

LASER SCANNING & PHOTOGRAMMETRY SURVEYING STANDARD FOR FIXED GAS & ELECTRICAL TRANSMISSION SITES

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TABLE OF CONTENTS

PURPOSE AND SCOPE	1
PART 1 – PROCEDURAL	2
1 GENERAL	2
2 SURVEY EXECUTION	4
3 SURVEY ACCURACY	8
4 SURVEY DETAIL & POINT CLOUD COVERAGE	9
5 DELIVERABLES	10
6 FORMS AND RECORDS	12
PART 2 - DEFINITIONS AND DOCUMENT HISTORY	13
7 DEFINITIONS	13
8 AMENDMENTS RECORD	14
9 IMPLEMENTATION	14
PART 3 - GUIDANCE NOTES AND APPENDICES	15
APPENDIX A – LASER SCANNING SURVEY BRIEF	15

PURPOSE AND SCOPE

- To allow National Grid laser scanning and photogrammetry services to be purchased in a standard method, format and type.
- To facilitate laser scanning and photogrammetry products to be captured and used as a gateway to the BIM environment.
- To ensure whole project regulation using scanning technology; as a front-end activity for design, as a mid-stage activity for as-built supervision, and as a back-end activity for construction validation.

This Specification defines requirements for Laser Scanning & Photogrammetry of National Grid infrastructure and assets, in particular for field data acquisition using laser scanning and photogrammetric technology, plus generation of standardised deliverables for National Grid BIM initiatives.

Description of Use

Field laser scanning technology will serve as a basis to support all National Grid project design elements. The data collected will be non-intelligent 3D data which can be used to feed into universal BIM software to enable National Grid's creation of intelligent 3D models for detailed design, design verification, interference detection, and equipment verification.

Corresponding photogrammetric outputs will be used for site visualisation requirements.

PART 1 – PROCEDURAL

1 GENERAL

1.1 Background

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.

Within recent BIM Trial recommendations, National Grid recognises that Laser scanning and photogrammetry provides not only enhanced quality of BIM deliverables when compared to the more traditional topographical site survey methods, but also at reduced cost and time. In particular, it has notably reduced repeat visits to hazardous areas. The level of detail that is captured with traditional methods is only a fraction of that which can be captured by laser scanning and far more prone to human error.

A further lesson learnt from the BIM trial project was the potential variation in specification and prices to complete the laser scanning survey. As laser scanning technology has advanced significantly over the past decade, National Grid has recommended that a rigorous Scanning Specification is put in place to provide a common quality standard in terms method, format, and type. This should cover all types of gas and electricity installations.

National Grid conclude that a defining standard will ensure best value quotes are obtained in line with a common professional standard for all laser scanning and photogrammetry services delivered.

1.2 Survey Approach

We are undertaking a best practice approach to provision of laser scanning services within National Grid installations. This will ensure standardisation of laser scanning field practices and also provide for delivery of integral and complete datasets which can be adopted for use across a wide range of applications.

The provision of robust laser scanning & photogrammetric surveys will provide accurate and complete data to improve our knowledge of each site environment. In addition, it will provide further cost and safety incentives through reduction of site visits. In this case, the majority of visual and measurement site inspections could be undertaken as a desk-based exercise.

1.3 Site Limits

1.3.1 Survey Location

In consultation with the employer, the laser scan service provider will be responsible for understanding the location where laser scanning will be performed. The location and areas will be discussed and agreed in advance prior to site mobilisation.

1.3.2 Survey Site Limits

Unless otherwise instructed by the employer, the laser scan service provider will survey the complete installation site area for the requested location. General indicators of site size are given as follows;

Gas Site Type & Approx. Size	Electricity Site Type & Approx. Size
1. Block Valve: 25 x 25 metres	
2. Pig Trap Compound: 100 x 100 metres	
3. Multi-Junction: 200 x 200 metres	
4. Compressor Station: 400 x 400 metres	
5. Terminal: 600 x 600 metres	

Alternatively, for any areas depicted by the employer within a particular site area / limit which herein define unique areas where laser scanning will be performed, the employer will be responsible for providing plot plan drawing(s), outlining scan areas, and photos (if available) representing the level of density of areas which require laser scanning, and a definition of work scope.

1.4 Trained Survey Personnel

A qualified and experienced laser scanning project manager shall oversee all aspects of laser scanning site work and office processing routines. To uphold the highest levels of project standard and quality, the project manager shall be a member of the Royal Institution of Chartered Surveyors (RICS) or Chartered Institute of Civil Engineering Surveyors (CInstCES), or of equivalent professional status.

Each scanning project shall be led by a senior laser scanning surveyor. The senior laser scanning surveyor shall have a minimum 2 years field leadership experience in laser scanning site survey operations, together with demonstrable experience in processing for laser scanning and photogrammetric outputs.

The senior laser scanning processor will have minimum of 2 years processing experience in delivery of laser scanning datasets. This will include experience and recognised training in use of proprietary scanning and registration software.

1.5 Safety & Certification

For each laser scanning survey undertaken, the laser scan service provider shall provide a Risk Assessment & Method Statement (RAMS) which clearly defines the safety procedures for all executed tasks that will ensure the safety of all personnel executing work at the site facility and / or office. For each location, this will bear reference to the local site hazards area plan.

For gas sites, this should be submitted in the form of a model risk assessment for the use of non-intrinsically safe electronic measuring devices in ignition risk areas. For electricity sites, this should be submitted in the form of a model risk assessment for completion of survey work within live electricity sites.

All site work will strictly comply with National Grid Safety Instructions and environmental regulations.

All site workers will require attendance at a local site induction prior to work commencement.

All survey personnel shall be trained and certified to the following minimum standards;

1.5.1 Safety Certification for Gas Sites

- Senior Surveyors – SCO Qualified (or site escort), EUSR Gas Safety Passport, CSCS Supervisor Trained, Emergency First Aid at Work, HS(G)47 Cable Avoidance Training
- Surveyors - CSCS Trained, Emergency First Aid at Work
- All gas site survey work to be undertaken in line with the National Grid safety document entitled '4. Gas Site Safety Presentation NG. Rev A Dec11.pdf'.

1.5.2 Safety Certification for Electricity Sites

- Senior Surveyors - CSCS Supervisor Trained, National Grid BESC AME, National Grid Persons, Emergency First Aid at Work, HS(G)47 Cable Avoidance Training
- Surveyors / Assistant Surveyors - CSCS Trained, National Grid BESC AME, National Grid Persons

As determined by the current operations been undertaken on site, It is envisaged that laser scanning survey works will not be subject to the Construction Design and Management (CDM) Regulations 2007. However, should CDM apply then the employer shall provide all information as required to the principal designer.

All laser scanners and laser measurement devices will comply with the International Electrotechnical Commission standard: IEC 60825-1 Ed. 1.2 en: 2001 - Safety of laser products - Part 1: Equipment classification, requirements and user's guide.

2 SURVEY EXECUTION

2.1 Scan Hardware Requirements

All laser scanning and photogrammetric data should be collected using a Leica C10 / P20 (or later model), or equivalent time-of-flight laser scanner. A time-of-flight scanner produces less noise in the measurement compared to a phase-based scanner, and gives a better range in dark light environments.

An alternative hardware solution will be acceptable to the employer subject to approval prior to its use. Alternative hardware must be sufficient to ensure delivery of requested dataset format types.

Laser scanning will not be undertaken during inclement weather including rain, snow, fog, mist & heavy wind, where the quality of data is affected due to returns and scattering from droplets, refraction of the measurement beam, or lack of balance in the tilt compensator. To minimise the impact of downtime as a result of inclement weather, the laser scan service provider will be responsible for contacting local site maintenance staff in advance of mobilisation to obtain an understanding of local conditions and future weather forecasting.

The scanner must be set up in a stable position during each scan cycle to ensure minimum movement and distortion within each scan image. The provider must be fully aware of all other potential error sources associated with laser scanning and seek to mitigate these errors accordingly in line with the given site environment and any prevailing conditions.

The scanner hardware shall accept an externally mounted high dynamic range (HDR) camera using nodal ninja tools, to ensure collection of high resolution colour photogrammetric imagery within each installation.

2.1.1 Calibration

In line with the supplier's manufacturing recommendations and servicing agreements, all laser scanners and laser measurement devices shall be fully serviced and calibrated prior to any work commencing.

The provider shall guarantee the calibration of each item of equipment, and shall provide copies of appropriate certification within the report deliverables.

No uncalibrated equipment shall be used under any circumstances. All equipment shall comply with the providers calibration procedures and / or with the manufacturer's specifications.

The provider shall ensure that the following general procedures are adopted during calibration;

- All equipment is checked to ensure all connections, battery housings and casings are correct and undamaged
- All equipment and components are clearly labelled with a calibration number to enable their identification and traceability

The completion of these check procedures will be supported by a field check sheet for presentation within the survey report.

2.2 Reference Control Survey

2.2.1 Horizontal Reference System

Système Internationale (SI) units shall be used throughout the survey.

Where details of an existing site / plant grid is supplied by the employer then this should be assumed by the provider as the basis of horizontal control. Otherwise, the Horizontal Reference System will be orientated and referenced to Ordnance Survey National Grid by observations to the Ordnance Survey Active GNSS network.

Static GNSS observations should be undertaken based on high precision static methods using dual frequency receivers, as specified in Guidelines for the use of GNSS in Surveying and Mapping RICS Guidance Note. This will include for absolute precision of horizontal position to +/- 5mm.

Scale factor shall not to be applied to horizontal reference system observations.

2.2.2 Vertical Reference System

All levels shall be in SI units related to Ordnance Datum Newlyn (ODN).

The Vertical Reference System will be established based on Ordnance Datum Newlyn by observations to the Ordnance Survey Active GNSS network.

Static GNSS observations should be undertaken based on high precision static methods using dual frequency receivers, as specified in Guidelines for the use of GNSS in Surveying and Mapping – RICS Guidance Note. This will include for absolute precision of vertical height to +/- 10mm.