

DIGITAL ENGINEERING (PAS 1192-2&5)

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PURPOSE AND SCOPE

This is a comprehensive Transmission Procedure describing all aspects of what can be delivered as part of a digitally engineered project.

The employers' information requirements (eir) will define each specific data requirement or data exchange protocol for each specific project. The bim execution plan (bep) will define how the requirements of the eir are satisfied and how the project will be delivered.

This Transmission Procedure specifies the requirements for procedures defining the use of digital engineering within the TP500 process, NDP Stages 4.2 to 4.5, compliant with BS 1192:2007 and PAS 1192-2:2013.

National Grid has adopted the terminology 'Digital Engineering' to represent a broader range of activities than those traditionally defined as purely 'BIM'.

It is also felt that 'Digital Engineering' better reflects the linear nature of its infrastructure.

The purpose of this Transmission Procedure is to define the requirements of the following:

- a) Incorporation of digital development models and digital construction models within the TP500 process, stages 4.2 to 4.5 of the investment process of Electricity Transmission Capital Delivery.
- b) NDP Phase 4.1 is handled by National Grid in the standard way, (i.e. no models are developed at this stage).

- c) Procedures and standards to facilitate information management for the capital/delivery phase of construction projects using building information modelling (BIM).
- d) Alignment of Building Information Modelling processes with Technical Data Process and Assurance TP 221
- e) Procedures and standards to facilitate the capability for integrating geographic information system (GIS) into Information Management process.
- f) Definition of the required Level of Detail, (LOD) and Level of Information, (LOI) for the Project Information Model, (PIM) at each TP500 stage.
- g) Provide definitions of the required Standard Protocols for use.
- h) Definition of Data Drops at each TP500 stage.
- i) National Grid BIM Execution Plan (BEP) template.
- j) National Grid Employers Information Requirements (EIR) template.
- k) National Grid GIS Execution Plan (GEP) template.

PART 1 – PROCEDURAL

1 RESPONSIBILITIES

To support compliance with Construction (Design & Management) Regulations, as well as other legislation in which dimensionally accurate drawings have a fundamental role, the overriding principle with respect to model and/or drawing production 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 Capital Delivery – Project Development / Delivery Vehicle

- a) Development Engineer / Project Engineer

The Development Engineer or Lead Project Engineer working on any specific project on behalf of National Grid shall:

- (i) Ensure that this procedure is fully complied with.

1.2 FEED Consultants & EPC Contractors

The Development Engineer or Lead Project Engineer working on any specific project on behalf of National Grid's Capital Delivery or modification works shall:

- a) Manage the model and drawing creation adhering to this Transmission Procedure.
- b) Manage all design information quality issues.
- c) Publish Data Drops at the project stages defined in this Transmission Procedure; refer to TP235-1 Employers Information Requirements, Section 6.3
- d) Assure compliance with LOI and LOD definitions; as defined in the post contract BIM Execution Plan

2 PROTOCOL AND STANDARDS

The production of co-ordinated design and construction information is a task- and time-based process, independent of which procurement route or form of contract is used. Each task needs to be carried out in a particular order for the mutual benefit of all those involved, otherwise known as "collaborative working". In a collaborative working environment, teams are asked to produce information using standardised processes and agreed standards and methods to ensure the same form and quality, enabling information to be used and reused without change or interpretation. If an individual, office or team changes the process without agreement, it will hinder collaboration – a participant insisting on "my standard" is not acceptable in a collaborative working environment. (PAS 1192-2:2013, British Standard Institute)

The Standards identified within this Transmission Procedure are provided to ensure that a consistent approach is undertaken by all participants throughout the project lifecycle.

2.1 Common Data Environment (CDE)

Details of the proposed use and management of a CDE must be provided as part of the pre-contract BIM Execution Plan for National Grid assessment. The CDE approach used shall be in accordance with processes outlined in BSI standard publications BS 1192:2007 and PAS 1192-2:2013.

2.2 File Naming Convention

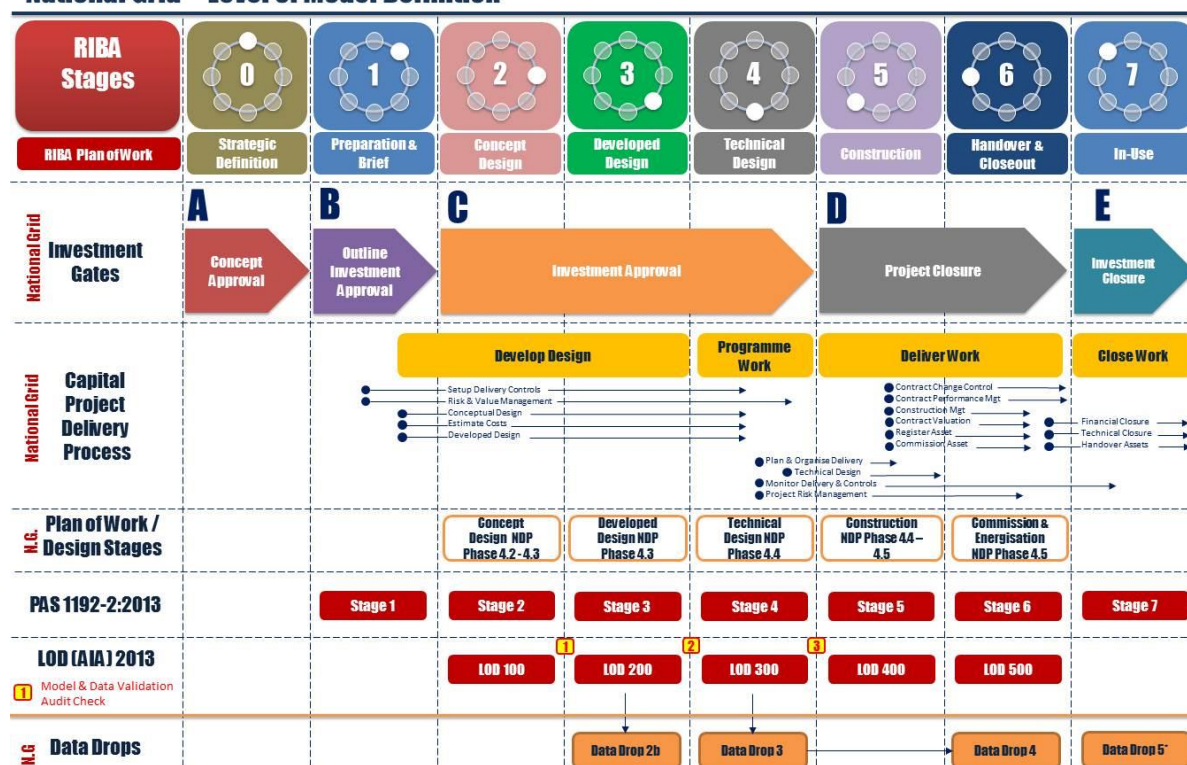
File and naming conventions shall be in accordance definitions provided in the BSI standard publications BS 1192:2007 and PAS 1192-2:2013.

2.3 Level of Model Definition

The level of model definition shall be in accordance with BSI standard publication PAS 1192-2:2013.

The level of model definition required in a model at an information exchange shall be defined in the EIR. The level of graphical information and data to be delivered at each information exchange will be defined by suppliers in the BEP with reference to industry standards.

National Grid – Level of Model Definition



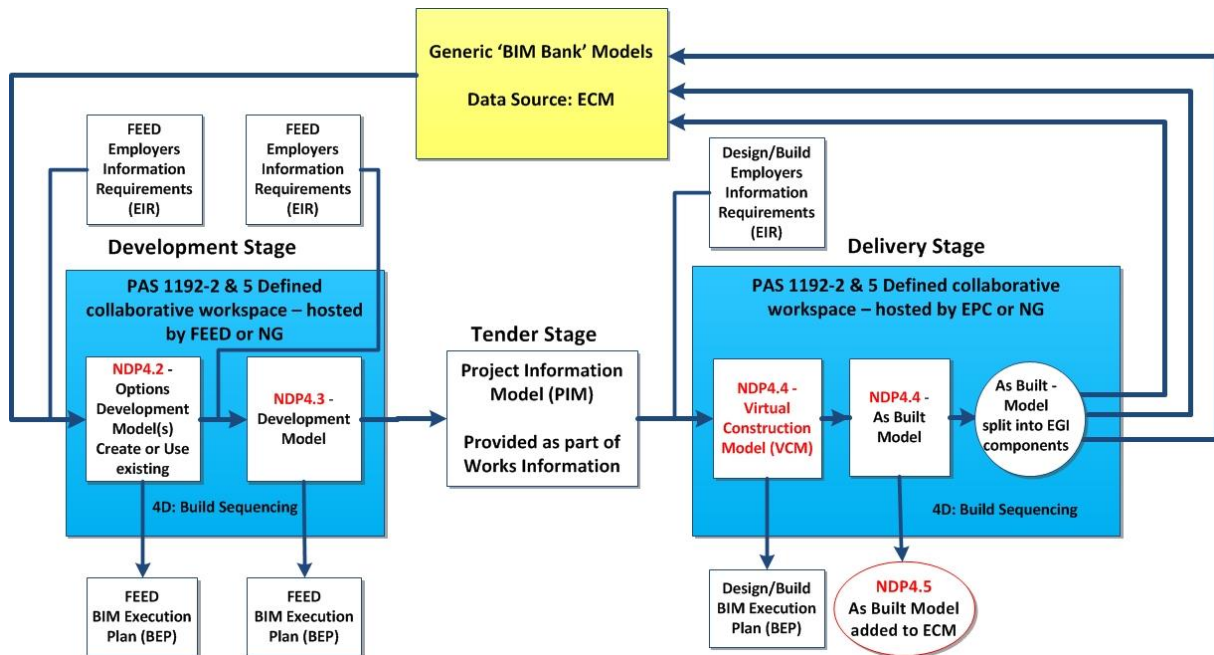
3 PROCESS STAGES / BIM PROTOCOLS

3.1 BIM Process Definition Overview

The BIM process is described in this section under the headings:

- What data** is transferred, reviewed and published at each NDP Stage
- How the data** is transferred, reviewed and published at each NDP Stage
- When is the data** is transferred, reviewed and published at each NDP Stage

This document is based on NDP phases as defined TP 500 process and supporting technical processes and standard as shown in the Process Flow Diagram, figure 2 below:



Process Flow Diagram; Figure 2

This Transmission Procedure provides user guidance on how the protocols are integrated into the procurement and delivery process. The key documents are:

- Employer's Information Requirements template
- BIM Execution Plan template
- GIS Execution Plan template

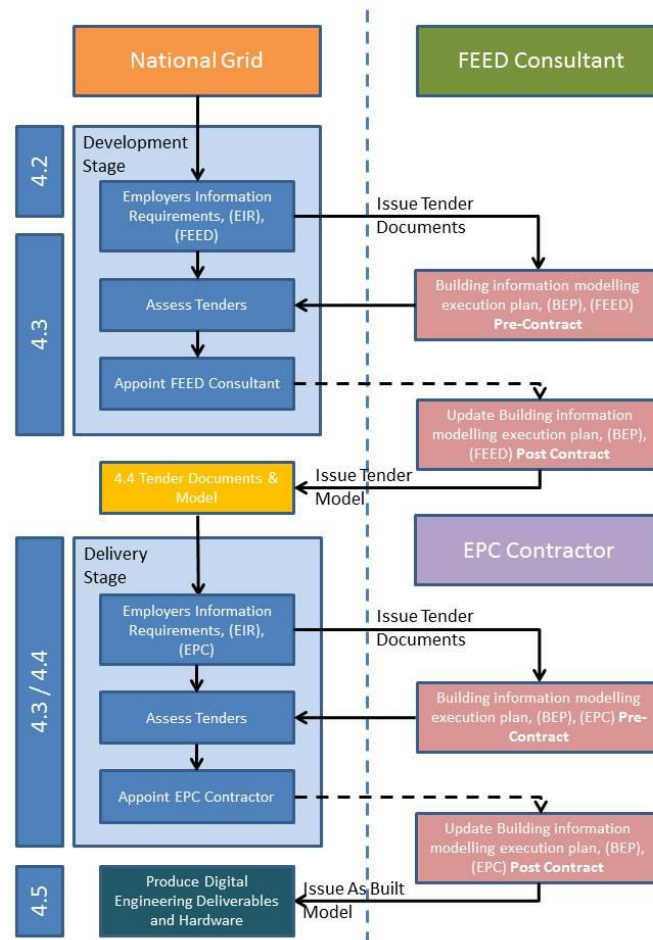
These documents represent the principle documents to begin to implement BIM on National Grid projects. All three documents will be informed and developed iteratively as projects progress. The versions presented in TP235-1 to TP235-3 should be tailored to meet current project maturity.

This overarching Transmission Procedure acts as a manual providing guidance on the role each document plays and how they complement each other in their use.

4 PROCUREMENT PROCESS

Integrating BIM requirements into the procurement process is essential to communicate project delivery requirements to the supply chain. The below process describes how the supporting BIM implementation documentation should be integrated into the existing National Grid procurement process, and defines the responsibilities of National Grid personnel to ensure their effective application on projects.

Figure 3; Procurement Process describes the integration of the BIM protocols into the tender process.

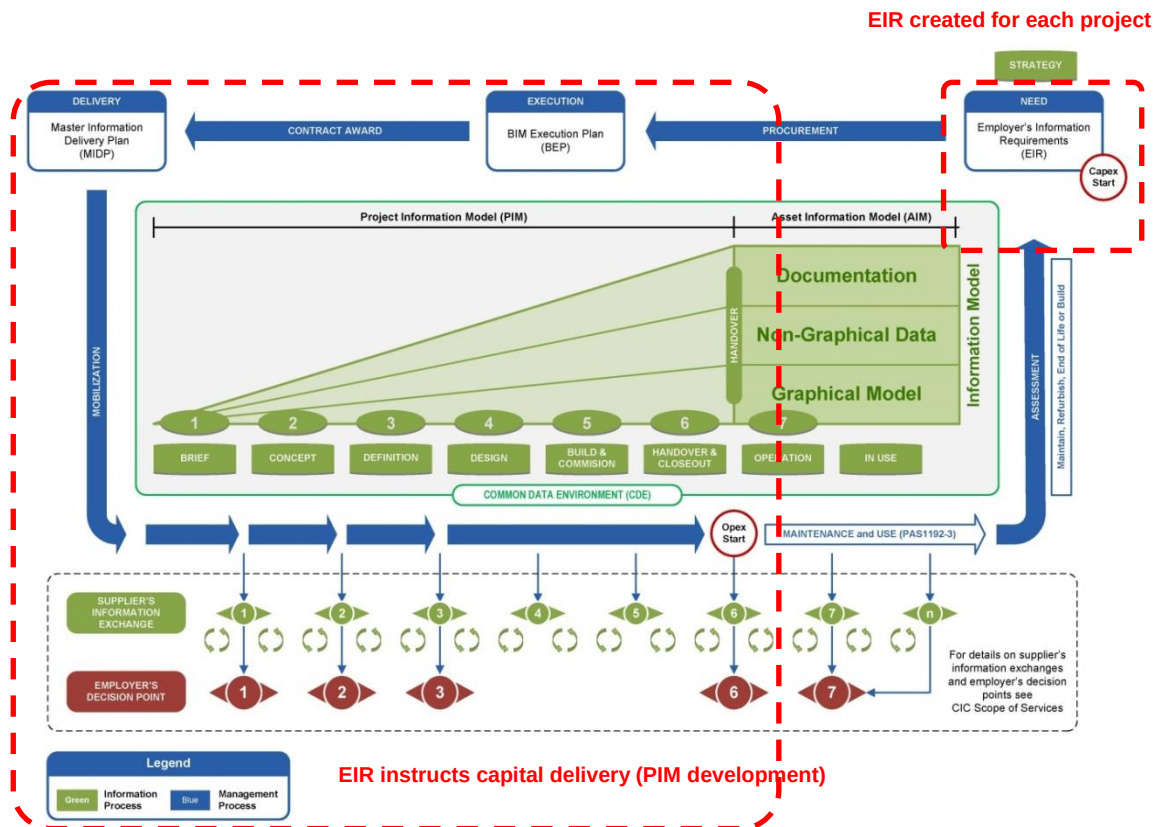


Procurement Process; Figure 3

5 EMPLOYERS INFORMATION REQUIREMENTS

To implement BIM processes on any project, National Grid must communicate their information requirements to its suppliers. The Employers Information Requirement (EIR) document clarifies the information to be delivered by the supply chain for capital projects at key decisions points and project gateways during design and construction. It also sets out the information requirements at handover for commissioning and into the Asset Management system.

In accordance with PAS 1192-2:2013, the EIR sets out the information to be delivered at each project stage. Each supplier will produce a pre-contract BIM Execution Plan in response to the EIR document to define how they will address the information requirements, and provide details of information management procedures. The pre-contract BIM Execution Plan should form part of the National Grid's assessment of a supplier's level of BIM maturity and competence.



Information Delivery Cycle; Figure 4 (image credit: PAS 1192-2:2013)

5.1 EIR Contents

"Identifying information requirements actually has very little to do with the technology being used itself. We have been generating information in a more or less organised fashion for over a hundred years – in construction drawings, specifications, scale models, component schedules, requests for information, bills of materials, photographs, as-built drawings, and dozens of other documents. To visualise an information model as a compendium of this type of traditional data is far easier than trying to visualise nD asset information. The ultimate objective is to compile this type of familiar documentation in a comprehensive, reliable, accessible and easily exchangeable information model for anyone who needs it throughout the lifecycle of an asset" (Smith, & Tardif, 2009).

The key items contained in the EIR are as follows:

- TP235-1 Employers Information Requirements, (EIR)

The EIR should give consideration to the following types of information exchange:

- Drawings Outputs
- Component Schedules
- Bill of Materials
- Design Specifications
- Classification Standard Codes

- g) Asset Codes
- h) Carbon Performance
- i) Unit Cost
- j) O&M Manuals

5.1.1 National Grid to advice on EIR data requirements

In the absence of data requirements being specified within the EIR, suppliers may document their own intended data requirements within the BEP documentation for National Grid approval.

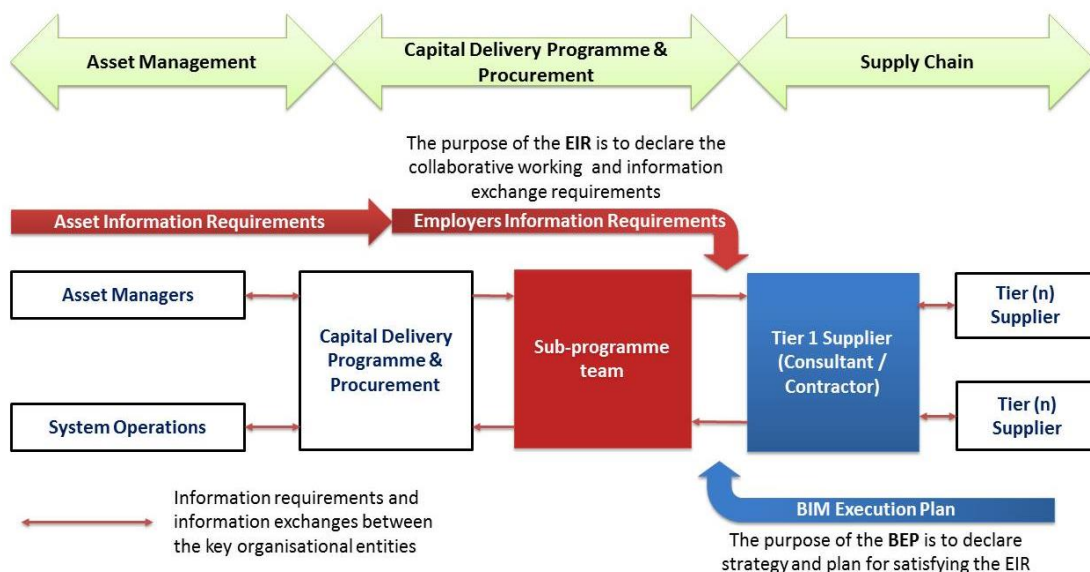
The EIR ensures that the supplier delivers the necessary information to make informed decisions during the development of the new asset and into asset management. This is the first step in the information lifecycle, ensuring the information generated early in the asset life transfers to the operation and maintenance stage.

As National Grid's BIM maturity develops, the EIR will evolve to include greater integration of asset data into the models that can transfer to the Asset Management Systems.

5.2 Template development

- a) The EIR template is provided in the following documentation:
- b) *TP235-1 Employers Information Requirements (EIR)* This template document contains guidance notes in *red italic text* describing the specific information that is required to be added or customised for each project brief.

These specific information requirements are driven by the operational business i.e. who will ultimately be responsible for the operation and maintenance of the new asset. As described in Figure 5 below, the Asset Management and Capital Delivery & Programme & Procurement teams will need to agree these requirements and content of the EIR prior to releasing tender information and subsequent responses from the supply chain.



EIR Development; Figure 5

For each project or sub-programme, key project stakeholders should meet to define the requirements to be captured in the EIR. This should include representatives from all directorates with an interest in the delivery of the project and its ultimate operation.

6 BIM EXECUTION PLAN (BEP)

The BEP is typically produced by all supply chain project delivery team to demonstrate how the requirements in the EIR are to be delivered throughout a project. There are two types of BEP:

- a) Pre-contract – To be submitted with a supplier's tender proposal.
- b) Post-contract – To be produced and agreed with NG on contract award.

The document will capture the BIM working practices intended to be used on the project and must be reviewed and approved by National Grid prior to any design works commencing.

The pre-contract BIM Execution Plan should form part of the National Grid's assessment of a supplier's level of BIM maturity and competence.

6.1 FEED Consultant & EPC Contractor BEP

- a) Pre-contract
 - (i) The Pre-contract BEP outlines the proposed delivery methodology by the supply chain. A more detailed version is produced after contract award.

In addition to information requested as part of any tender process, a comprehensive BEP will include the following information:

- b) The Project BIM Implementation Plan
 - (i) Project goals for collaboration and information modelling
 - (ii) Major Project milestones consistent with the project programme
 - (iii) Key Project BIM Stakeholders
 - (iv) Information model delivery strategy

6.2 National Grid BEP Assessment

The EIR will act as a basis to review the contents of the tenderer's BEP to demonstrate competence and detail proposed information management procedures in response to the EIR requirements.

National Grid will review the BEP to ensure its completeness.

6.2.1 Post-Contract

- a) The post-contract BEP adds the remaining detail to the pre-tender documentation to ensure efficient project delivery and success. Its purpose is to set out with clarity how BIM will be used on a project.

The BEP should be owned and maintained by the Consultant / EPC Contractor.

The BEP is a live document and will be monitored, updated and revised as needed through the course of the project. As a minimum the document should be updated at each key stage of the project, with minor updates on an as-required basis.

6.3 Considerations for Best Practice

The following section outlines considerations for best practice relating to BIM methodologies. These examples are provided for information and should not be considered a definitive list:

- a) **Standards:**
The alignment of project practises with current industry standards.
- b) **Common Data Environment (CDE)**
The CDE is a means of providing a collaborative environment for sharing work and can be implemented in a number of ways.
- c) **Key Roles and Responsibilities:**
Identification of key roles and responsibilities associated with model production, analysis and management and coordination.
- d) **Level of Detail (LOD) and Level of Information (LOI) Definitions:**
Definitions shall be in alignment with TP500 (Capital Project Delivery Process).
- e) **Model Production and Delivery Table (MPDT):**
MPDT defines the scope of the model at defined project stages.
- f) **Survey Data:**
Consideration to be given to how existing information is to be managed.
- g) **Collaboration Process:**
The sharing of information between stakeholders; giving consideration to spatial coordination and How, Who and When
- h) **Design Review:**
Review of federated design models with multi-stakeholder input; giving consideration to How, Who and When
- i) **Model coordination:**
To ensure accurate co-ordination of all design information produced by stakeholders.
- j) **Conflict, Interference, Clearance and Collision Detection:**
Design model conflict / interference / clearance and collision simulation and reporting; giving consideration to How, Who and When.
- k) **4D / 5D Process:**
Time (4D) and cost (5D) simulation; giving consideration to How, Who and When.
- l) **Software:**
When software from different vendors needs to communicate, then communication rules need to be formalised and agreed within the BEP.
- m) **Parametric Object Libraries:**
Parametric rules associated with objects to provide a reduction in geometric, spatial and alignment errors.
- n) **Deliverables:**
Assessment of required outputs for each stage of the project