

LASER SCAN TO REVIT MODELLING STANDARDS - EXISTING CONDITIONS FOR ELECTRICITY TRANSMISSION SITES

This document is for internal and contract specific use only.

Disclaimer

NGG and NGET or their agents, servants or contractors do not accept any liability for any losses arising under or in connection with this information. This limit on liability applies to all and any claims in contract, tort (including negligence), misrepresentation (excluding fraudulent misrepresentation), breach of statutory duty or otherwise. This limit on liability does not exclude or restrict liability where prohibited by the law nor does it supersede the express terms of any related agreements."

TABLE OF CONTENTS

PURPOSE AND SCOPE	1
PART 1 –PROCEDURAL	1
1 INTRODUCTION	1
2 MODEL LIMITATIONS	2
3 SOFTWARE & DELIVERABLES	2
4 MODEL EXECUTION	3
5 CATEGORY DETAIL LEVELS	7
6 EXISTING CONDITIONS BIM MODELLING BRIEF	20
7 IN –PLACE FAMILY CONVERSION	23
8 QUALITY CHECKLISTS & REPORTS	28
9 FORMS AND RECORDS	31
PART 2 - DEFINITIONS AND DOCUMENT HISTORY	31
10 DEFINITIONS	31
11 AMENDMENTS RECORD	32
12 IMPLEMENTATION	32
PART 3 - GUIDANCE NOTES AND APPENDICES	32

PURPOSE AND SCOPE

The purpose of this document is to provide guidance for 3D modelling of existing National Grid infrastructure and assets (above ground) from supplied 3D Point Cloud Data. This is to ensure a consistent approach is adopted by Suppliers.

PART 1 –PROCEDURAL

1 INTRODUCTION

Laser scanning and photogrammetry has recently been deployed on a live National Grid Capital Delivery project and has been approved as a Best Practice within Gas Transmission. This Best Practice status has ensured its contractual presence on future projects. Scanning applications have also been of significant interest to several recent design projects for electrical transmission sites.

This document should be read in conjunction with TS3.01.08 Laser Scanning Standard *Scanning & Photogrammetry Survey Specification*.

Existing conditions 3D models will serve as a basis to support all National Grid project design elements. The data collected will be a combination of accurate 3D geometry with semi-intelligent 3D data to be used by National Grid for detailed design, design verification, interference detection, and equipment verification.

2 MODEL LIMITATIONS

2.1 Survey completeness

An accurate 3D model can only be generated from accurate survey data. If any areas are not fully defined they will be noted in the model physically and communicated back to the supplier of survey data.

Unless specified in the work scope, modelling work will not be undertaken within site buildings (internally). All modelling work will be limited to the external site environment only.

Also, modelling may be required to collect critical features up to 20 metres outside of the external site perimeter to aid future extension works. This will be confirmed by the employer at the work scope stage.

2.2 Below Ground Services

Below ground services are not available from 3D Laser Scanning and as such cannot be included in the 3D models.

3 SOFTWARE & DELIVERABLES

3.1 Native modelling Software

All modelling is to be completed with Autodesk Revit in the approved release version.

As Autodesk Revit files cannot be back saved to earlier versions all modelling tasks must be undertaken in the approved software version. Earlier versions are not permitted as library content and templates cannot be back saved. Later versions will not be permitted as updates and changes to library content will not be compatible with earlier versions or potential future projects.

Revit 2015 is the preferred native modelling software at this time. Software versioning may be reviewed at a later date.

3.2 Data Security, Encryption & Archiving

The provider will be responsible for defining an employer approved data management and archiving procedure.

3.3 Deliverables

3.4 Native Models

Native models will be provided at the completion of the modelling process.

Native model delivery will include linked Survey model containing point clouds in RCS format. (RCS point clouds must be supplied as separate files to be hosted on client network and relinked to Revit models).

3.5 Viewer Models

Intermediate deliverables for checking to be supplied as federated DWFx of 3D view containing all elements.

Final delivery will include a DWFx and Navisworks 2015 NWC export of the federated* design models.

*Federation only required if multiple model strategy has been used.

Any alternative software solution or version is acceptable to the employer subject to approval prior to use, and providing it will be sufficient in delivering the requested format datasets.

3.6 Survey Reports

A detailed post modelling report shall be provided to include;

- National Grid site name and location.
- National Grid unique site identifier.
- Dates of current Model.
- Modelling personnel who constructed the model.
- Quality assurance checklists and reports.

All deliverables issued by the provider will be controlled by a suitable transmission note which clearly documents items delivered to the employer.

4 MODEL EXECUTION

4.1 Datum and Coordinates

4.1.1 Revit Coordinate Systems

Revit contains 3 coordinate systems. One is fixed and two are user adjustable.

Revit datum. This is effectively a fixed Cartesian 0,0,0 point.

Survey Point. This is the coordinate system used to locate the model at a real world location. This is also the coordinate system that is used between models or other software.

Project base point – This is a coordinate system used within a single model and related to that model only.

There are also 3 ways to link files together based on these coordinate systems:

- If another Model, Point Cloud or Cad drawing is linked by origin it will use the location of the 0,0,0 in each file and overlay the two at that point.
- If another Model, Point Cloud or Cad drawing is linked by centre it will use the geometric centre of all the included geometry of the incoming file.
- If another Model, Point Cloud or Cad drawing is linked by shared coordinates it will use the survey point (or WCS for Cad) of each file and overlay the two at that point.

4.1.2 Revit 20 Mile Limit

Revit has an inbuilt limit relating to the 0,0,0 datum. The distance from origin limit will be applied to objects placed more than 20 miles from the inbuilt 0,0,0 within Revit. Any item outside this limit may suffer a reduction in accuracy or display issues.

Due to the distance from origin limitations in Revit, point clouds should be placed inside this limit to eliminate causing graphical display issues and severe decimation of point cloud resolution.

Depending on how the point clouds have been registered the import process may vary. It is important to establish if the point clouds have an arbitrary datum or true coordinates especially when being supplied in pieces that need to line up when imported.

4.1.3 Survey Datum

If the clouds have an arbitrary datum, providing it does not exceed 20 miles from 0,0,0 they can safely be linked by origin. Additional clouds can then be linked by origin to overlay in the correct place.

Note: If the point clouds were provided with an arbitrary datum, coordinates can later be specified at a known point with written coordinates provided by the surveyor for that point.

If the clouds have been registered with true coordinates then they will likely be beyond the 20 mile limit and in this case the clouds need to be initially placed closer to 0,0,0 and the coordinates will need to be acquired however coordinates can only be acquired from line work or geometry contained in a link and cannot be acquired from point clouds

To successfully implement and acquire survey based coordinates when using point clouds there are two options:

a) Coordinates from CAD Survey Drawing

If a CAD survey drawing has been provided containing the same coordinates as the point clouds it can be linked to Revit (centre to centre) to align close to the Revit origin point.

Coordinates can then be acquired from this.

Once coordinates have been established from the CAD link the point clouds can then be linked in by shared coordinates and the CAD removed.

b) Coordinates from Revit Datum File

Create a datum Revit file by linking a point cloud into a new Revit file (origin to origin)

Note: resolution may not display correctly due to distance from Revit origin but can be ignored for now.

Link this RVT datum file into the Revit project model by Centre to Centre. This should link in near the Revit origin of the host file.

Now acquire coordinates from the link.

Once coordinates have been established from the datum Revit model the point clouds can be linked in directly by shared coordinates and the original Datum link can be removed.

Note: You will need to model a 3D element in the Datum file to allow selection for acquiring coordinates when linked into the project file

4.2 Point Cloud Formats and Conversion

Point Clouds received from survey contractors may need to be converted to a proprietary format for use In Revit models. Revit can convert most native point cloud formats into the required RCS format. It is important to import native point clouds using the origin to origin placement, especially if the survey has been split into smaller zones.

Note: While converting to RCS format Revit will display a progress bar. Revit can still be used once the conversion has commenced however the process uses a large amount of CPU which can impact performance

Once the conversion is complete re-import the resulting RCS format point cloud using the origin to origin placement option.

4.3 Establish Levels

As these sites are often large and contain many standalone pieces of equipment and multiple buildings and structures a project datum level should be established.

Set the project base point elevation at this level to be 0 (Zero).

This will be used to host objects (with + or – offsets) additional levels are not required unless defined changes in level are present (Benching / retaining) or if internals of buildings are required to be modelled.

The datum Level can be based on an existing structural element or building floor level or a known datum point or peg on site.

4.4 Split Models

The preference for National Grid existing condition surveys is to contain all information in a single Revit model (except linked Point Clouds).

If multiple models are used (for size or workflow reasons) they must be established on shared coordinates and contain the same survey and project base points to ensure linking to and linking between these files is consistent.

Coordinates, links and survey data should be established in split models prior to any modelling work.

4.5 Component Naming

All Revit component families are to be named using the method below:

- <DISCIPLINE PREFIX> <CATEGORY ABBREVIATION> <Main Descriptor>_<Second Descriptor>

e.g. E_Elec_Shunt Reactor_Type 4
- Disciplines:

A – Architecture

E – Electrical

S – Structural
- Category Abbreviations are effectively the first 4 letters of the Revit category. E.g. Electrical Equipment = Elec

Exceptions include:

Electrical Fixture = ELEF

Furniture System = FURS

Structural Framing = STRF

Structural Column = STRC

Structural Foundation Pad = STRP

- Type Naming

Families with only one type do not require specific type naming. For families with multiple types (for changes in height etc) Type are to be named as “*Type 1_<Height>*” e.g. *Type 1_6250h*

4.6 Model Accuracy and Detail

Typically for existing conditions modelling from point cloud data the industry accepted definitions for level of detail (LOD) only applies to the geometric form. The corresponding level of information (LOI) typically provided in a design model will not be included. It is possible to apply this information with input by others however it cannot be obtained from the point cloud directly.

Refer to Appendix A for further details on geometric detail required for different categories of items and refer to Appendix B for client specific detail and accuracy requirements for each site.

4.7 Geometric Detail Overview

LOD 200 – Item represents element category and approximate overall size and shape but does not indicate construction type. Deformations less than 60mm may be ignored. Similar Item can be replicated without individual variations.

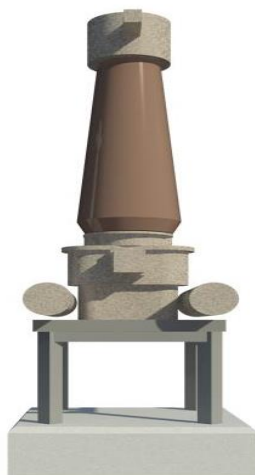
LOD 300 – Item represents actual size and shape with approximate construction type. Profile shapes may be simple (Architraves, Fascia, Gutter, Structural Members) Deformations less than 30mm may be ignored. Similar Item can be replicated without individual variations.

LOD 400 – item accurately represents entire element construction.

Profile shapes to be accurate (Architraves, Fascia, Gutter, Structural Members). Include Fixings, flanges, bracing. Deformations less than 15mm may be ignored. Similar items must be individually modelled for replicated instances to allow for unique variations



LOD 200



LOD 300



LOD 400

4.8 Quality Assurance / Quality Control (QA/QC)

Before handing the model to the client several QA checks need to be performed. Report templates and checklists for QA checking can be found in Appendix D

Visual checks will be conducted to ensure completeness of the model against the point cloud survey. A grid of approximately 25m x 25m is to be laid over the entire site and each quadrant cropped in plan and 3D. This cropped area is then visually checked against the point cloud to check for missing geometry. For each quadrant a checklist is to be completed.

Checks will be conducted to ensure the content and items are constructed as per the individual project brief as well as per this specification and industry best practice. This involves checking the content and categories are built to the requested level of detail and accuracy. Checkers will look at individual components and compare them to the point cloud data. A check list of components is to be provided.

Model is to be checked by an Electrical engineer to confirm elements have been named and constructed appropriately. HV engineers can check the native Revit model or a DWF / Navisworks export. Any non-compliant items are to be listed with the existing naming and suggested naming. Provide screen shots of items where possible

5 CATEGORY DETAIL LEVELS

5.1 Buildings

All Insitu buildings on site are to be modelled using system families (Walls / Floors / Roofs etc).

Buildings are to include all external openings (Windows / doors / Vents) as component families.

Note: Curtain wall families are not to be used to model windows and vents unless they are replicating on site reality such as commercial glazing systems.

Note: Portable structures (Including shipping containers, prefab structures, and temporary structures) will be modelled as component families and covered under section 2.7 Site Structures.

5.1.1 Walls

a) LOD 200

Single layer.

Wall thickness to be nominal

Materials not required.

b) LOD 300

External materials to be nominated where easily identified.

Can be single layer.

Wall thickness modelled where known.

Internal materials not required.

c) LOD 400

As above with the additional of:

Changes in material

Control joints

Trims

5.1.2 Doors

a) LOD 200

Include Swing

Approximate Leaf size.

Hardware not required.

Trims not required

b) LOD300

Swing

Include Nominal glazing

Leaf size

Leaf offsets from face.

Hardware not required.

c) LOD400

Swing

Include Nominal glazing

Accurate Leaf size

Leaf offsets from face

Include kick plates or grilles where applicable.

Nominal Architraves / trims to external face where applicable

Hardware not required.

5.1.3 Windows / Louvres

a) LOD 200

Windows to approximate overall dimensions

b) LOD 300

Windows to approximate overall dimensions

include nominal mullion / transom break up.

Indication of opening panels not required.

c) LOD 400

Windows to accurate overall dimensions

Windows to include nominal mullion / transom break up.

Nominate opening panels.

Nominal external trims and sill to be included

5.1.4 Roofs

a) LOD 200

Roof construction may be single layer

Roofs to include slopes where visible

b) LOD 300

Roof construction can be single layer

Roofs to include slopes where visible

Roofs to include Nominal Gutters and Fascia's

Roof material to be nominated where known

Fascia and gutter material not required

c) LOD 400

Roof construction can be single layer

Roofs to include slopes where visible

Roofs to include Accurate Gutters, Fascia's and Down Pipes

Roof material to be nominated where known

Fascia and gutter material to be nominated where known

Soffits to be separate layer

5.1.5 Floors

a) LOD 200

Nominal thickness sufficient to visually represent any foundation depths visible externally or to extend into topography

Material not required

b) LOD 300

Floors can be constructed to a nominal thickness unless known

Floors should visually represent any foundation depths visible externally. (Floor Slab Edge or foundation walls may be used for raised floor slabs)

Material to be indicated where known

c) LOD 400

As above with the addition of:

Falls to drains

Construction Joints

5.1.6 Ramps and Steps (In Situ)

a) LOD 200

Total fall or number of steps to be modelled

Material not required

- b) LOD 300
 - Include landings or change in slope for ramps
 - Material to be indicated where known
- c) LOD 400
 - Include nosing profiles for steps
 - Include edge upstands to ramps
 - Material to be indicated where known

5.1.7 Stairs and Railings (Buildings)

- a) LOD 200
 - Total number of risers and approx. overall dimensions
 - Railing not required
 - Materials not required
 - Stringers or defined stair construction not required
- b) LOD 300
 - Indicate construction type (open / monolithic etc)
 - Include Nominal rail and baluster type
 - Indicative Materials where known
- c) LOD 400
 - Include complex stair construction including tread type, nosing's, stringers
 - Include rail and baluster type with supports, turn downs etc*
 - Indicative Materials where known
 - *Complex railings may be modelled as In-Place families if system families cannot replicate actual to a suitable level of detail and accuracy