeology	ENV/006/002		
	Flora and fauna	ENV/006/001		
	Special environmental sites	ENV/006/001		

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice			
Version:-	3.0	Date of Issue:-		May 2024	Page	9	of	13

Design Issue	Aspect	Northern Powergrid Document	CDM Regulation	External Regulation
	Asbestos	ENV/003/001HAS 012		Control of Asbestos Regulations (2006)
Equipment Selection	Ratings	IMP 001 909 IMP 001 913 IMP 001 914		
	Approvals	PRC 200 IMP 001 913 IMP 001 914		
	Indoor / outdoor	IMP 001 913 IMP 001 914		
	Height of operating position	SAF CONS 05		SI 2005 No 735
Site Layout	Access / egress (construction)	NSP 007 005 NSP 007 010	4,5,6,11,18,26,36,37,39,40,41	E/R S2/4 E/R P2/6 Eng. Tech Reports ET 130 & 131 Associated with E/R P2/6
	Access / egress (operation)			
	Over-sailing overhead lines		4,5,6,11,18,34	BS 7354
	Storage space		4,5,6,11,18,26	
	Welfare facilities		4,5,6,11,18,9(1)b,13(7),22(1)c	
	Parking facilities		4,5,6,11,18,26,36,37	Planning conditions
Structure Design / Construction	Integrity of existing structures		4,5,6,11,18,28	
	Integrity of existing buildings		4,5,6,11,18,28	
	Fragile materials		4,5,6,11,18,26	
	Failure modes and effects	INV 001 INV 002		
	Electro-mechanical loads			BS 7354

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice		
Version:-	3.0	Date of Issue:-		May 2024	Page	10	of 13

Design Issue	Aspect	Northern Powergrid Document	CDM Regulation	External Regulation
Working at Height	Hazardous materials	SAF COS 01		HSE INDG 401
	Existing plant and switchgear	HAS 034	4,5,6,11,18	
	New plant and switchgear	NPS Technical Specs		
	Existing building and ancillary equipment			
	New building and ancillary equipment			
Confined Spaces	Excavations	HAS 013 NSP 007 026 SAF CONF 01	4,5,6,11,18,31	HSE ACOP L101
	Basements			
	Cable tunnels			
	Pits			
	Sumps	SAF COS 01 HAS 013		
	Hazardous substances			
Access	Cable trenches	NSP 007 005 NSP 007 010 SAF CONF 01 HAS 013	4,5,6,11,18, 40	BS 5395 E/R S2/4 HSE ACOP L101
	Bunds			
	Pits			
	Basements			
	Plant and switchgear (installation)			
	Plant and switchgear (operation)			
	Plant and switchgear (maintenance)			
	Vehicle			
	Pedestrian			
Manual Handling	Selection of fixed building materials	HAS 024 HAS 033	4,5,6,11,18	HSE ACOP L23

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice			
Version:-	3.0	Date of Issue:-		May 2024	Page	11	of	13

Design Issue	Aspect	Northern Powergrid Document	CDM Regulation	External Regulation
	Selection of removable covers and panels			
	Support structures			
	HV electrical equipment			
	Ancillary electrical equipment			
	Impact on access design			
Cranes & Lifting equipment	Access for cranes and other plant			HSE ACOP L113
	Ground conditions			
	Lifting and handling plant (construction)		4,5,6,11,18,27,36,37	
	Lifting and handling plant (maintenance)			
Security	Unauthorised access (construction)	IMP 002	4,5,6,11,18,27	
	Unauthorised access (maintenance / operation)	IMP 002		
Fire Mitigation	Transformers	HAS 017 DSS 031		Regulatory Reform (Fire Safety) Order (2005) E/R S2/4
	Switchgear			
	Ancillary electrical equipment			
	Fire suppression equipment			
	Emergency exit routes, signs and lighting		4,5,6,11,18,40	
	Adjacent sites			
	Construction phase temporary heating		4,5,6,11,18,40,41	
	Storage of flammable materials and fuels		4,5,6,11,18,40,41	

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice			
Version:-	3.0	Date of Issue:-		May 2024	Page	12	of	13

Design Issue	Aspect	Northern Powergrid Document	CDM Regulation	External Regulation
	Hazardous substances	SAF COS 01		
Electrical Systems	Substation earthing design	NSP 007 012		ENATS 41-24
	Electrical clearance: access	NSP 007 005 DSR		BS 7354 E/R S2/4 E/R P2/6
	Electrical clearance: working			
	Electrical layout: construction			
	Electrical layout: operation			
	Electrical layout: maintenance			
	Overhead lines: clearance	NSP 004 011		ENATS 43-8
	Overhead lines: connection			ENATS 43-7
	Cables: access	OPM Section WC		
	Cables: connection			
	Cables Installation			
	HV electrical plant and mains: continuous ratings	IMP 001 909 IMP 001 913		ENATS 41-36 ENATS 41-37
	HV electrical plant and mains: Fault ratings	IMP 001 914 NPS Technical Specs		
	HV electrical plant and mains: Operation	DSR OPM		
	HV electrical plant and mains: maintenance	MNT 005		
	Protection and control; panels			
	Protection and control; cables			
	DC system	NSP 007 014		BS 7354
	LVAC system	NSP 007 013		BS 7354

Document Reference:-		NSP/007/001	Document Type:-		Code of Practice			
Version:-	3.0	Date of Issue:-	May 2024	Page	13	of	13	

Design Issue	Aspect	Northern Powergrid Document	CDM Regulation	External Regulation
Pressure Systems	Heating and lighting	NSP 007 011		
	Hazardous substances	SAF COS 01		
	Compressed air system	SAF PRES 01		Pressure System safety Regulations, ACOP L122
	SF6 (switchgear)	SAF PRES 01		
	Hydraulic (switchgear)			
	Nitrogen (cables)			
	Fire mitigation system			
	Other gases: construction			
Substation Maintenance	Documented procedures	MNT 002		ESQCR
	Plant records	MNT 004		
	Plant operation manuals	MNT 005		
	Mains records			
	Site health & safety file	HAS 037		
Demolition	Demolition survey	NSP 007 029	4,5,6,11,18,29	BS 6187 (2000)
	Hazardous substances	SAF COS 01		COSHH Regulations
	Asbestos	ENV/003/001HAS 012		Control of Asbestos Regulations (2006)