

MANAGEMENT OF DRAWINGS (ELECTRICITY ASSETS)

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	2
1 RESPONSIBILITIES	2
2 USE OF NATIONAL GRID DRAWING MANAGEMENT SYSTEM (ECM)	4
3 GENERAL REQUIREMENTS FOR DRAWINGS	4
4 PREPARATION OF DRAWINGS	8
5 DRAWING REFERENCE NUMBERS	13
6 SITE DRAWING INDEX & FILING SYSTEM	14
7 IDENTIFYING CHANGES TO DRAWINGS	15
8 MANAGEMENT OF DRAWINGS FOR A CONSTRUCTION PROJECT	16
9 RECEIPT OF DRAWINGS / MANUALS FROM A CONTRACTOR	20
10 EMERGENCY OIL CONTAINMENT & DRAINAGE PLANS	22
11 CIVIL, STRUCTURE, AND BUILDING ENGINEERING DRAWINGS	23
12 SUBSTATION MASTER TEMPLATE	23
13 DRAWINGS FOR OVERHEAD LINES (OHL)	25
14 FORMS AND RECORDS	28
PART 2 - DEFINITIONS AND DOCUMENT HISTORY	28
15 DEFINITIONS	28
16 AMENDMENTS RECORD	29
17 IMPLEMENTATION	30
PART 3 - GUIDANCE NOTES AND APPENDICES	30
18 REFERENCES	30
APPENDIX A – EXAMPLE 'CONTRACT DRAWING LIST (CDL)'	32
APPENDIX B – LAYOUT OF DRAWING TITLE & REVISION BLOCKS	33
APPENDIX C – DRAWING CATEGORY NUMBER CHART	35
APPENDIX D – MODEL TEMPLATE OF A SITE DRAWING FILING INDEX	37
APPENDIX E – TP135 PROCESS MAP (SUBSTATIONS)	46
APPENDIX F – TP135 PROCESS MAP (OVERHEAD LINES)	47
APPENDIX G – TARGET TIMESCALES FOR PROJECT DRAWING KEY TASKS	48
APPENDIX H – CHECKLIST FOR MASTER DRAWING UPLOAD INTO ECM	49
APPENDIX I – GUIDANCE FOR LAYERING CONVENTION	51

PURPOSE AND SCOPE

This business procedure specifies the requirements for the management of drawings associated with National Grid UK electricity transmission assets.

Where work impacts on master drawings owned by a third party, it is also necessary to fully comply with the drawing management processes specified by the asset owner concerned.

As the owner and operator of electricity transmission assets, National Grid has specific duties and statutory obligations with respect to the provision, design, construction, operation, and maintenance of its transmission plant and systems. In order to satisfy these obligations, and as a safe, prudent, efficient and competent operator, National Grid's policy is to produce and maintain appropriate drawing records for its transmission assets. It is therefore a mandatory requirement that the requirements of this procedure are fully complied with by any party that undertakes work, which also impacts on asset drawings, whether such assets are new, or already in existence.

The following items are within the scope of this document; electronic master drawings, site held prints of drawings, site management of Construction Drawings, and Operation & Maintenance manuals.

PART 1 – PROCEDURAL

1 RESPONSIBILITIES

To support compliance with Construction (Design & Management) Regulations as well as other legislation in which accurate drawings have a fundamental role, the overriding principle with respect to drawing production and updating is that primary responsibility for these activities rests with the party that undertakes work on the assets concerned. The key responsibilities associated with discharging the requirements of this procedure can be summarised as follows: -

1.1 Electricity Transmission Asset Management (ETAM) - Business Assurance & Systems

1.1.1 Data Delivery Manager

The Data Delivery Manager has overall responsibility for the safe custodianship and lifetime management of all master engineering drawing records and Operation & Maintenance manuals for assets that form the National Grid (UK) owned, high voltage electricity transmission system.

1.1.2 Drawings Leader

Reporting to the Data Delivery Manager, the Drawings Leader; specifies drawing management processes and procedures, monitors and reports on user compliance with the requirements of this procedure, identifies drawing quality issues, and oversees improvement actions/initiatives to resolve any shortcomings as may be identified.

1.2 Capital Delivery - Delivery Vehicle

1.2.1 Project Engineer

The lead Project Engineer with the overall responsibility for capital delivery or modification works must ensure that this procedure is fully complied with, and that the project Health & Safety file is fully updated with the correct drawing references in compliance with National Grid procedure UKBP/TP137.

The following shall be entered into the project programme to capture key drawing deliverables on a circuit, bay, or asset basis, for the purpose of monitoring and periodic progress reporting as required: -

- a) Accurate and clean final 'As-installed' drawings are accepted
- b) At sites with filed drawings, clean As-installed prints are incorporated into the site filing system and the Master site drawing index is updated electronically
- c) Timely provision of the electronic final drawing pack and Operation & Maintenance Manuals (see section 9 below) to National Grid (Drawing Management)

Additionally, a milestone is to be added to the programme to commence monitoring the sign-off of the 'As-installed' drawing status approximately two months prior to Stage 2 commissioning with a monthly report to be produced and provided to the Project Engineer on a per-project basis.

1.3 Contractors

1.3.1 Principal Contractors Site Manager

The Principal Contractors Site Manager (PCSM) is defined as the person who is responsible on site assuming the role and responsibilities of the Principal Contractor with accountability for site delivery. As such, the PCSM is responsible for implementing this procedure in relation to the management at site of all drawings associated with the project.

During the construction and installation stage, a project specific site filing system shall be established and maintained, which clearly indexes a reference set of drawings that have been accepted for construction following successful completion of contractor design approval and assurance as defined in National Grid procedure UKBP/TP188.

1.3.2 Contractors Site Manager

For projects involving a single contractor then the Contractor Site Manager will have accountability for site delivery. As such, the Contractor Site Manager is responsible for implementing this procedure in relation to the management at site of all drawings associated with the project.

During the construction and installation stage, a project specific site filing system shall be established and maintained, which clearly indexes a reference set of drawings that have been accepted for construction following successful completion of contractor design approval and assurance as defined in National Grid procedure UKBP/TP188. Electricity Transmission Asset Management (ETAM) - Operations

1.3.3 Delivery Manager

For any work that supports capital delivery activity, the nominated Operations site representative shall ensure that, where requested, comments on project drawings and/or guidance on site filing requirements, shall be returned within two weeks, or as otherwise agreed by all parties.

In the case of work where the project management responsibility is assigned to Operations, the individual within Operations appointed to the role of Project Engineer is responsible for ensuring compliance with the requirements of clause 1.2.1 above.

For non-project related work, e.g. site maintenance, fault repairs, etc. any changes affecting accuracy of master drawings must be captured at site and arrangements made for the master electronic file to be updated within twelve weeks of completion of the site works (or where site works are not applicable, within twelve weeks of identifying that drawing updates are required).

In those instances when prints of final As-installed drawings are received from a Contractor, and it has been agreed these are not to be checked, accepted and incorporated into the site filing system by the Contractor responsible for site works, then this task shall be undertaken by a nominated individual within National Grid (Operations) who must prioritise the work to enable the Contractor to submit the final drawing pack to National Grid (Drawing Management) within the timescale stated in item 9.1 below.

Delivery Managers, through their nominated site representatives, shall ensure that, for relevant sites, all printed engineering drawings held in the site drawing filing system (post works completion/commissioning) are maintained to accurately reflect the As-installed conditions. This shall include a fully maintained index that lists all prints of drawings be permanently available at site, as required by Operations. The site index master shall be maintained and held in electronic format, alongside the master drawings in National Grid's central repository i.e. ECM.

2 USE OF NATIONAL GRID DRAWING MANAGEMENT SYSTEM (ECM)

ECM (Enterprise Content Management) is National Grid's chosen tool for the storage and management of its master drawing records and other project related documents. All parties involved in work on National Grid assets and who also have a need to view and/or modify master drawings, must do so via use of ECM.

To enable access to records in ECM, each nominated user must firstly acquire an appropriate user licence. Following confirmation of the latter, a user account shall then be set up with the relevant access rights and user permissions. The overall processes to be followed for user account management and associated responsibilities are described in National Grid procedure UKBP/TP196 entitled CPM Livelink & ECM User Account Management.

3 GENERAL REQUIREMENTS FOR DRAWINGS

3.1 One 'Master Record' Principle

- 3.1.1 A drawing shall have only one version recognised as the master. With the exception of item 3.1.2 below, in the case of a National Grid owned asset the master drawing is defined as the single record, and associated image file, stored by National Grid in its master drawing repository i.e. 'ECM'. Electronic drawing records for third party owned assets, shall not normally reside within ECM however where it is agreed by National Grid (Drawing Management), electronic copies of drawings for non National Grid assets may be stored for reference purposes only, but these must not be regarded (or treated) as the master record.
- 3.1.2 Specifically in the case of the National Grid owned operational telecommunications network e.g. optical fibre systems and associated assets, etc. as maintained on its behalf by an appointed third party, any associated master drawings shall be retained as a complete electronic data set within a dedicated repository supplied and maintained by the same third party. Whilst the appointed party is responsible for determining and applying suitable drawing management procedures, these should also be consistent with the general requirements outlined within this procedure unless agreed otherwise by National Grid (Drawing Management).
- 3.1.3 If changes are required to an existing drawing the electronic master must firstly be 'reserved' in ECM by the party that is responsible for undertaking the site work. Following verification of any drawing changes by comparison with the site installation (say as part of a capital delivery project, site maintenance work, etc.) the master must be subsequently returned to National Grid for upload back into ECM in accordance with item 9.1 below. In the case of updates to a master drawing that is not controlled by National Grid, the party undertaking the site work must liaise with the master drawing owner with a view to ensuring compliance with the third party's drawings modification process.
- 3.1.4 If a Contractor requires a National Grid master drawing that is 'reserved' by another party, they must in the first instance liaise directly with that party to negotiate release of the master, or agree a mutually acceptable plan of action. The respective project requirements should be considered at this stage, and in the event that a suitable solution cannot be established, the matter shall be escalated to the respective Design Manager(s) for resolution. If after escalation the issue remains unresolved, the matter should be brought to the attention of National Grid (Drawing Management) who will then provide facilitation so that the parties can jointly agree a solution, as appropriate.
- 3.1.5 When concurrent project time-scales prevent the return of a reserved master that is still being worked upon, a modified approach is required which necessitates full co-operation between all parties. In this instance the sequence of any site installation activity must be considered such that the parties freely exchange information by making available a suitable electronic copy of the requisite drawing file(s), i.e. one which reflects the applicable site conditions at the time that work is implemented at site. This high level of co-operation is

paramount to enable each party to progress its design activity using information that reflects the actual site installation at the time that work will be carried out.

- 3.1.6 If any party subsequently amends a previously supplied electronic file, a copy of the updated file must also be forwarded to the other affected party so that the impact of any changes can be taken into account as appropriate.
- 3.1.7 Where there is a short time period between the site works completion/commissioning between two (or more) concurrent projects it will be necessary for any site drawing mark-ups arising out of the completed works/commissioning to be incorporated by the reserver/requestor, as agreed between the project engineers, such that the master electronic file is fully rationalised to accurately reflect the as-installed conditions. When required, site meetings shall be held between the Principal Contractor Site Managers (Contractor Site Manager for non-notifiable projects) for each project to ensure that data capture is properly co-ordinated. In the event of apparent conflicts shown on pre-existing drawings (e.g. duplicate conflicting versions, etc.) it will be necessary to involve the Operations site engineer to assist in verifying the actual installed conditions as appropriate.
- 3.1.8 Subject to formal agreement between the relevant parties, it is appropriate for any such mark-ups to be incorporated into the master electronic file by a Contractor that did not necessarily undertake the site works to which the drawing changes specifically relate.
- 3.1.9 All finalised 'As Installed' drawings shall be made available for acceptance and incorporation into the site filing system, within the timescale stated in item 8.4.1.

3.2 File Format

3.2.1 Newly Created Drawings

All newly originated master As-installed drawing records shall be in vector format. In line with this policy, and unless specified otherwise, two dimensional engineering drawings shall be saved in the oldest fully supported version of AutoCAD™ software ('.dwg'), as officially declared by the vendor (i.e. Autodesk Ltd.) on the day that the master(s) is/are received by National Grid (Drawing Management).

Prior to final issue of electronic masters, all files must be purged to delete any unused components such as named objects, layers, line types, etc. This shall also include any 'contractor specific print/plotting characteristics' individually assigned to the files that are not relative to file format. This requirement does not apply to master three-dimensional models identified in item 13.1 below.

In the case of equipment schedules and material lists, or similar (including thermal ratings) it is preferred for these to be prepared using Microsoft Excel™ (up to and including version 2010). Spreadsheets containing macros must be avoided unless **prior** agreement has been obtained from National Grid (Drawing Management). All spreadsheets and vector files must comply with the file size limits stated in item 3.2.5 below.

Refer to section 13 for additional requirements associated with drawing records for overhead electricity transmission lines.

3.2.2 Pre-existing 'As-built' Drawings

If an existing drawing needs to be amended, it is allowable to retain the pre-existing file format, but if the file format is to be changed the resultant format must comply fully with item 3.2.1 above. If a drawing file format is converted in this way, the resultant image must be visually checked against the original to confirm that no corruption or loss of information has occurred.

Drawings that pre-exist in vector format must not be down graded into raster format. In this event such files will be rejected and returned for immediate rectification.

If pre-existing Microstation™ drawings are to be updated and the original file format is to be retained, Microstation (.dgn) Version 8.5 (or earlier) shall be used.

If pre-existing TIFF master drawings are to be updated and the original format is to be retained, then appropriate raster image editing tools must be utilised – re-scanned prints of existing TIFF files will be rejected unless prior agreement to such an approach is given by National Grid (Drawing Management).

TIFF files shall be monochrome (black & white), utilising CCITT Group 4 compression, in non-tiled format and at original size. The resolution shall not exceed 300 dpi, but to reduce electronic file size 200 dpi is preferred subject to achieving adequate legibility of content. These drawings shall comprise black raster entities on a white background when viewed in standard Microsoft Imaging software. This shall also apply to new TIFF files generated by scanning of hard copy media where no master image exists in any suitable electronic format. All raster files must comply with the file size limits stated in item 3.2.5 below.

3.2.3 Generic Drawings

Generic drawings reside in ECM within the dedicated 'Asset Type Library' area, which is further subdivided to cater for 'Route Equipment' and 'Substation Equipment'. Generic master drawing records shall be submitted to National Grid (Drawing Management) who will arrange for their upload as appropriate.

The term 'Generic Drawing' describes a manufacturer's standard issue drawing associated with items such as assemblies, components, plant, equipment, etc. By definition a generic drawing cannot contain any site specific details or references.

Whilst all newly created As-installed master drawings must comply with the file format requirements stated in item 3.2.1 above, in the case of generic drawings that cannot be supplied in the preferred format, National Grid will accept electronic masters submitted as an Adobe™ Acrobat Portable Document File (PDF), up to version 9.1, provided that National Grid (Drawing Management) can reasonably satisfy itself that the drawing will not have a foreseeable need to be amended in the future.

Each generic drawing should cater for the allocation of a National Grid drawing number, however it is accepted that this may not be possible in cases where the equipment manufacturer is unwilling to provide electronic drawings in CADD format.

The inclusion of a second overall drawing border which surrounds the equipment manufacturer's original drawing border will not be accepted.

All documents in PDF format must comply with the file size limits stated in items 3.2.5 and/or 9.2.2 below, as appropriate.

3.2.4 Electronic Drawings Submitted During the Design Period

Whilst all finalised As-installed drawings must be created using CADD systems and in the preferred electronic format defined in 3.2.1 to 3.2.3 above, it is acceptable to electronically submit drawings for design assurance purposes using Adobe™ Acrobat PDF format.

All PDF Images created from scanned documents and/or raster files should be saved at the same ISO paper size as the original file (1:1 scale of original drawing sheet e.g. an A1 sized drawing should be PDF'd to A1 size. The resolution shall not exceed 300 dpi, but to reduce electronic file size 200 dpi is preferred subject to achieving adequate clarity of its contents.

All raster image content contained within an AutoCAD DWG file output, to a PDF should at least match the output resolution requirement within the original file. Content should be correctly orientated to the drawing border, Landscape images should be supplied in Landscape orientation. They should be good quality, free from skew/deformity, have good definition and be clean and free from speckle.

PDF's produced from CADD applications should avoid the use of the scale to fit setting, and the PDF program set-up so there are no margins on the selected paper size (to enable a true size PDF to be produced). Line weights should be applied, adaptive line weights should not be used, a logical approach to line weight selection when composing the drawing should be considered so that a 1:1 scale PDF image will have lines of no lower than 1 pixel width. In AutoCAD this can be achieved by using a 0.13 minimum line weight (AutoCAD default line weight.) The correct pen tables should be used to ensure that line weight's meet this minimum 1 pixel requirement. Black and white content to be PDF'd to Monochrome not Greyscale, Colour content to be PDF'd colour where only colour display on Hardcopy images is required. Appropriate pen tables should be used for the production of Red/Green images.

Upon completion of site works, all finalised As-installed master drawings submitted to National Grid must fully conform to the requirements stated in items 3.2.1 to 3.2.3 above.

3.2.5 Electronic Content

All electronic master drawings supplied to National Grid shall be in the form of single, self supporting files, which do not require access to any externally referenced data, unless previously agreed by National Grid (Drawing Management).

With the exception of drawings specified by National Grid where three dimensional modelling capability is to be preserved, all drawings created using intelligent drawing packages shall be 'dumbed down', that is, all technical content intelligent blocks should be converted to components (lines, circles, arcs etc) and any tags/attributes converted to standard text.

All so called 'dumbed down' drawings should be fully editable within standard AutoCAD. Drawing borders are excluded from this if the tag/attribute references use logical identifiers, e.g. Title 1, Title 2, Revision etc.

Each finalised electronic master drawing submitted to National Grid must adopt a minimal file size through purging /deleting unnecessary content etc. as identified in item 3.2.1 above. Any individual electronic master drawing that exceeds a file size of 10Mb shall be rejected unless agreed otherwise by National Grid (Drawing Management).

3.3 File Naming

Master electronic drawings shall adopt a standard file naming convention illustrated as follows:

'NG Drawing No._Sheet No._Revision No._File Extension. E.g. 44NG12345_1_F_dwg'

If the file is a multi-sheet drawing, utilise '1' as the default for Sheet Number. If the drawing does not possess a National Grid drawing number, the originators drawing number shall be used instead.

3.4 Ownership & Security of Electronic Data

All final As-installed electronic files associated with any asset owned by National Grid are deemed to be the sole property of National Grid and must be entered into the master drawing repository specified by National Grid (Drawing Management) for secure retention. National Grid may use such files for any purpose without reference to the Contractor that produced the file.

It is the responsibility of the Contractor to ensure the security of the data in transit, and to prevent its corruption and/or contamination of data with computer viruses whilst in its care.

3.5 Operation Diagrams & Single Line Diagrams

Production and maintenance of Operation Diagrams shall be in accordance with National Grid procedure UKBP/TP119.

Operation Diagrams, due to their specific nature, must not be reserved (in ECM) or subjected to any modification by anyone other than National Grid Operational Support or its nominated representative(s).

Specific guidance on the requirements for Single Line and Key Line Diagrams and how these differ from Operation Diagrams is given in Construction Design Handbook DH11.

3.6 Bulk Purchased Equipment Drawings

The responsibilities for the supply of drawings associated with bulk purchased equipment sourced by National Grid are defined in Transmission Procedure UKBP/TP211; otherwise all other requirements for drawings shall be in accordance with UKBP/TP135.

3.7 Emergency Oil Containment & Drainage Plans

Emergency Oil Containment and Site Drainage Plans shall be prepared in accordance with National Grid procedure NGUK/PM/SHE/201. Also see Section 10 below for additional information.

3.8 Underground Hazard Plan

Hazards arising out of buried services shall be identified on an Underground Hazard Plan which shall be prepared and maintained in compliance with National Grid procedure(s) NGUK/CD/BP209 and NGUK/CD/BP213E.

3.9 Drawings For Type Registration

National Grid procedure UKBP/TP183 identifies the requirements for drawings and manuals prepared for Type Registration purposes and therefore this procedure does not apply to such drawings.

3.10 Retention of Master Drawings

All master drawings for National Grid (UK) owned electricity transmission assets shall be retained within the master drawing repository for a period as specified as below: -

Asset Type / Drawing Content	Retention Period
Any buried assets (i.e. plant, equipment, or services)	For the duration that services, plant or equipment remains in the ground plus 5 years
Any drawing that falls outside of the above criteria	For the duration that the asset remains in situ plus 5 years

4 PREPARATION OF DRAWINGS

4.1 Technical Requirements

4.1.1 Drawing Standards and Graphical Symbols

All new drawings shall be prepared in line with appropriate Company, National and International Standards relating to engineering drawings, as listed in Section 18.

All drawing symbols shall be drawn with the primary plant and/or equipment in the open, reset, de-energised, or discharged / de-pressurised state.

4.1.2 If an existing drawing is modified, the changes shall adopt symbols in the original (or pre-existing) drawing style i.e. use of mixed symbols to represent identical mechanical or electrical system components must not be used.

4.1.3 Drawing Sheet Size

All drawings will use the ISO standard dimensions shown below, normally with a landscape orientation;

<u>Paper Designation</u>	<u>Paper Size</u>
A0	1189 x 841mm
A1	841 x 594mm
A2	594 x 420mm
A3	420 x 297mm
A4	297 x 210mm

4.1.4 Colours and Layers

Colour can be used as an aid to CADD operators and to give clarification when viewing files on screen but unless stated otherwise, all prints of drawings shall be monochrome.

In the few instances where As-installed drawings are required to be in colour (e.g. Site Hazard Plans, Emergency Oil Containment & Drainage Plans, and Site Security Plans) a suitable colour/line palette shall be adopted to facilitate clarity of drawing content. For guidance purposes Appendix I identifies a suggested layering convention for use on new drawings.

Where a colour hardcopy print is required as outlined above, the use of yellow (or any other pale colour that gives poor contrast against a white paper background) must be avoided.

Where colours are used to indicate system voltage, a standard convention shall be adopted in accordance with BS ISO 14617. When colours are duplicated, the lower voltage circuit will be denoted by use of a thinner line.

4.1.5 Borders, Titles & Revision Block

The importance of the drawing border and associated title block data cannot be understated as this enables the drawing to be identified, retrieved, and interpreted.

For generic drawings (as defined in item 3.2.3), or for manufacturers drawings that relate to third party standard equipment, the drawing originators own drawing border is acceptable.

For all other contract specific drawings, these shall be prepared either using a standard National Grid drawing border as shown in Appendix B, or an alternative border may be used subject to prior agreement by National Grid (Drawing Management).

Blank National Grid (Electrical Assets) Drawing Borders/Frames exist in the form of AutoCAD™ files. These files can be accessed via ECM (on the 'Enterprise Workspace Page') for download as required.

4.1.6 Drawing Revision History

All issued drawings will preferably utilise an alphabetical revision identifier, always starting with issue 'A', together with a brief description of the modifications applied at that revision. Note; generic revision statements such as 'modified to site marked print', or 'modified as per comments', etc. must not be used.

When a master drawing is subsequently modified and reissued, a further revision block will be added, and the next revision letter in the correct sequence will be assigned. Once revision Z has been reached, the sequence shall continue as follows: - AA, AB, AC to AZ, then BA, BB, BC, etc.

The revision sequence shall be continued for the full life of the particular drawing - numerical and alphabetical revision sequences must not be mixed on the same drawing.

Steps shall be taken to ensure excessive revisions to drawings for a given project or site work is minimised as far as is reasonably practical. Revisions detailed on each drawing shall reflect only the formal issues/re-issues of the drawing to National Grid i.e. where a Contractor uses indicators for preliminary or unofficial revision status during the detailed design stage, such indicators shall not appear on drawings that are formally issued. Additionally, drawing revisions shall not increase unnecessarily by virtue of the design and construction process, i.e. Contractors must collate sets of comments rather than increasing revisions in line with individual comments during the design and/or verification stages.

All final As-installed drawings must be up-revised such that the revision box commentary includes the text 'Verified As-Installed' and a note of the relevant National Grid Investment number, plus a concise description of any content changes (or identify 'No Change to Content' if appropriate), to record the fact that the drawing has been signed-off as being accurate.

In the case of multi-sheet drawings, it is recommended that any amendment to an individual sheet should be reflected by increasing the revision number for only the sheet concerned thus minimising the need to amend and re-issue all sheets within the set.

The revision box text shall contain concise details pertaining to the creator/modifier and shall include the detail depicted in Appendix B (see paragraph B4).

4.1.7 Checking of Drawings

A suitably experienced and qualified individual (or individuals) shall be appointed by the Contractor to check and sign-off all drawings and associated calculations to confirm the following: -

- a) The specified design has been correctly interpreted and depicted.
- b) Correctness and consistency with all supporting technical information, including compliance with other relevant instructions, specifications and standards.
- c) That sufficient and relevant details are shown, and without any ambiguity.
- d) That the drawing correctly interfaces with other related drawings or documents.

The date and initials of the individual that checked the drawing shall be recorded within the drawing revision box (see Appendix B - items B3 and B4).

Individuals appointed to check and sign off a document must not be the person who also compiled the drawing or design calculations.

4.1.8 Approval of Drawings

After successful completion of checking, each drawing shall be signed-off as 'approved' by a suitably experienced and qualified individual appointed for this task by the Contractor. The individual who prepared or checked the drawing shall not undertake its approval.

The date and initials of the drawing approver shall be recorded in the drawing revision box to confirm that the current revision of the drawing is fit for its intended purpose (see Appendix B - items B3 and B4).

It is allowable to arrange for the drawing approval process to directly correlate with design verification and therefore the Contractor is at liberty to pursue such an approach if desired.

It is important to note that checking and approval (including design verification) shall be totally separate to the design assurance process as specified in National Grid procedure UKBP/TP188.

4.1.9 Obsolete and Superseded Drawings

Drawings that are obsolete or superseded are described as follows: -

- a) An **obsolete** drawing is one that is no longer required and is not superseded by another drawing (see below). Normally this applies where decommissioned plant and equipment is removed, and is not replaced. In this event, the master shall be amended such that the text 'DRAWING OBSOLETE' is prominently shown, preferably in close proximity to the drawing title block. Additionally, the master record in ECM shall be labelled such that the text 'OBSOLETE' is included within the drawing record title field.

The drawing revision number does not need to be incremented.

- b) A **superseded** drawing is one that is fully replaced by another drawing showing similar or equivalent content. Note: within the context of this definition, the term 'superseded' is not intended to apply if a drawing is up-revved and reissued using the same drawing number.

In this event, the superseded master drawing shall be amended to prominently show the text 'SUPERSEDED BY DRAWING No. xxxx*', preferably in close proximity to the drawing title block, and the drawing revision number shall be incremented.

Any new drawing that replaces a superseded drawing should include a note placed near to the title block that identifies the (National Grid) drawing number of the drawing that is superseded.

* *Where: xxxx represents the National Grid drawing number as appropriate.*

All obsolete and superseded drawings must be individually identified by the Contractor in the final Contract Drawing List (see item 9.3.5 below).

4.1.10 Prints Issued To Site

All prints of drawings issued to site for inclusion within the site drawing filing system shall be full size. Additionally, all prints must be monochrome (black on white) with the exception of drawings identified in item 4.1.4 as being required in colour.

4.1.11 Multi-sheet Drawings

Subject to achieving adequate legibility at the intended print size, it is preferred that drawings shall comprise of a single sheet rather than comprising of multiple sheets.

Where multi-sheet drawings cannot be avoided, it is required that the set of multiple sheets show content that falls into only a single National Grid drawing category, e.g. circuit diagram, wiring diagram, general layout, etc. (see Appendix C for a list of individual categories).

It is acknowledged that the above requirement may in some cases not be practical due to standard drawing output of automated design tools employed by a Contractor or equipment manufacturer. In this event individual sheets shall not contain mixed content as specified above, although mixed content will exist between individual sheets within the set. Unless otherwise agreed, these drawings shall be assigned with a drawing category number for 'Multi-sheet Composite Drawings' as stated in item 5.2.8 below.

For information, see Figure 1 below for a depiction of a multi-sheet composite drawing.

All sheets that form part of an individual multi-sheet drawing shall utilise the same drawing number which must be shown on each individual sheet. The latter applies to both the Originator and the National Grid drawing number (see also section 5 below).

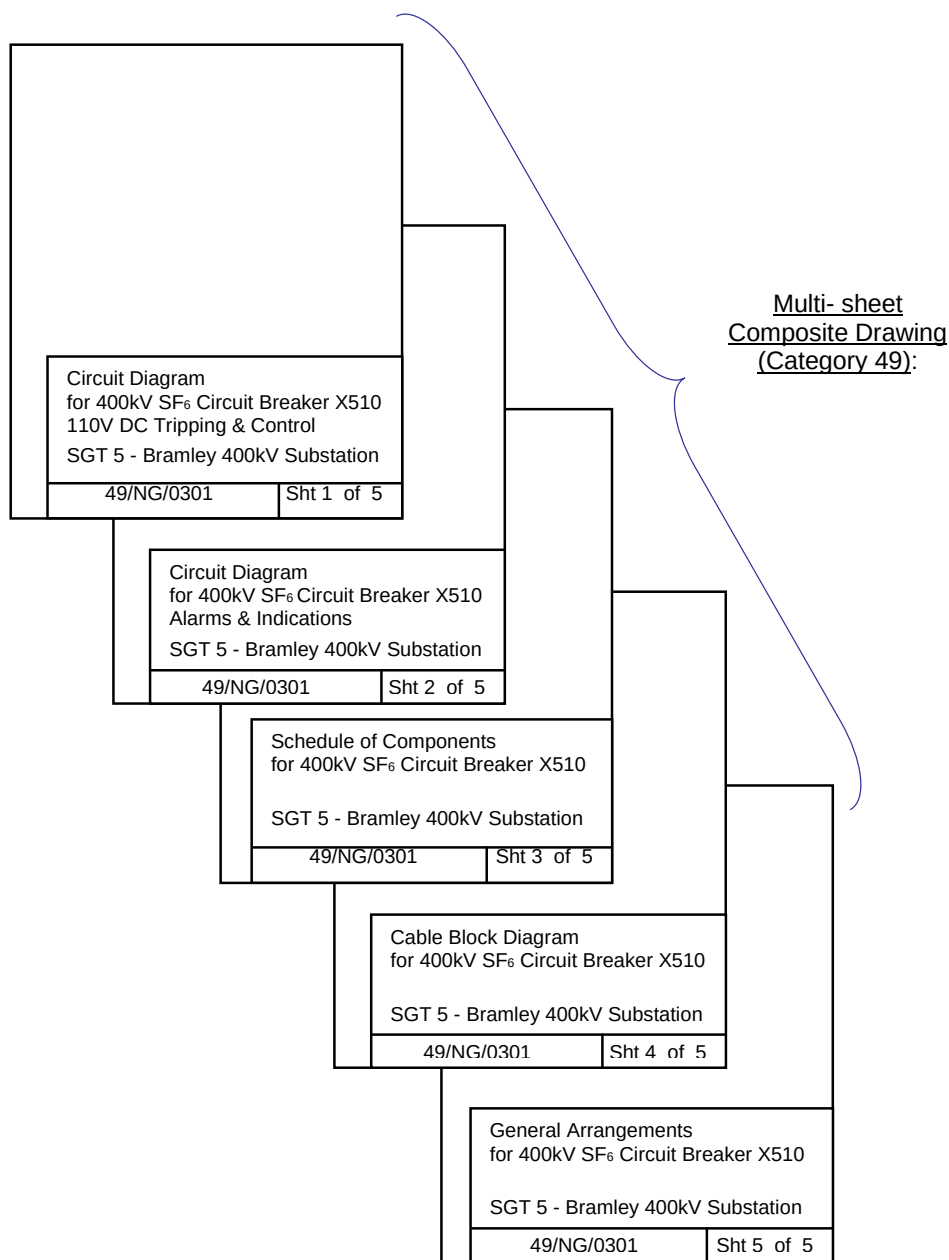


Figure 1 – Multi-sheet Composite Drawing

5 DRAWING REFERENCE NUMBERS

5.1 Originators Drawing Number

- 5.1.1 All drawings shall be allocated a unique reference number determined by the drawing Originator which must be shown in the drawing title block. The Originator is defined as the party that created the first issue of the drawing e.g. Contractor, Equipment Manufacturer, etc.
- 5.1.2 The Originators drawing number assigned at the first issue shall not be changed, and further Originators drawing numbers must not be added thereafter i.e. Multiple originator drawing numbers must not be used.
- 5.1.3 An Originators drawing number is not required if a drawing is created internally by National Grid, in which case only the National Grid drawing number will appear.

5.2 National Grid Drawing Number

- 5.2.1 In addition to the originators drawing number, all drawings shall be allocated a separate National Grid drawing number, to be added to the drawing title block by the drawing originator prior to its issue for comment/design assurance.
- 5.2.2 Multiple National Grid drawing numbers must not be used.
- 5.2.3 To prevent duplication of National Grid drawing numbers these must be tracked by the Contractor using a 'Self Allocation' National Grid drawing number log (in MS Excel format) that is unique to each Contractor. The Contractor must nominate the individual(s) within their organisation who has responsibility for maintaining the drawing number log to ensure that drawing numbers are never duplicated.
- 5.2.4 The master drawing number logs are held in ECM - these logs must be 'reserved & downloaded (as for a drawing record) as and when drawing numbers need to be allocated. The sequential element of the drawings number must utilise a minimum of 4 digits, which can increase beyond the value 9999 as necessary.
- 5.2.5 If it is required to establish a new Contractor, 'Self Allocation' National Grid drawing number log, a request must be submitted to National Grid (Drawing Management). Tier 2 Suppliers/Sub-contractors working on a construction project shall request National Grid drawing numbers directly from the Principal Contractor who appointed them. In this instance, the Principal Contractor shall allocate appropriate numbers from their respective drawing number self-allocation log.
- 5.2.6 The National Grid drawing number shall be adopted as the primary means of cross referencing between drawings - but the originators drawing number can also be used provided it is additional to the former. The only allowable exception applies in the case of a Generic Drawing that does not possess a National Grid drawing number, in which case only the Originators reference number shall be used.
- 5.2.7 Individual drawing cross references must be clearly indicated wherever drawing content is continued on, or interfaces with, the contents of another drawing (or sheet) i.e. where a drawing cannot be used in a totally stand alone context it must show a specific cross reference to all necessary related drawings - this applies to all drawing types irrespective of the engineering discipline.
- 5.2.8 Unless agreed otherwise by National Grid (Drawing Management), multi-sheet composite drawings (see 4.1.11 above) shall utilise the special number category of 49).

5.3 Structure of NG Drawing Number

5.3.1 The National Grid drawing number structure shall consist of a character string comprising three elements, namely 'X_Y_Z', where:-

X = a two digit NG Drawing Category code* (e.g. Wiring Diagram =) **44**

Y = a two or three digit 'Contractor' code allocated by NG (e.g. Central Alliance =) **CEA**

Z = a 'user' selected sequential number utilising four or more digits (e.g. next available unique number =) **54321**

Thus from the above example, the resultant drawing number is: - **44_CEA_54321**

* A full list of drawing category codes for electricity assets is shown in Appendix C.

6 SITE DRAWING INDEX & FILING SYSTEM

Each National Grid electricity substation (or similar operational site) shall maintain an up to date drawing filing system and associated index of any paper drawings that need to be permanently available at site for operational requirements.

The specific drawings to be held and filed at site shall be specified by National Grid (Operations), including any key drawings for third party owned assets that interface with National Grid assets. Typically, the latter will relate to substation protection and control, synchronising, and plant interlocking schemes, but other systems can also apply.

All site held prints must be clearly indexed and stored so that they can be easily retrieved when required, and a site filing index maintained so that it fully aligns with the retained drawings.

Prior to use of a site held print, it is the responsibility of the relevant user to confirm that the site print is not superseded by a later version held electronically in ECM.

In addition to the above, drawings which depict site security arrangements and related systems must be separately filed at site so that access to sensitive information is restricted as appropriate.

6.1 Site Drawing Index

6.1.1 Any party that completes work on assets that also requires changes to engineering drawings (e.g. new/updated particulars, removal of obsolete drawings, etc) must ensure that: -

- a) The latest and 'Verified As-installed' site drawing is incorporated as a clean print within the filing system (and submit electronic master for upload into ECM) – refer to item 8.4 below.
- b) The site filing master index is updated electronically and a paper copy is left on site (and submit electronic master for upload into ECM)

6.1.2 The process for implementing updates to the electronic master drawing index shall be identical to that for modifying master drawings. I.e. the master file must be firstly reserved, downloaded, modified, then re-uploaded as a new revision document, and finally un-reserved.

- 6.1.3 The electronic master index for each site at a given voltage level should be in MS Excel format, in the form of a single workbook with multiple worksheets as required. It is recommended that the structure of the site filing system should be based on the model template shown in Appendix D. The document revision reference shall be recorded in the form of 'Revision Date' and the latter shall appear consistently on each respective sheet when printed.
- 6.1.4 Where a copy of the master site-drawing index exists electronically, this shall be obtained by the party undertaking work at site by reserving it in ECM. The amended electronic file shall be returned to National Grid (Drawing Management) within a period not exceeding twelve weeks after works completion/commissioning/de-commissioning, whereupon arrangements will be made for the master file to be re-uploaded into ECM.
- 6.1.5 Apart from the entry of all relevant metadata associated with the final As-installed record (e.g. Drawing Title, Drg. Number, Revision Date, etc.) the layout and/or format of an existing index shall not be changed in any way without prior agreement.
- 6.1.6 If an electronic copy of the site drawing index is found not to exist, the Contractor shall as a minimum provide and incorporate new index sheets at site for each section of the drawing system that has had drawings added or removed. In this event the index sheet format shall comply with item 6.1.3 above, and upon completion an electronic copy shall be forwarded to National Grid (Drawing Management).
- 6.1.7 Where an index is to be updated or newly created, and drawings are already filed at site in a clear and logical manner, it is not necessary to re-engineer the drawing filing system, thus the index simply needs to reflect the already established site filing methodology.
- 6.1.8 Further advice in relation to site drawing indexes stored in ECM can be obtained by contacting National Grid (Drawing Management).

6.2 Site Filing System

- 6.2.1 The site filing system shall comprise of standard four drawer cabinets, preferably fitted with suspension hangers to locate folded drawings. However, where an existing site filing system needs to be expanded to increase capacity, and it already utilises specialist drawing hanging cabinets, the latter may be used instead if so required.
- 6.2.2 Cabinets shall be clearly labelled externally for quick identification of each drawer contents, as illustrated in Appendix D.
- 6.2.3 Drawings shall be stored such that they are grouped/sectioned in the sequential order shown within the site index.
- 6.2.4 At existing sites, drawings must be incorporated into the site filing system using the existing filing methodology. E.g. drawings will either be folded with print side inner-most or outer-most, or unfolded if drawing hanging storage cabinets are used. At new sites, all drawings will be folded inner-most to reduce wear and tear on the print surface, or alternatively hanging storage cabinets can be utilised. Irrespective of the storage method, each drawing shall be clearly marked in ink with the relevant site index number such that it can be viewed when the drawing is filed.

7 IDENTIFYING CHANGES TO DRAWINGS

To facilitate efficient delivery of both site installation work and/or drawing upkeep, it is required to ensure that any identified changes and/or drawing corrections are clearly highlighted – this approach shall apply to all drawings types.

7.1 Colour Convention

7.1.1 The following colour convention shall be adopted for hand marking drawings (prints): -

- a) Any additions to drawings shall be either drawn in RED &/or highlighted in RED or PINK.
- b) Any deletions to drawings shall be either marked in GREEN &/or highlighted in GREEN.
- c) Any 'comments or mark-up notes' not intended to be included as a drawing modification will be marked &/or highlighted in BLUE.
- d) Where drawings are being used to indicate progress of work at site, e.g. testing, etc. this may be indicated by highlighting in ORANGE.

7.1.2 Hand markings applied to drawings shall be deemed as a temporary measure pending updating of the electronic 'Master' and subsequent checking and acceptance of updated clean prints by comparison with the hand marked drawing retained at site.

7.1.3 For changes to construction project drawings, the requirements of item 8.1.3 below must always be met.

7.2 Recovery of Pre-existing Site Mark-up's

7.2.1 To facilitate the production of project drawings, and following confirmation of correctness by the National Grid (Operations) site representative, any pre-existing hand marked corrections shown on relevant site filed drawings (which may not be reflected on the master electronic file) should be captured by either colour scanning of site held prints, or by creating a duplicate hand marked print which can be used for reference away from site.

7.2.2 Using the data acquired from site prints, all corrections that remain relevant to the future installation shall then be reflected on the electronic master drawing through either: -

- a) Incorporation into a new CADD drawing (where appropriate), or alternatively,
- b) Updating of the original CADD master to utilise the next revision letter together with a revision note to identify that drawing changes are based on hand marked corrections on site held prints.

In the event of 7.2.2 b) above, the drawing can then be further 'up-revved' to reflect the changes arising directly as a result of the construction project and an electronic copy of both versions of the drawing must be submitted when the final As-installed drawing pack is returned to National Grid.

7.2.3 Any site-scanned drawings shall be used only for reference purposes – these files must not be treated as the electronic master unless previously agreed by National Grid (Drawing Management).

8 MANAGEMENT OF DRAWINGS FOR A CONSTRUCTION PROJECT

For ease of reference, a process map that outlines the preparation and site management of project drawings at (i), any site requiring site filed drawings (e.g. Substations) and (ii), a site that does not require site filed drawings (e.g. OHLs) is shown in Appendix E and Appendix F respectively. Suggested timescales for commencement of key drawing activities for a project are provided in Appendix G.

The Principal Contractors Site Manager (Contractor Site Manager for non-notifiable projects) as defined in item 1.3.1 and 1.3.2 above, shall ensure that the site controls defined in this section are established so that the latest version of each accepted construction drawing is readily identifiable, and a single reference print is fully maintained and controlled as a construction site master reference document.

Each drawing that depicts system/scheme logic that is fundamental to achieving a specified operating function shall be controlled at site such that all proposed amendments are formally agreed as highlighted in 8.1.2 and 8.1.3 below.

The Commissioning Panel (as defined in National Grid procedure UKBP/TP106) shall normally identify the drawings that are to be controlled in this manner, and the relevant construction prints shall be marked with a red ink stamp to highlight that the drawing is **'SITE CONTROLLED COPY FOR COMMISSIONING PURPOSES'**. The stamp shall be applied only to drawings firstly identified as **'ACCEPTED FOR CONSTRUCTION'** and which will be used to support site commissioning activities. This applies only to the following drawing types:

- a) Electrical Schematics
- b) Electrical or Mechanical Functional Logic
- c) Pipeline System Schematics (oil, air, gas, etc.)
- d) Mechanical Interlocking

8.1 Projects Involving a Single Contractor

Prior to commencing the production of construction drawings for a substation project, it is recommended that the Contractor should complete a site survey at the Tender stage to establish the condition of the site drawing filing system (where applicable) and to identify master drawing records that will need to be obtained and updated. With support from the National Grid (Operations) site representative, such a survey must also identify details of any relevant drawings that remain un-filed at site.

Where there is only a single Contractor involvement at a particular site, the following shall apply:-

- 8.1.1 Following completion of design verification and appraisal, at least four weeks prior to outage / work commencement (whichever occurs first) the Contractor shall ensure that sufficient sets of construction drawings are provided at site and clearly stamped (or identified) on the drawing as **'ACCEPTED FOR CONSTRUCTION'** - see 'Identifier B' in Appendix E or F. This shall also apply to construction drawings that do not need to undergo Design Assurance to UKBP/TP188, and is equally applicable to all Temporary Works Contracts. As a minimum, one set shall be used as a working copy for installation/testing purposes, whilst a separate full set of drawings will be used as the site construction reference set. A further set of construction drawings may be required for recording the As-Installed conditions after works or final commissioning / decommissioning is complete - see item 8.3 below.
- 8.1.2 For projects that require a Commissioning Panel to be established in accordance with National Grid procedure UKBP/TP106, the Commissioning Panel Chairman shall confirm those individuals with the authority to mark up/amend construction drawings that are stamped **'SITE CONTROLLED COPY FOR COMMISSIONING PURPOSES'** – see 'Stamp C' in Appendix E.
- 8.1.3 The Commissioning Panel Chairman shall also confirm those individuals with the authority to approve changes to 'site controlled' drawings during the construction stage. Any proposed amendments to the latter drawings must be brought to the attention of, and agreed by, the appointed authority.