NSP/004/031 – Code of Practice for the Survey of Overhead Line Routes

1. Purpose

The purpose of this document is to provide a code of practice for the survey of EHV Overhead line routes located on the Northern Powergrid Distribution Network.

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

Document Reference	Document Title	Version	Published Date
NSP/004/031	Code of Practice for the Survey of Overhead Line Routes	1.1	July 2019

2. Scope

This code of practise covers the requirements for a ground line survey of the route of a proposed EHV overhead line route suitable for Wood Pole or Steel Tower lines using conventional terrestrial surveying techniques and the subsequent preparation and plotting of the associated profile drawings. This specification does not preclude the use of alternative airborne LIDAR surveying technologies for the data collection stage or a combination of both systems provided that similar accuracies and final output deliverables can be confirmed.

In addition this document also details the data collection element for the re-survey of existing overhead line routes to allow the maximum design rating of a line to be established.

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3. General

The Contractor's survey shall employ modern survey techniques such as electronic total stations (which record distance, slope and horizontal angles and convert them to co-ordinate values) satellite GPS positioning systems or Airborne LIDAR systems or a combination of all technologies to collect land profile data. This data shall be subsequently processed using CAD systems to develop line profiles that will confirm that either new proposed routes or re-surveyed existing routes fully comply with the Northern Powergrid code of practise *NSP/004/011 - "Guidance on Overhead Line Clearances".*

3.1. Accuracies

In the following Code of Practise, when accuracies or tolerances have been specified, they generally refer to vector errors and are defined statistically as root mean square errors (r.m.s.e.), or maximum tolerances. The r.m.s.e. is equivalent to a 67 % tolerance, and a 90 % tolerance is 1.65 times the r.m.s.e. when a representative sample of points is tested. The angular value for deviation angles should be given to a nominal accuracy of 1 in 4 000 (one minute of arc, two centigrade).

3.2. Survey Content

3.2.1. Width of Survey Swathe

The survey shall extend either side of the route centre line to include details beyond the conductors' alignments. The extent of the survey is shown in the table below, but may be curtailed due to the protrusion of an extensive obstruction into the swathe. Where airborne laser swath mapping systems (ALSM) are employed they shall provide a 100m (min) digital terrain map allowing the centre line of the selected route to be located anywhere within the surveyed corridor.

Nominal line voltage (kV)	Nominal Offset (m)	Standard (m)	Wide (m)
33/66	5	12	20
132	7	15	25

Reference should be made to the Project Specification for details of the survey width required. The nominal offset indicates the spacing of the profile lines to be generated on the final drawing.

3.2.2. Planimetric Information

The following general categories of detail shall be surveyed:

- Buildings/structures including temporary/mobile buildings.
- Visible boundary features: walls, fences, hedges.
- Roads, tracks, railways.
- Street furniture and surface markers for main underground services.
- Isolated trees/wooded areas.
- Water features.
- Earth works.
- Industrial features.
- Overhead cables and transmission lines.

In addition the visual nature of the ground, whether cultivated, woodland etc. shall be recorded.

Contractors shall also take cognizance of the situations detailed within the Northern Powergrid code of practice NSP/004/012 – "Guidance on the Risk Assessment of Overhead Lines" to try to avoid were practicable routes that unnecessarily create new or additional high risk sites which must then be mitigated against by Northern Powergrid.

3.2.3. Accuracy of Planimetric information

The accuracy of planimetric detail shall be such that the plan position of any well-defined point of detail shall be correct to within 300 mm r.m.s.e. when checked from the nearest permanent control station.

3.2.4. Height Information

Height information shall be surveyed to enable a digital terrain model to be constructed. Sufficient levels shall be surveyed such that the ground configuration, including all discontinuities greater than 300 mm, is represented in the model and on subsequently generated sections.

3.2.5. Spot Heights

The maximum distance between adjacent spot levels along the line of the route shall be 50 m, with a median distance not exceeding 30 m. across the swathe the spacing shall not exceed 1.5 times the nominal offset. Ground survey spot levels on hard surfaces shall be correct to ± 30 mm r.m.s.e. and on soft surfaces to ± 100 mm r.m.s.e. Levels to ditches and watercourse bed levels may be taken to a lower accuracy.

3.2.6. Obstruction Heights

Features rising above the general ground level shall have indicative heights recorded to enable their inclusion in the terrain model. In the case of buildings and other tall obstructions the heights shall be recorded to the same accuracy as spot heights. Any such buildings and other obstructions, which are positioned up to 15 m outside the swathe width, shall also be surveyed. For buildings the limit of land ownership adjacent to the swathe shall be surveyed, where such boundaries are obvious.

Any power line passing within 50 m of the centre of the swathe shall be surveyed. When an existing line crosses the swathe then the support points to either side shall be located.

3.3. Survey Control

3.3.1. General

For all surveys there is a requirement to place permanent control stations that will enable future surveys to be related to the work being undertaken under this project. The survey should also be related to the National Survey Grid so that existing mapping can be used in conjunction with the new survey.

3.3.2. Control Network

The Contractor shall ensure the following requirements are satisfied:-

a) Establish plan controls at a density sufficient to achieve the specified accuracies.

b) In all cases control stations shall be positioned such that at least two (2) reference points can be sighted.

c) The control network shall be sufficient to enable the complete survey to be co-ordinated accurately onto a single grid system.

3.3.3. Permanent Survey Control Stations

The main survey stations shall be of stable construction. In all cases the markers used, shall be of a type suitable to remain in position for at least five (5) years after completion of the survey.

3.3.4. Temporary Ground Markers

Pegs placed to mark the route line or support positions and intended for use as markers for construction alignments shall be of treated timber which has, in addition, been painted to provide a sealed gloss surface. All pegs must be driven flush to the ground, or 50 mm below ground in areas where livestock are likely to be present. The pegs should be cut from timber 50 mm × 50 mm in cross section. Where LIDAR

survey techniques are employed instead of terrestrial survey, a series of GPS points and tie-in sketches to permanent features shall be provided to allow these points to be subsequently re-established on the ground.

3.3.5. Survey Grid

Each section of the survey shall be based upon the centre line of the route, with zero chainage at the centre of the lower numbered support position. The route centre of each support is defined as the mid position between the lower crossarm attachment points, or the equivalent theoretical position in the case of a single circuit support. In the case of angle supports with asymmetric arms the support may be offset such that the support centre point and route centre line will not coincide, but will be separated by a known distance. Correspondingly, the centre line of the route is always central to the conductors on a double circuit route.

At each angle support National Survey Grid co-ordinates shall be supplied for the support centre position to accuracy sufficient to enable the support position to be plotted upon the largest scale national mapping available.

3.3.6. Accuracy of Permanent Survey Control Stations

The maximum error between adjacent permanent survey control stations or their reference points shall not exceed 1 part in 20 000.

3.3.7. Height Control

Height Control may be established by levelling, trigonometrical heighting, or by Satellite Positioning observations. The Contractor must clearly demonstrate that the chosen method has achieved the required accuracy.

3.3.8. Level Network

The Contractor shall establish vertical control at a density sufficient to achieve the specified accuracies.

3.3.9. Level Datum

All levels shall be related to the National Datum checking the selected datum benchmark against at least one other existing benchmark. Bench marks adjacent to the route should all be checked where possible and be used to adjust the height control when appropriate.

3.3.10. Accuracy

The height difference between any two (2) points used as permanent bench marks shall not be in error by more than ± 12 × k mm, where k is the square root of the distance in kilometres between the points being considered.

3.4. Calibration

3.4.1. General

The Contractor is required to demonstrate that the equipment used for the survey is in correct adjustment and consistently accurate.

Electronic instruments are placed in two categories, total stations and satellite positioning systems.

Total stations / EDM

All electronic measuring instruments used for surveying control or for conductor observations shall have been calibrated within the previous twelve (12) months over distances equivalent to those to be observed in the field, such calibration being traceable to the National Standard. A copy of the calibration certificate must be supplied prior to commencement of the work.

If the calibration has been by comparison with a certified instrument then the calibration must have been effected within the past year. Check adjustments should be carried out in accordance with the manufacturer's instructions upon arrival on site and prior to commencing survey work.

Satellite Positioning Systems

Each pair of satellite positioning system instruments shall be checked over a short level baseline not exceeding 5m, immediately before and after each survey.

Optical measuring Instruments

All optical measuring instruments used for surveying control or for conductor observations shall be adjusted in accordance with the manufacturer's instructions upon arrival on site and prior to commencing survey work. Where significant adjustment is required then subsequent checks shall be carried out to ensure that the instrument remains in good adjustment.

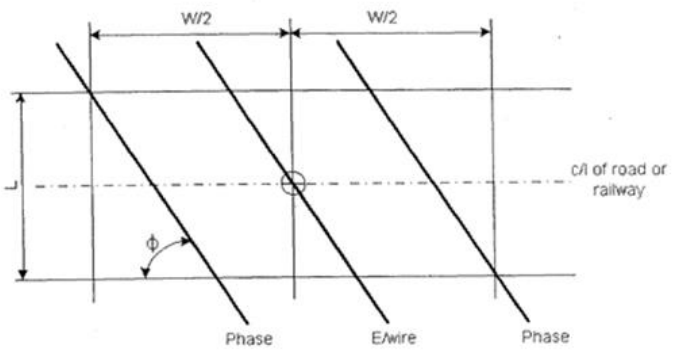
3.5. Three – dimensional ground survey

A detailed three-dimensional ground survey shall be carried out at motorway, major road and railway crossings to enable the positions for skycradles and/or scaffolding to be established. The survey shall cover a width determined by clause 3.2.1 or the following formula whichever is greater:

$$W = 40 + 17/\sin\phi + L / \tan\phi$$

where

W = Width of survey (m)
L = Length of crossing (m)
ϕ = Angle of crossing (degrees)



3.6. Graphical Data

3.6.1. General

This part of the Specification covers requirements for the graphical representation of the ground line and subsequent plotting of the supports and conductor and is applicable irrespective of method of obtaining the data.

3.6.2. Style of drawing

Drawings produced shall be to a consistent style and all the features specified shall be presented on the final plan or data set to a neat and legible standard.

a) Drawings shall be to scale, fully detailed in Metric Units.

b) All drawings shall be produced on a CAD (Computer assisted drafting) system in both a 3D and 2D format with files saved in a suitable file format for future viewing and manipulation by Northern Powergrid in the Optimal Software POLECAD or TowerCAD systems operating within a Microstation CAD system.

c) The final drawings shall be produced at a scale of 1: 200 vertically and 1: 2 000 horizontally.

d) The scale or scales used shall be stated on the drawing as a ratio together with a linear scale(s) at a convenient position along the margin of the original drawing sheet.

e) The physical draughting requirements in respect of line density, strength, contrast, spacing and character legibility shall be met to ensure drawings are suitable for conversion into PDF. To ensure a graphical consistency of the features recorded within the drawings Northern Powergrid will provide a copy of the existing PGINF.dtb file or agreed the content of a contractor supplied file that details the graphical representation of observed features within the CAD environment (e.g. in terms of layering convention, pen sizes, fonts, colours, line strings etc.).

f) All drawings shall bear in the bottom right-hand corner a title block in English. The system of numbering and layout of the title block shall be to the approval of the Engineer.

g) Unless stated to the contrary in the Project Specification, the title block shall include the following information:

- Name of Client
- Name of Contractor
- Site and/or route details
- Voltage
- Circuit Details
- Support Nos. and Route ID
- The contractor's contract number
- Title of drawing
- The contractor's drawing number
- Sheet size
- Current Revision number
- The client's drawing number

h) Adjacent to the title block shall be the revision details including the nature of each revision, author and date with provision for and inclusion of the Contractor's QA 'Checked' and 'Approved' signatures and dates.

3.6.3. Profile drawings – General

Included on each profile should be a suitable table or tables giving details of the phase conductor and earthwire used together with their design bases, Fixed or equivalent, Maximum operating design temperature, survey details, survey dates and standards used.

Northern Powergrid will provide contractors with CAD cell libraries of all current EHV overhead line design standards necessary to populate the overhead line profile.

Specification Reference	Specification Description & Operating Voltage
NSP/004/042	11-33kV single pole construction to ENA TS 43-40
CE/C/37 - OHL4 Portal	33-66kV Portal H construction
NSP/004/045	33-132kV single and Rutter pole construction
NSP/004/030 (L4M & L7M and L3)	66, 132 & 275kV DC Tower lines -

3.6.4. Profile Drawings – Size and Scales

The profile shall be created with the direction of the line route left to right on the profile sheet, i.e. from low numbers to high numbers. In general, individual profile sheets/CAD drawings shall commence and finish at tension supports but where this is not practicable and continuation sheets are found to be necessary the ground line is drawn so that there is an overlap of at least one span length between adjacent sheets. The chainage of each section between tension supports shall start at zero, be on a 50 mm printed grid line and not less than 150 mm from the left-hand margin. Generally there shall be a right-hand margin of approximately 150 mm when continuation sheets are used. Each section shall normally be started on a new sheet. The date of the survey of each section shall be added.

If more than one section is drawn on one sheet, a gap shall be left in the ground line of not less than 150mm.

The grid shall be plotted to an accuracy of ± 0.2 mm r.m.s.e. and shall consist of 5 mm × 5 mm crosses depicting chainages at 50 m and heights at 10 m multiples.

3.6.5. Profile Drawings - Detail

The following details and information are to be included on each profile drawing:

a) At each angle position a 'tie-in' sketch shall be provided on the profile sheet. This sketch shall clearly show the location of the support using as reference, where possible, permanent and unambiguous points which can be located both on the ground and on the 1: 10 000 or closest available scale of survey map. Where these points are not shown on the largest scale national mapping available, then additional indicative distances shall be given to such features.

b) The direction of the line and angle of deviation shall be shown stating also whether the deviation is left or right. Where reliable maps of reasonable scale and accuracy are not available for locating and plotting support positions, survey methods acceptable to the Engineer shall be employed to establish grid co-ordinates with supports and ground features being related to these.

c) Profiles shall be plotted for the section centre line and for left and right offsets at the spacings given in clause 3.2.1. Where the offset profile levels differ from the centre line levels by less than 0.5 mm at plotting scales then only the centre line need be plotted. Where the slope breaks upward beyond this, offset distance levels will be recorded up to a specific horizontal offset distance.

d) Left and right offset profiles shall be clearly distinguishable from each other, using a dashed line for left and a chain line for right offsets.

e) The profile shall show all changes of level 300 mm or more along the route centre line and along the offset lines. All features such as hedges, fences, graves, ditches, roads, railways, rivers, buildings, canals, telephone and railway lines and all power lines shall be shown with their correct heights plotted. Features that cross the section line shall be shown on left and right profiles as appropriate, with their height continuously indicated within the extent of the feature. Major construction features such as bridges may require a separate profile in similar format to the power line crossing profile in order to be depicted with sufficient clarity.

f) Plans at 1: 500 scale shall be provided on separate drawings for crossings of motorways, major roads and railways.

g) When numerous power line crossings occur and there is inadequate space on the main profile sheets then a series of separate sheets shall be provided, each showing one crossing. If this method of presentation is adopted then all power line crossings should be shown in this manner, the main profile showing only the support structures and centre line conductor height.

h) Each section profile shall be plotted with chainage commencing with zero at the lower number angle position. Chainages and levels shall be given to the centre of all principal features along the profile and at reference pegs placed on the centre line. Where few features exist then

additional chainage values shall be shown at about 200 m intervals. Left and right level values shall be given for principal features where such values differ significantly from the centre line value.

i) The specified Datum shall be the basis for all levels and the level above the specified Datum shall be shown at 10 m vertical intervals at the beginning and the end of each profile sheet. When more than one section is drawn on one sheet the Datum scale shall also be included in the gap between ground lines. Levels shall be shown at each peg on line and at every obstruction or geographical feature.

j) The visual nature of the ground shall be noted and named to match the agreed feature library, whether cultivated, woodlands, etc. with special reference to marsh, soft ground or rock and other relevant information such as soil instability. Land usage shall be marked along the full length of the profile.

k) All buildings, high obstructions or other features within 30 m of the centre line shall be shown dotted at their measured height with the distance left or right of line indicated.

l) Where the ground contour rises to a point, which would be less than 100 mm from the top of the profile sheet, the ground line shall be terminated and then continued on the same sheet with a new Datum. An overlap of at least one span length of line route should be shown without leaving any break in the chainage. Adequate room should be allowed for plotting both support position and lowest conductor.

m) Above the main profile a further profile shall be plotted covering the crossing of a power line. The following detail shall be shown for crossings of power lines.

   i. Voltage and type of construction

   ii. Ground levels at the point of crossing, support structures and the periphery of the route swathe

   iii. Height of top (bottom) phase conductor and earth wire (if appropriate) at the point of crossing, at the attachment points on the support and at the periphery of the route swathe

   iv. Distance from the crossing point to support structures along the route of line to be crossed if more than one support if the crossing point is close to a support

   v. Angle of crossing

   vi. Air temperature at time levels were taken (state date and time)

   vii. Support structure numbers

n) If required by the Project Specification, a route swathe plan shall be drawn along the bottom of the profile sheet. The plan shall be to the same scale as the horizontal scale of the profile, showing all relevant details within a distance of 30 m each side of the route centre line. All items covered by sub clauses (a) to (m) above, as appropriate, shall be included. Topographical features, such as banks, etc. shall be shown dashed whilst features which form potential obstructions, roads and railways shall be shown in solid lines. The angle of deviation at the end of each section shall be shown by a heavy solid line correctly plotted with the value stated.

3.6.6. Identification of Pole Positions

If intermediate support positions have been indicated on the agreed route plans then each support position can be pegged as the line is set out. Where final support positions have not been fully approved, then the route shall be established by a series of "line pegs" normally set in hedges or fences where they are least likely to be disturbed. This enables the line to be retained until such time as final wayleaves are negotiated when the actual support positions can be pegged and "line pegs" removed.

Angle and terminal positions should be tied in to permanent features so that a tie-in sketch can be drawn and the support position can be re-established if the peg is lost.

When installing pegs, a 250 mm square x 50 mm deep of turf should be removed and the peg driven into the ground so that the top of the peg is 50 mm below ground level - this will increase the visibility of the peg at a later date and reduce the risk of damage to farm machinery and stock. Pegs are used to mark support positions as follows:-

- A single peg, in line, to mark intermediate support positions
- A single peg, across the line, for a line peg
- Two pegs, side by side across the line, to mark terminal pole positions
- Two pegs, edge to edge with the longer sides pointing approximately along the two directions of the line, to mark angle pole positions

3.7. Supporting Documentation to be Provided

3.7.1. Co-ordinate Schedule

A schedule shall be supplied showing the National Survey Grid co-ordinates of each support position (including intermediate supports). In addition at angle support positions, the section lengths and deviation angles calculated from these co-ordinates after correction for any conductor offsets, together with the actual measured section lengths and deviation angles. In addition the schedule Supports shall be listed indicating the surveyed information and including comment on any anomalies relating to the observed geometry of the supports or the conductor alignments.

3.7.2. Line Schedule

A line schedule shall be supplied giving as a minimum the following information;

- Support number
- Support type
- Angles of line deviation
- Numbers of stays required on stayed supports
- Span lengths
- Equivalent span
- Section length
- Distance in metres from the preceding tension support
- Setting level of the support
- In span crossings
- Details of the foundations, orientation of hillside leg extension, types and quantities of insulator sets, conductor fittings etc.

All schedules shall be provided in either an excel or pdf file format

3.7.3. Route Maps

The Contractor shall record on a set of the latest issue of Ordnance Survey Maps of approved scale such particulars as will allow an accurate reference to be made of the line route and support locations.

The map shall show the exact position of each support with approved reference marks. The maps shall be supplemented, unless the profile route swathe plans are marked by sketches where necessary to

delineate boundary positions of supports which cannot be clearly indicated on the maps. Support number, including route identification codes, shall be added adjacent to each support including a note indicating if fibre optic joint box is mounted upon it.

When any map has a substation located upon it, this should be shown accurately and its name / voltage added. When any line reaches the edge of any map sheet, then the name and direction of the next substation along the line should be shown.

3.8. Additional Information Required when Re-surveying Existing Overhead Lines

3.8.1. Overhead Line Supports

For existing lines and supports, the following data is required for each support position, and confirmation made of measured dimensions against the design information of that support type held on the line schedule and appropriate support dimensions:

- All top of stub (TOS) or base plate levels – Steel supports
- The height and location of the top of support(s) relative to support centre peg (If applicable).
- The location and height of the insulator set attachment point on the underside of bottom cross arm (If applicable).
- The height and location of the conductor at the insulator set attachment point.
- The height and location of the earthwire attachment point.
- Both circuits shall be surveyed (If applicable).
- Levels shall also be taken sufficient and appropriate to allow checking of the verticality for each support on the route.
- Where displacement of the support peak has occurred, measurement should be made of this in each of two right-angle faces of the support (transverse and longitudinal to the line). Where the resultant displacement exceeds 0.7° from the vertical, further measurements should be taken as per appendix A.
- Digital photographs should be taken of the support in each of two right-angle faces (transverse and longitudinal to the line).
- Orientation of all concrete chimney and steel leg extensions.

3.8.1.1. For Lattice Supports

Notes should be made of and supporting digital photographs produced for any distorted bracings apparent on the support. If the TOS or base plate is not visible, the level of the first full horizontal plan bracing between support and legs should be recorded. The bracing erection bar reference should be noted. If bar references are not visible, a photographic record should be made of the bracing measured to allow identification against a General Arrangement Drawing of the support concerned.

3.8.1.2. Section Length

The overall length of any section shall be accurate to the lesser of 0.5m or 1: 2 000. Individual span lengths shall be accurate to better than 0.2m.

3.8.1.3. Support Levels

Support levels shall be accurate to ± 30 mm r.m.s.e. when levelled from the nearest permanent control station.

3.8.2. Survey of Catenaries

3.8.2.1. Conductor Information

A minimum of three survey measurements are required, in each span, in order to accurately plot the catenary adopted by the lowest conductor in each circuit. Additional measurements shall also be taken for all line crossing points in a similar way below the crossing span to similarly allowing the crossing span conductor to be plotted. In such situations the highest conductor and/or the earthwire of the lowest line and the lowest conductor of the highest line will require measurements to be recorded.

3.8.2.2. Observations Required

Observations shall be taken to include the lowest point and positions close to the quarter span points. Where the lowest point is significantly displaced from the centre of the span then a further observation shall be taken close to the central position. Additional observation points shall always be recorded at all road and rail crossings.

3.8.2.3. Observational Accuracy

The observations recorded shall be sufficiently accurate to form a smooth mathematical curve between the conductors' attachment points. Where visual inspection indicates an erroneous observation, a further set of observations may be required. The observational method must not rely upon visual alignment of a target under the conductors.

With each sag measurement, the following data shall be recorded:

- Date and time of measurement;
- Ambient temperature;
- Direction and speed of the wind at 2 m above ground level;
- A general note of weather conditions.

4. References

4.1. External Documentation

Reference	Title
None	

4.2. Internal Documentation

Reference	Title
NSP/004/011	Guidance on Overhead Line Clearances
NSP/004/012	Guidance on the Risk Assessment of Overhead Lines
NSP/004/042	Specification for HV Wood Pole Lines up to and including 33kV
NSP/004/045	Code of Practice for EHV Wood Pole Lines operating up to 132kV with span lengths up to 220m
NSP/004/030	Specification for the construction and refurbishment of 33-132kV tower lines
O311 - OHL4	66kV single and H Portal construction

4.3. Amendments from Previous Version

Reference	Title
Whole Document	Document reviewed no changes required – Paul McAdoo 03/10/2023 Doc approved by email Paul Black 05/10/2023 Doc republished to grid and externally - LB 07/11/2023

5. Definitions

Reference	Title
ALSM	Airborne Laser Swath Mapping systems
Datum	A spot height may be expressed as AOD for "above ordnance datum". Usually mean sea level (MSL) is used for the datum
EDM	Electronic Distance Measurement instruments
GPS	Global Positioning System
LIDAR	LIDAR is a surveying technology that measures distance by illuminating a target with a laser light.
Planimetric	Planimetric elements in geography are those features that are independent of elevation, such as roads, building footprints, and rivers and lakes
RMSE	The root-mean-square error (RMSE) is a frequently used measure of the differences between values (sample and population values) predicted by a model or an estimator and the values actually observed.
TOS	Top of Stub

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	07/11/2023

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
Ged Hammel	Senior Policy and Standards Engineer	27/06/2016

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.

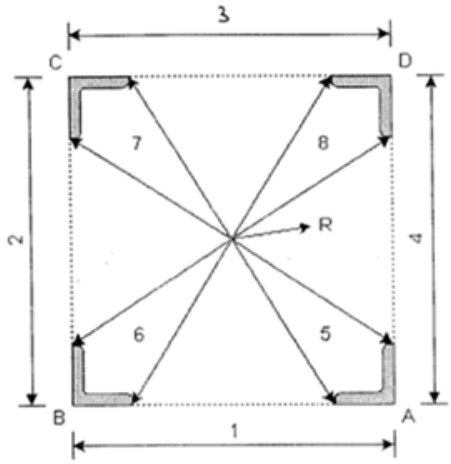
		Date
Paul McAdoo	Lead Policy and Standards Engineer	03/10/2023

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Paul Black	Head of System Engineering	05/10/2023

Appendix 1 – Verticality Check



Verticality Check

Verticality Measurement							
Date	Amount of lean	Direction towards	Amount of lean	Direction towards	Resultant R	Direction towards	Remarks

Square of Diagonal measurements									
Date	1	2	3	4	5	6	7	8	Remarks