Office for Nuclear Regulation

ONR GUIDE			
CIVIL ENGINEERING - BUILDING INFORMATION MODELLING (BIM)			
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LIST OF ABBREVIATIONS

2D/3D	2/3 Dimensional
4D/5D	4/5 Dimensional (see Glossary)
AIM	Asset Information Model
BEIS	Department for Business, Energy and Industrial Strategy
BEP	BIM Execution Plan
BIM	Building Information Modelling
CAD	Computer aided design
CDBB	Centre for Digital Built Britain
CDE	Common Database Environment
COBie	Construction Operations Building Information Exchange UK 2012
CPNI	Centre for Protection of National Infrastructure
EIR	Employers Information Requirements
EIMT	Examination, Inspection, Maintenance, Testing
ERP	Enterprise Resource Planning
iBIM	integrated BIM
IFC / IFD	Industry Foundation Classes
IPR	Independent Peer Review
ISA	Independent Structural Assessment
ISO	International Standards Organisation
ITA	Independent Technical Assessment
LTPR	Long Term Periodic Review
MIDP	Master Information Delivery Plan
MSC	Management Safety Committee
NSC	Nuclear Safety Committee
pBIM	proprietary BIM
PIM	Project Information Model
PSR	Periodic Safety Review
RGP	Relevant Good Practice
TIDP	Task Information Delivery Plan

GLOSSARY

Term	Description	
3D Model	This is the digital representation of a structure or building created out of a range of inputs from clients, dutyholders, architects, designers, contractors, suppliers, and facility management companies. It is presented as a 3D Model that is held in the clients or dutyholders Common Database Environment (CDE). Level 3 BIM will require all parties to have access to the CDE (this could be a server or a cloud-based system).	BIM [2]
Employers Information Requirements (EIR)	This defines the Employers requirements at the start of the project of what model information is required, when and to what level of detail and definition. The EIR covers technical, management and commercial areas. These models are key deliverables in the "data drops" required prior to key gateway decisions. For more detail on data drops refer to later section on COBie (Construction Operations Building Information Exchange).	BIM [2]
BIM Protocol	This is a contractual agreement that puts responsibilities on parties to detail and produce the BIM models in a standard format on behalf of the employer (often the dutyholder).	BIM [2]
BIM Execution Plan (BEP)	This is the response from prospective suppliers (i.e. referred to as designers and contractors in civil engineering) and sets out their proposed approach and capabilities to meet the EIR. Once the contract is awarded the supply chain then confirms its capabilities and provides a Master Information Delivery Plan (MIDP).	BIM [2]
Construction	"construction work" means the carrying out of any building, civil engineering or engineering construction work and includes— (a) the construction, alteration, conversion, fitting out, commissioning, renovation, repair, upkeep, redecoration or other maintenance (including cleaning which involves the use of water or an abrasive at high pressure, or the use of corrosive or toxic substances), de-commissioning, demolition or dismantling of a structure; (b) the preparation for an intended structure, including site clearance, exploration, investigation (but not site survey) and excavation (but not pre-construction archaeological investigations), and the clearance or preparation of the site or structure for use or occupation at its conclusion; (c) the assembly on site of prefabricated elements to form a structure or the disassembly on site of the prefabricated elements which, immediately before such disassembly, formed a structure; (d) the removal of a structure, or of any product or waste resulting from demolition or dismantling of a structure, or from disassembly of prefabricated elements which immediately before such disassembly formed such a structure; (e) the installation, commissioning, maintenance, repair or removal of mechanical, electrical, gas, compressed air, hydraulic, telecommunications, computer or similar services which are normally fixed within or to a structure, but does not include the exploration for, or extraction of, mineral resources, or preparatory activities carried out at a place where such exploration or extraction is carried out	Construction (Design and Management) Regulations 2015 (CDM2015)
	The activities related to installation or building, modifying, testing, remediating, repairing, renovating, repurposing, alteration, refurbishment, replacement, maintaining, decommissioning, decontamination, dismantling or demolishing a civil engineering structure, system or component. 'Construction' can happen at any stage in the lifecycle of the site, including earthworks, site preparation, enabling works, ground investigations, geotechnical or ground engineering, foundations and superstructure construction works, mock-ups and trials, and temporary works to support the same. Construction may also include civil engineering works associated with examination, inspection, testing and maintenance.	For the purposes of this TAG and the associated annexes
Construction Operations Building Information Exchange UK 2012 (COBie)	This is the central spreadsheet that delivers all the project information except the graphical data that can be shared, updated and securely stored throughout the project. COBie makes provision for the information to be handed over at four stages during the lifecycle of the project, referred to as "Data Drops" 1 to 4 which are- 1. Requirements and Constraints. 2. Outline solution.	BIM [2]

	3. Construction and Information. 4. Operations and Maintenance information. The dutyholder or client will use these to inform operations, asset care and maintenance. These data drops are significant project stages where checks can be made: • To assure the data meets the projects requirements, • The data is mature enough to go forward into the next development stage, • Adequate levels of rigour have been applied within the peer review process and independent challenge. The Inspector can find more information at (Ref. 16). Understanding data drops will aid an ONR Inspector's decision as to the relevant stage of the facility's lifecycle to plan their regulatory strategy and use of appropriate licence conditions.	
Design	This civil engineering TAG and associated annexes applies equally across all stages of a nuclear facility's lifecycle, including generic and/or concept design, licensing, site identification, site specific design, construction and installation, operation, modifications, post-operation, decommissioning and demolition, 'care and maintenance' phase etc. 'Design' can also include, the safety case documentation, supporting references, justification and substantiation of claims, modelling or other analysis tools, the process(es) and records of design decision making, and independent reviews of the above. It should be recognised, within the life cycle of 'civil engineering works', that the assumptions made by the designer and incorporated within the justification of the design within a safety case, must be properly carried through the construction stage and through to modifications, demolition and site clearance. All associated construction activities throughout the life cycle are much a part of the safety case as the design.	For the purpose of this annex
	"design" includes drawings, design details, specifications and bills of quantities (including specification of articles or substances) relating to a structure, and calculations prepared for the purpose of a design;	CDM2015
Dutyholder	For the purpose of this annex, the dutyholder is any organisation or person that holds duties under legislation that ONR regulates. 'Dutyholder' includes Licensees, Requesting Parties, Potential Future Licensees, Operational Licence Dutyholders, Decommissioning Site Licensees, New Build Site Licensees, budget holders, vendors and supply chain members.	For the purpose of this annex
IFC / IFD	Refers to the neutral file format for exchanging data across different software platforms. Most software platforms have the ability to export and save data in IFC / IFD (Industry Foundation Classes) format.	BIM [2]
Level of Detail	Detail refers to the amount of data within a 3D model as a given point in time.	BIM [2]
Level of Development	Development refers to the degree that an element design has been progressed through, together with the level off reliance the project team can consider when using the model.	BIM [2]
Master Information Delivery plan (MIDP).	This is a document that is developed from the BIM Execution Plan that details team roles and responsibilities; deliverables, timescales, approval procedures and arrangements for interoperable file sharing.	BIM [2]
Nuclear Facility	A facility and its associated land, buildings and equipment in which nuclear materials are produced, processed, used, handled, stored or disposed of on such a scale that consideration of safety is required.	Definition from WENRA Decommissioning Reference Levels (DSRL)
Project Information Model and Asset Information Model (PIM and AIM)	Over its lifetime, project teams create structured and accurate data in the model that is stored in the CDE until it is fully handed over to the Client or dutyholder. Before handover, this information is called the Project Information Model and after is called the Asset Information Model.	BIM [2]

Structure	"structure" means— (a) any building, timber, masonry, metal or reinforced concrete structure, railway line or siding, tramway line, dock, harbour, inland navigation, tunnel, shaft, bridge, viaduct, waterworks, reservoir, pipe or pipeline, cable, aqueduct, sewer, sewage works, gasholder, road, airfield, sea defence works, river works, drainage works, earthworks, lagoon, dam, wall, caisson, mast, tower, pylon, underground tank, earth retaining structure or structure designed to preserve or alter any natural feature and fixed plant; (b) any structure similar to anything specified in paragraph (a); (c) any formwork, falsework, scaffold or other structure designed or used to provide support or means of access during construction work, and any reference to a structure includes part of a structure;	CDM2015
Structures Systems and Components (SSCs)	Definition from WENRA Decommissioning Reference Levels: A general term encompassing all of the elements (items) of a facility or activity which contribute to protection and safety, except human factors. - **Structures** are the passive elements: buildings, vessels, shielding, etc. - A **system** comprises several **components**, assembled in such a way as to perform a specific (active) function. A **component** is a discrete element of a **system**.	WENRA DSRL
Task Information delivery plan (TIDP).	These are produced for each individual information deliverable and are the basis for producing the MIDP above.	BIM [2]
3D	Describes something in a 3D view including walkthroughs, animations and virtual reality.	BIM [2]
4D	4D is the added aspect of time into a projects phasing, sequencing and planning (i.e. MS Project /Primavera).	BIM [2]
5D	5D is the added aspect of cost estimating and analysis.	BIM [2]
6D	6D is the added aspects of lifecycle management including maintenance, space and supply chain.	BIM [2]
7D	And beyond; where a number of practitioners claim different purposes for these acronyms, however there is no established convention for this.	BIM [2]

1 INTRODUCTION

1. This appendix provides guidance on the use of Building Information Modelling (BIM) considered relevant to nuclear safety on nuclear licensed and authorised sites. It provides guidance to inspectors on the application of the SAPs [1] to the assessment of work using BIM.

2. Building Information Modelling is a process that manipulates large amounts of data with proprietary software to create a three-dimensional model (3D) of a project. The stakeholders within the dutyholder's project team provide the data and the model is then used as a platform to collaboratively share, add and manage information over the lifecycle of the structure, building or facility.

3. There are a number of definitions of BIM.

   - Centre for Digital Built Britain [2] defines BIM as:

     "BIM is a collaborative way of working that facilitates early supply chain involvement, underpinned by the digital technologies which unlock more efficient methods of designing, creating and maintaining our assets. BIM provides a digital representation of the physical and functional characteristics of an asset to support reliable decision making and management of information during its life-cycle."

   - The US National Building Information Model Standard Project Committee [3] has the following definition:

     "Building Information Modelling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition."

4. The UK Government has established a BIM Task Group to develop and encourage the uptake of BIM within the construction industry. They have defined various stages of development and maturity levels described as Level 0 to 3 (Refer to Fig 1).

5. The Levels are defined [4] as:

Level 0

6. Unmanaged CAD probably 2D, with paper (or electronic paper) as the most likely mode of data exchange.

Level 1

7. Managed CAD in 2 or 3D format with a collaboration tool providing a common data environment, possibly some standard data structures and formats. Commercial data managed by standalone finance and cost management packages with no integration.

Level 2

8. Managed 3D environment held in separate discipline "BIM" tools with attached data. Commercial data managed by an Enterprise Resource Planning (ERP). Integration on the basis of proprietary interfaces or bespoke middleware could be regarded as "pBIM" (proprietary). The approach may utilise 4D programme data and 5D cost elements, and inform operational systems.

9. The requirement to comply with Level 2 BIM came into force for all government departments on 4 April 2016 and in the civil engineering industry is sometimes referred to as "fully collaborative 3D BIM".

10. **Level 3**

11. Fully open process and data integration enabled by “web services” compliant with the emerging Industry Foundation Classes (IFC / IFD) standards, managed by a collaborative model server. This could be regarded as integrated BIM (iBIM), potentially employing concurrent engineering processes.

12. An overview of BIM level definition is provided here.

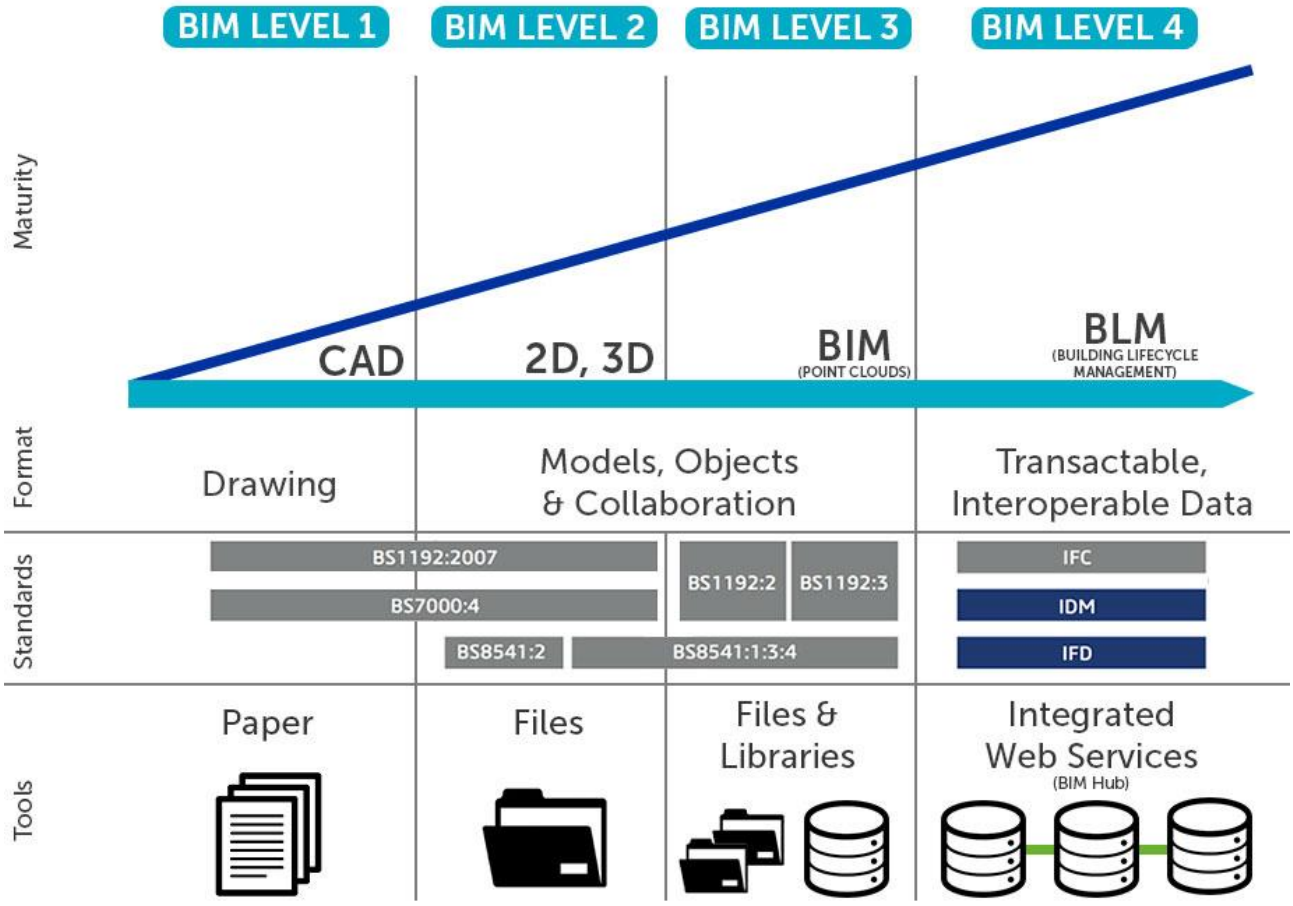

Figure 1: The BIM Maturity Model by Mark Bew and Mervyn Richards [5]

13. For civil engineering, BIM is primarily used in the design and construction phase of a project, but the information in the 3D model can also inform the projects holistic lifecycle and applies to maintenance, asset care, modifications, operations and decommissioning.

14. BIM has not yet been implemented to its fullest potential in the UK, and the UK civil engineering industry as a whole is yet to realise best value from digital tools. As an example, in 2019, the Institution of Civil Engineers produced a report “Breaking Barriers in BIM” [6] which found the following barriers and sources of errors when using BIM on UK civil engineering projects:

- that there is incomplete data at the design phase
- changes to design can be more onerous to change a model than a drawing,
- Means of exchanging information across different parties e.g. incompatible software systems or changing between software systems.

15. As such, the Inspector should be aware of the changes in use of BIM as the UK industry develops over time, and what sources of errors may still exist.

16. The 3D model enables the simulation of design and construction processes before manufacturing and site construction. This aids problem solving, clash identification, elimination of hazards and risk reduction, more informed and quicker decision making, improved understanding and clearer communications within the dutyholder's team. That distillation can then generate improved safety and programme, together with cost information and supply chain requirements in relation to lead in times, manufacturing and delivery dates.

17. Similarly, the dutyholder can use the 3D model information to develop arrangements for:

- commissioning, operational rules and instructions, training arrangements, asset care registers, plant maintenance schedules. These also support the basis of record keeping and arrangements for modifications, refurbishments and periodic reviews,
- emergency arrangements,
- safeguards and security provisions,
- decommissioning and demolition.

2 LICENCE CONDITIONS

18. ONR regulates by permissioning activities through compliance with the requirements of the Licence Conditions attached to the Site Licence. BIM covers the life cycle of a project and the following Licence Conditions have particular relevance for civil engineering:

- LC6 Documents, records, authority's certificates and Certificates,
- LC7 Incidents on the site,
- LC11 Emergency arrangement,
- LC12 Duly authorised and other suitably qualified and experienced persons,
- LC 14 Safety documentation,
- LC 15 Periodic Review,
- LC 16 Site plans, designs and specifications
- LC 17 Management systems,
- LC 19 Construction or installation of new plant,
- LC 20 Modification to design of plant under construction,
- LC 21 Commissioning,
- LC 22 Modification or experiment on existing plant,
- LC 23 Operating rules,
- LC 25 Operational Records,
- LC 28 Examination, inspection, maintenance, testing,
- LC 35 Decommissioning.

19. The Inspector may focus upon the LC(s) listed which have specific applications to BIM:

2.1 LC6 Documents, records, authorities and certificates

20. Aspects for potential consideration include:

- how are changes on site recorded in the feedback of information into an updated BIM model,
- accuracy and adequacy of recording changes,
- potential for changes to effect nuclear safety,
- revisions and upgrades to or redundancy of software over the total life of the facility that can affect the storage and recoverability of information,
- document management systems and audit trails of information, records or certifications within the overall BIM process,
- configuration control, the control of changes after initial establishment of configuration documents.

2.2 LC7 Incidents on the site

21. Aspects for potential consideration include:

- collection of data in the BIM environment in relation to security, safeguard or health and safety incidents and accidents which can be analysed for trends and root cause analysis,
- compliance with the requirements of PAS 1192-6 2014.

2.3 LC11 Emergency arrangement

22. Aspects for potential consideration include:

- compliance with recommendations of COBie and PAS 1192-4:2014,
- arrangements within a paper-based safety case are reflected within the MIDP and COBie.

2.4 LC12 Duly authorised and other suitably qualified and experienced persons

23. Aspects for potential consideration include:

- demonstrable experience of managing projects undertaken using BIM, at the BIM level to be adopted,
- demonstrable experience in the application of the software package(s) and how individuals have met the guidance in the PAS standards. This is a key consideration because the civil engineering industry is at different stages of the maturity of its understanding and application of BIM,
- expected suitably qualified and experienced personnel (SQEP) attributes within the dutyholder and supply chain, including track record of collaborative working.

2.5 LC14 Safety Documentation and LC16 Site plans, designs and specifications

24. Aspects for potential consideration include:

- accessibility of information held within the EIR, BEP, MIDP, TIDP, COBie and 3D model,
- effectiveness of single and multi-discipline design reviews and the process for peer review through Independent Peer Review (IPR), Independent Structural Assessment (ISA) or Independent Technical Assessment (ITA), Management Safety Committee (MSC) and Nuclear Safety Committee (NSC). All these parties need access to appropriately mature information if the peer review functions are to be effective and robust.
- demonstration that the BIM information is current, accurate and appropriate for the maturity of the design or facility.

2.6 LC15 Periodic review

25. Aspects for potential consideration include:

- demonstration that the BIM information underpins the Periodic Safety Review (PSR) / Long Term Periodic Review (LTPR) process,
- recognised the requirement to make suitable provision to collect operational data information, store and retrieve relevant information.

2.7 LC17 Management systems

26. Aspects for potential consideration include:

- quality assurance process for managing the large volume of generated data,
- adequacy of the duty holder’s change control processes,

- whether the dutyholder has applied an appropriate level of challenge and peer review to the BIM output. Note that there is the human factor tendency of users not questioning the output from the software

2.8 LC19 Construction or installation of new plant

27. Aspects for potential consideration include:

- appropriateness of format of construction and safety documentation for intended use,
- potential for conflict, contradiction or omissions between paper and electronic based documentation, adequacy of understanding of hierarchy between 3D models and 2D drawings. This consideration can be particularly applicable to situations where drawings are made following use of computer software to refine the design e.g. de-clashing software for reinforcement and embedded items.

2.9 LC20 Modifications to design of plant under construction

28. Aspects for potential consideration include:

- adequacy of the change control processes. BIM could allow quicker decisions that may, in some cases, be irrecoverable or would be difficult to reverse. BIM may also allow normal change control processes to be circumnavigated, either intentionally or unintentionally,
- sampling appropriately categorised modifications. When assessing the dutyholder's underpinning of the change, the Inspector should note that the evidence may be contained within the BIM model and also in the supporting processes, further back in the projects lifecycle i.e. the EIR.

2.10 LC21 Commissioning

29. Aspects for potential consideration include:

- clear demonstration that the original safety requirements and functions have been satisfied,
- demonstration that appropriate updates are made to the BIM data reflecting the "as built" information,
- appropriate access to adequate information to underpin the safety case, e.g. quality assurance information, verification and commissioning period test results, etc.

2.11 LC22 Modification or experiment on existing plant

30. Aspects for potential consideration include:

- effectiveness of data capture during the design and construction phase, together with the adequacy of the record keeping during operations, maintenance and asset care,
- confidence that the electronically held information that the duty holders are reliant upon for the modification is retrievable, accurate and reliable.

2.12 LC23 Operating Rules

31. Aspects for potential consideration include:

- adequacy of transfer of design information into the definition of the operating rules (and limits),
- adequacy of the underpinning and the consistency of the information within the BIM environment which informs the definition of the operating rules.

2.13 LC25 Operational Records

32. Aspects for potential consideration include:

- demonstration that adequate records are maintained and are retrievable as storage software and hardware evolves over time,
- demonstration that the information is reliably captured within the BIM model and supporting processes, such as the Project Information Model and Asset Information Model (PIM and AIM).

2.14 LC28 Examination, Inspection, Maintenance, Testing (EIMT)

33. Aspects for potential consideration include:

- adequacy of the arrangements in place for facility and asset management, including maintenance schedules which is used to inform the EIMT schedule,
- demonstration that the BIM process generates an accurate, reliable feedback loop of data with adequate arrangements for controlling how that data is used in the decision process to sentence shortfalls, issues or defects that have a potential impact on nuclear safety,
- the scope, type and relevance of the data collected, together with its assurance and reliability. The Inspector may wish to consider whether the arrangements are supported with a demonstration of adequate peer review, challenge and responsibility within the sentencing process.

2.15 LC35 Decommissioning

34. Aspects for potential consideration include:

- demonstration that the BIM information underpins the strategy and approach to decommissioning and demolition,
- the expectation that the dutyholder can develop an outline strategy that considers the end of life scenario,
- reviewing evidence that operational experience and data from EIMT activities has been included in the decommissioning strategy.

3 SAPS

35. The list of Safety Assessment Principles (SAPS) [1] below that are applicable to BIM is not exhaustive but focuses on how BIM is used in respect of culture, process and technology.

36. The Inspector may wish to consider the BIM system as a safety system in its own right if the dutyholder depends on BIM in developing their nuclear safety case and ensuring nuclear safety.

37. The Inspector may wish to consider relevant points from below to suit the circumstances:

- Fundamental principles,
  - FP2 Leadership and management for safety
  - FP4 Safety assessment.
- Leadership and management,
  - MS1 Leadership,
  - MS2 Capable organisation,
  - MS4 Learning from Experience – (relevant where LFE informs dutyholder improvements as the use of BIM increases).
- Safety case process,
  - SC1 -8 – (relevant where BIM contributes to the development and visibility of an adequate safety case over the life span of the facility).

- Civil engineering,
  - ECE1 to 24.
- Maintenance, Inspection and testing,
  - EMT1 Identification of requirements,
  - EMT6 Reliability claims (relevant where BIM enables systems to be visualised and so informs provision of maintenance and asset care arrangements),
- Human Factors,
  - EHF 1 Integration with design, assessment and management (relevant where BIM's requirement for collaboration and cooperation are influenced by elements of HF),
  - EHF 9 Procedures Integration with design, assessment and management of systems.
- Control of Nuclear Matter,
  - ENM1-8 (relevant where a dutyholder uses the BIM platform to record details of nuclear matter covered by these SAPS).
- Accident Management and Emergency Arrangements,
  - AM.1 Planning and preparedness (relevant where the information in the BIM model informs the development of the plans and strategies required).
- Decommissioning,
  - DC1 to DC DC9 – relevant where the COBie data sheet or other BIM related data informs the planning and strategies for decommissioning.

4 STANDARDS

4.1 Framework for producing standards

38. The policies and guidance associated with BIM are rapidly evolving and although at the time of writing this Annex, the specifications are valid and up to date, at the time of reading, they may not be.

39. Additional relevant information is likely to become available alongside advances the application of BIM within the civil engineering industry. The Inspector is advised to check the standards and guidance documents sought are current and up to date.

40. At the time of writing, it is worth noting that different organisations are using different BIM specifications. PAS 1192 series of standards are commonly used with projects that started prior to 2019. BS EN ISO 19650 [7] supersedes the PAS 1192 specifications in 2019 and is widely used. The standards are being updated often.

41. The standards have been and continue to be drawn up with collaborative effort between several groups:

- the previously known 'BIM Task Group' has been subsumed into the Centre for Digital Built Britain (CDBB) [8] where CDBB is a partnership between BEIS and Cambridge University,
- the government has been working on BIM for Britain with CDBB using a UK BIM Alliance [9] in collaboration with; CDBB, BEIS etc.,
- UK BIM Framework produces the output for the UK BIM Alliance, BSI and CDBB [10] and [11].

42. There are numerous standards that apply to BIM, the principal ones are referred to in the tables below.

43. The following are the current BS EN ISO standards are available in [12]:

Reference	Title	Subtitle	Part title
BS EN ISO 19650-1: 2018	Organization and digitization of information about buildings and civil engineering works, including building information modelling	Information management using building information modelling:	Part 1 concepts and principles,
BS EN ISO 19650-2: 2018			Part 2 delivery phase of the assets,
BS EN ISO 19650-3: 2020			Part 3 Operational phase of the assets.
BS EN ISO 19650-5: 2020			Part 5 Security Minded Approach to Information Management

44. The following are the current BS and PAS standards:

Reference	Title		Status
BS 1192-4:2014	Collaborative production of information	Part 4: Fulfilling the employer's information exchange requirements using COBie (Code of practice)	Current, under review
PAS 1192-6:2018.	Specification for collaborative sharing and use of structured Health and Safety information using BIM.		Current

45. The following current Codes of Practice relate to BIM:

BS 8536-1:2015	Briefing for design and construction. Code of practice for facilities management (Buildings infrastructure)	Current, under review
BS 8536-2:2016	Briefing for design and construction. Code of practice for asset management (Linear and geographical infrastructure)	Current

46. The following standards have been withdrawn or superseded by the above current standards

Reference	Title	Status
BS 1192: 2007 + A2:2016	Code of practice collaborative production of architectural, engineering and construction information	Withdrawn, Superseded by BS EN ISO 19650-1: 2018 & 19650-2: 2018
PAS 1192-2:2013	Specification for information management for the capital/delivery phase of construction projects using building information modelling	Withdrawn, Superseded by BS EN ISO 19650-2: 2018
PAS 1192-3:2014	Specification for information management for the operational phase of assets using BIM	Withdrawn, superseded by BS EN ISO 19650-3: 2020
PAS 1192-5:2016	Specification for security-minded building information modelling, digital built environments and smart asset management. It has been sponsored by UK Government Centre for Protection of National Infrastructure (CPNI),	Withdrawn, superseded by BS EN ISO 19650-5: 2020
PAS 1192-7	Specification for defining, sharing and maintaining structured digital construction product information	Not yet issued, development paused 2020

4.2 Guidance Documents

47. These guidance documents are available:

Reference	Title	Ref / Status
PD 19650-0:2019	Transition guidance to BS EN ISO 19650, prepared specifically to help the existing users of BS 1192 and PAS 1192-2 understand any changes made between the UK's existing standards, and the ISO documents which are to replace them.	[7]
Guidance part 1 (2nd Edition):	The Concepts Guidance first released in April and updated in July 2019 is brief and high level and is aimed at a broad audience.	[12]

Guidance part 2 – Processes for Project Delivery (4th Edition)	The Processes for Project Delivery Guidance is an evolving resource. This fourth edition addresses key areas that are relevant to all project team members with guidance into the areas of exchange information requirements.	This guidance will subject to quarterly updates. [13]
Government Soft Landings –	Updated for ISO 19650. Revised guidance for the public sector on applying BS8536 Parts 1 and 2	[14]
BIP 2207	Building Information Management. A standard Framework and guide to BS 1192:2007	[15]

5 GUIDANCE TO INSPECTORS

5.1 Intelligent Customer (IC) Role

48. The Inspector is directed toward the following general guidance:

- ONR-NS-GD-TAST-049 'Licensee Core and Intelligent Customer Capabilities'. Paragraph 2.3 defines the concept of the Intelligent Customer,
- ONR-NS-GD-TAST-079 'Licensee Design Authority Capability'. This introduces the duties upon the Responsible Designer(s). The Design Authority (DA) should act as an Intelligent Customer by specifying requirements, supervising the work and technically reviewing the output before, during and after implementation.

49. The Intelligent Customer role will be involved in the procurement of BIM models. The Inspector may wish to seek assurance that the Design Authority Intelligent Customer role understands the purpose and functionality of BIM, where BIM management is an element of the nuclear safety case.

5.2 Sampling

50. The Inspector may wish to conduct a broad high-level sample across the dutyholders processes to see if the stated policies and arrangements give ONR confidence in the adequacy of their intelligent customer function and management systems.

51. The Inspector may consider the degree of commercial fragmentation on civil engineering projects. This is a key consideration, as the effectiveness of BIM is dependent upon collaborative working, recognising a holistic lifecycle view of the project requirements. The Inspector may seek demonstration of the following where applicable:

- collaborative team working that reflects their understanding of the end objective of the project, i.e. how the asset is going to deliver its required safety functions and be maintained towards the end of its operational life. The requirements to meet those objectives could be reflected in the project's design phase,
- an understanding of the requirements of BIM to produce a safe and robust design,
- robust arrangements to supervise and peer review the BIM output,
- robust oversight of the potential issues created by the use of BIM (beyond normal design issues).

52. The Inspector may wish to seek demonstration that the dutyholder is meeting relevant good practice by any or all of the following, as appropriate:

- explaining and demonstrating that they have followed their overall BIM management arrangements,
- demonstrating that the management arrangements have been robustly tested, challenged, reviewed and are sufficiently mature to support the projects decision gateways,
- demonstrating appropriate scope of each data drop,
- providing an electronic copy of relevant supporting documents to confirm the dutyholders statements on claims, argument and evidence,
- making arrangements for the Inspector to view appropriate parts of the dutyholder's model, including 3D visualisations and walkthroughs.

53. The Inspector may wish to seek assurance in the collaboration of the BIM process by corroborating the dutyholder's statements with their supply chain because of the reliance on cooperation.

5.3 Focused Sampling

54. The Inspector may reach a judgement that a deeper sample is required. In these circumstances, the Inspector can use this guidance to inform a focused sampling approach through inspection of specific Licence Conditions (LCs). The Inspector can inspect and compare the dutyholder EIR requirements against the deliverables at the data drop points [16] under the appropriate LC. These data drops reflect the quantity and maturity of the data at any point in the design, construction or operation, together with the effectiveness of the data feedback process. Guidance on laser scanning of existing structures

55. The use of laser scanning in the civil engineering industry is a comparatively recent development and has applications to the nuclear industry. Laser scanners can very rapidly record millions of distance measurements in the form of a 'point cloud' that can be sufficiently dense to allow visualisation of the surveyed object. These surveys are often related to asset care of ageing structures, survey prior to modification or change of use and decommissioning.

56. The Government's BIM Task Group has produced a client guide to 3D scanning and data capture, often using a point cloud. The accuracy and applicability of the data is reliant upon the SQEP resource (BIM Modellers) correctly interpreting and transferring the relevant information. The Inspector should be aware that the point cloud results reflect surface geometry only.

57. When using point cloud data, this is often combined with additional data such as material properties, structural details, systems layout and functional data.

58. The Inspector should be aware that laser scanning equipment can be used as a means to reduce dose to workers, but that the effects of radiation can impact the equipment and the accuracy and totality of data collected.

5.4 Record Keeping and accessibility

59. If the dutyholder is placing reliance on BIM to support its LC6 and LC 25 obligations, the Inspector may wish to sample and assess the adequacy of the dutyholder arrangements:

- outlining a clear plan of the roles responsible for maintaining the BIM model throughout the lifespan of the facility, including post operations,
- that ensure construction, operation and EMIT records are accessible and understandable to all parties who may need to refer to them, as well as those who are expected to provide updates to the model,

- measures to verify that data remains in a usable format and does not become corrupted, damaged or lost when shared between parties or when placed into / taken out of storage,
- for ensuring that the BIM model remains up to date and is a comprehensive record of all relevant information for operation and EMIT records. The arrangements could include measures for validating and verifying the model. The Inspector may wish to consider whether the arrangements include proposals for revision control and appropriate metadata, such as tracking who changed which data, why and when,
- for ensuring that the model data remains compatible with future updates to software and hardware. This may include providing legacy facilities for back verification following any system upgrade or transfer of data.

60. For more information on record keeping, see:

- ONR-NS-TAST-GD-033 ‘Duty Holder Management of Records’.

5.5 Other Considerations

61. There is an outline proposal between the Department for Business, Energy and Industrial Strategy (BEIS) and the Centre for the Protection of National Infrastructure (CPNI), as the key government stakeholders, to develop a common approach to accredit certification for organisations offering a full range of BIM Level 2 services. The concept may be developed over the coming years, as UKAS has stated they are undertaking a Pilot Assessment Programme for the accredited certification to 19650-2 [17].

62. BIM is intended to apply the latest Information Technology of 3D modelling and linked data sets to maximise the efficiency and reliability of building information. It has the potential for use over the whole lifecycle of a nuclear facility and its safety case.

63. The Inspector should be aware that decisions may be unreliable if the BIM model is incomplete and/or there is a risk of over reliance on the output of the model where underpinning evidence has not been checked, challenged or peer reviewed.

64. Where an assessment samples the decision gate meetings that utilise BIM as a source for the decision-making information, the Inspector may wish to seek demonstration that:

- collaborative processes and culture are adopted,
- the information that informs the gate meeting and upon which decisions are made is suitable and sufficient for the intended stage,
- other factors have been included or considered in the decision gate,
- risks associated with the use of BIM are being appropriately managed,
- suitable and sufficient checks, reviews and acceptance processes are in place and assumptions and inputs are appropriately challenged,
- the reliance placed upon the output of the BIM process is commensurate with the reliability and confidence in the input information and of the BIM processes and software itself.

5.6 Statement on Relevant Good Practice (RGP)

65. Successful BIM relies on a holistic project approach and applying it throughout the supply chain. The Inspector may wish to seek demonstration that the process has been subject to robust challenge and appropriate peer review.

66. The Inspector may wish to consider the adequacy of the processes in place for the capture, review, input and update of information which is added into the model.

6 ADDITIONAL INFORMATION

67. For further information, see:

- BIM and Health and Safety [18] which considers the Construction Design Management Regulations 2015,
- CIRIA report C725 ‘Implementing lean in construction: lean construction and BIM’ [19],
- Little book of BIM, 2020 Edition [20],
- CPNI Guidance information [21],
- ONR-CNS-TAST-GD-4.3 ‘Oversight of Suppliers of Items or Services of Nuclear Security Significance’,
- ONR-CNS-TAST-GD-7.1 ‘Effective Cyber & Information Risk Management’,
- ONR-CNS-TAST-GD-7.2 ‘Information Security’,
- ONR-CNS-TAST-GD-7.4 ‘Physical Protection of Information’.

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