IFC Rail Project

Storyline (SL) Implementation Report (IR)

New High-speed Line (NHL)- Energy

Detailed Design Phase (DD)

SL-IR- NHL-DD-CRBIM

Contents

Room:	Railway Room	**Date:**	2021.10.28
Project/Activity:	IFC Rail Phase 2	**Test Leader:**	Jin Guang
Document Title:	WP1: Storyline (SL) Implementation Report	**ID:**	SL-IR-NHL-DD-CRBIM
Version:	1.0	**Stakeholder:**	CRBIM

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1 Storyline documentation update

The team mainly cooperated with Bentley China team, and received the strong support and guidance from PMO and CRBIM.

1.1 Work Organization

1.1.1 Test Team & SWV

Activities Storyline	Test Leaders	Technical Expert	Track	Energy	Signal	Infra	SWV
New HSL Energy	Jin Guang	Jin Guang	Zhang Gaoyang	Jin Guang+Zhang xin+Huang Wenxun	Liu Xiaoqi	Luo Yong+Jin Meng	Bentley(Peddy Wang+Zhao Guanghui)

1.1.2 Organization in terms of periodic SL Meetings

No.	Meetings	Frequency	Participants
1	Test Leader Meeting	About Twice or three times a month	PMO, Test Leader
2	Domain Experts Meeting	About once a month	PMO， Domain Leader
3	Summit Meeting(Online)	Twice a year	Domain and Test leader
4	Technical Service Meeting	About once a month	Zhang Chi, Test leader of CRBIM
5	SL Pogress Meeting	About twice a month	Test leader, Technical Expert, SWV

1.1.3 Tasks of SL test

No.	Tasks	Responsible	Content
1	work plan and preparation	Test Leader and Domain Experts from CRBIM	▪ The organization of test team ▪ Collect and document the datasets.
2	Storyline Documentation	Test Leader	▪ Define the storyline and identify the Exchange Scenarios. ▪ Elaborate the specific detailed process map for the storyline.
3	Unit Test and Storyline test preparation	Test Leader and Software Vendors	▪ Prepare the unit test dataset ▪ Software deployment for IFC 4.3
4	Storyline test validation	Test Leader and Software Vendors	▪ Complete the test model in Bentley. ▪ Export of IFC file according to the Exchange Scenarios.
5	SL Implementation report	Test Leader	▪ Validate the test results. ▪ Write the SL Implementation report.

1.2 Updated Storyline Synthesis

<table>
<tr><td>Room:</td><td>Railway Room</td><td>Author: Domain Expert</td><td>Jin Guang</td></tr>
<tr><td>Project/Activity:</td><td>IFC Rail Phase 2</td><td>Verification: Technical Expert</td><td>Peddy Wang</td></tr>
<tr><td>Document Title:</td><td>Storyline: New High-Speed Line Design-Energy</td><td>Approbation: Test leader</td><td>Jin Guang</td></tr>
<tr><td>Version:</td><td>1.0</td><td>PMO checker:</td><td>Guy Pagnier</td></tr>
<tr><td>Date:</td><td>2021.11.26</td><td>ID:</td><td>ENNHL-DD</td></tr>
<tr><td>Description (a)</td><td colspan="3">Planed: This storyline concerns the implementation of traction power system design in a new high-speed railway, mainly includes the design of OCS and traction substations. This case mainly focuses on 4 Use cases (RDM, ICM, 3DV, QTO) in Detailed Design phase.
Actual: Due to the limit of time and resources, this storyline mainly concerns the implementation of OCS design in a new high-speed railway, no substation included.
(PS:we can refer to other domain test case. For example, the design of substation is similar with other BTS(Base Transceiver station) of telecom domain.)</td></tr>
<tr><td>Project Phases (b)</td><td colspan="3">☐ PL - Planning
☐ ID - Intermediate design
☒ DD - Detailed design
☐ Build
☐ Operation & Maintenance
☐ Dismiss</td></tr>
<tr><td>Use Cases (c)</td><td colspan="3">☐ ECM - Existing Condition Modelling
☐ RDM - Railway Design Modelling
☐ RDM.DD - Feasibility Study for Railway
☐ RDM.RIDM - Railway Intermediate Design Modelling
☒ RDM.RDDM - Railway Detailed Design Modelling
☒ ICM - Interference and Coordination Management
☒ 3DV - 3D Visualization
☒ QTO - Quantity Take-Off
☐ INMP - Handover from Builder to Maintainer (Information Needed for Maintenance Perspective)</td></tr>
<tr><td></td><td colspan="3">Due to the difficulty of Software deployment between multi-domain collaboration based on IFC 4.3, detailed modelling and data exchange of infra domain no considered in RDM.</td></tr>
<tr><td>Domains</td><td>☒ Track (*)</td><td colspan="2">Planed: Track
Actual: Only linear placement of track considered, turnout and other complex elements are not included.</td></tr>
<tr><td></td><td>☒ Signalling (*)</td><td colspan="2">Planed: Signal equipment or devices
Actual: Signal equipment</td></tr>
<tr><td></td><td>☒ Energy (*)</td><td colspan="2">Planed: OCS, Substation
Actual: Only OCS(Pole, Cantilever assembly, foundation, overhead contact line and switch) considered, substation is not included.</td></tr>
<tr><td></td><td>☐ Telecom (*)</td><td colspan="2"></td></tr>
<tr><td></td><td>☒ Alignment (*)</td><td colspan="2">Planed: Cant, Alignment
Actual: Only Alignment</td></tr>
<tr><td></td><td>☐ Other (*)</td><td colspan="2">Planed: Bridge, Subgrade, Building(technical room)
Actual: No building(technical room)</td></tr>
<tr><td>Tested Concepts (d)</td><td colspan="3">Alignment, linear/point placement, OCS breakdown structure, Spatial structure, OCS elements.</td></tr>
</table>

Test Leader TL (e)	Jin Guang, FSDI(CRBIM) email :252619643@qq.com
Domain Experts DE (e)	Jin Guang, Zhang xin, Huang Wenxun
Technical Experts TE (e)	Jin Guang
Software Vendors SW (e)	Bentley(Peddy Wang, Guanghui Zhao)
Test Dataset (e)	CRBIM

(a) 2 lines description (b) chose maxi 1 phase and 4 use cases (c) list only domains for the test (d) indicate Covered Unit Test Topics (e) specify names and companies
(*) *specify further sub-disciplines*

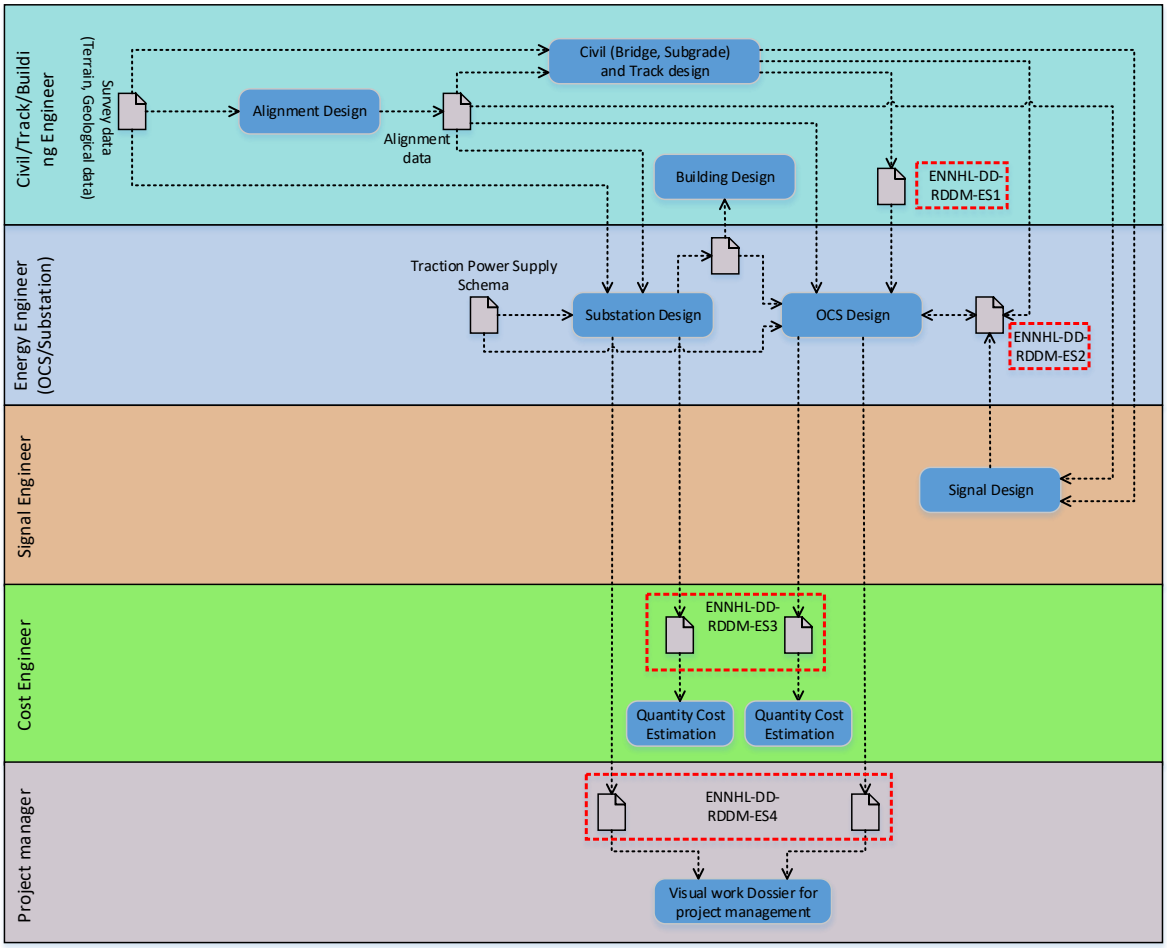
1.3 Updated Storyline Description

Description of the Business case	**Planed:** During this Design phase, Traction substation and OCS Engineer determine the main technical standard(power supply mode/OCS suspension type) according to the design of interface exchange data(such as alignment, bridge and subgrade etc.). OCS Engineers will exchange data with alignment, , track, signal, Infra(station, bridge, subgrade etc.) to complete the layout of poles, catenary, equipments. Substation Engineers will exchange data with alignment, building to complete the site selection of substations and layout of equipments/cables. All interface exchange data requested by OCS/Substation or to be provided to other domains should be exchanged. Below are some data about the new railway line: ▪ Project: Xi'an to Shiyan high-speed railway in China ▪ speed:350km/h ▪ Length:266km  **Actual:** **Changes/Modifications:** 1. The scope mainly include OCS system, substation is not considered. 2. OCS Engineers mainly exchange data with alignment and other Infra domains (bridge and subgrade) reference model to complete the layout of poles, catenary, equipments. 3. Select a section(about 0.5km) from Lantian to Shangluoxi in this project due to the large volumn of planed scope.
Duration	Planned: Some weeks. Actual: About several months to realize a digital representation of the new high-speed railway line compliance with IFC 4.3, so we simplify the range of test.
Aim	The aim of the study is to define: • If the entities and properties defined in IFC4x3 satisfy to the design of hign-speed railway • Define the exchange data between Energy domain and other related domains • Produce datasets as Test Data based on the selected 4 Use cases • Implement IFC import and export without losing information

	• Layout/Positioning the elements/equipment (poles, catenary, etc.) • Detect collision with other domains • The accurate quantities and cost based on BIM model and database • 3D visualization of the OCS and substation. Some existing and projected information are also required: • Standards of railway project • Existing alignment geometry (horizontal, vertical, cant) or survey data • Existing data of infra and other domain
In Scope	Physical energy elements of OCS system(mainly track-side parts). Includes foundation, pole, cantilever assembly, overhead contact line and etc.
Out of Scope	• Low voltage distribution power system • System schema of traction power supply

Specific Detailed Process Map for this Storyline

[process map that defines realistic exchange scenarios between software applications ; reference to general processes defined in the IFC Rail Requirements analysis report Chapter 2 : IFC Rail Process Map also called High-level Reference Process Map (HLRP)]



PS: substation is not considered, other else remain the same.

HLRP	ES nbr	From	To	Note [optional]
1	ENNHL-DD-RDDM-ES1	Civil Designer	Energy Designer	RDDM-Railway Detailed Design Modelling
2	ENNHL-DD-ICM-ES2	Energy/Signal/Civil Designer	Coordinator	ICM-Interference and Coordination Management

3	ENNHL-DD-QTO-ES3	Energy Designer	Cost Engineer	QTO - Quantity Take-Off
4	ENNHL-DD-3DV-ES4	Energy Designer	Project Manager	3DV - 3D Visualization

2 Exchange Scenario (ES) and Tests

2.1 Exchange Scenario: SLNHL-DD-RDDM-ES1

2.1.1 Updated Exchange Scenario

Id	**SLNHLT-DD-RDDM-ES1**
Exchange Scenario Description *[please describe the ES and define In/Out of Scope topics]*	
1. Determine the main technical standard(tensioning length, span length, tensile force, overlapping span and etc.) based on the standard specifications for the project of railway(line and climate informations). 2. According to the technical requirements of OCS system, further planning for a new line requires informations about the alignment and civil conditions. Then OCS Engineers should import the modeling of alignment, track, signal, civil (bridge, subgrade etc.) to complete the layout of poles, catenary, equipments. • Based on the alignment data/model • Import the civil(bridge, subgrade etc.) and track reference model	
Geometry and positioning requirements *[General description / concepts => specific on Excel sheets]*	
• Alignment: Horizontal Alignment, Vertical Alignment, Cant Alignment, … • Civil(bridge, subgrade etc.) and Track reference model	
Spatial requirements *[General description of spatial element requirements => specific on Excel sheets]*	
• Linear/Point placement, spatial structure, alignment/track reference • Position reference: Mileage, Vertical offset and elevation deviation with alignment	
Physical and functional requirements *[General description of physical elements, functional elements and important information => specific on Excel sheets]*	
Line requirements: • Line name/ID, speed (limit and commercial), key Line characteristics, etc. Data/Model requirements: • Alignment data • Reference model and key location informations of bridge, subgrade, track, etc.	
Covered Unit Test: to be filled by Technical Expert(s)	
ID	Unit Test
1	Energy elements breakdown
2	Railway Spatial structure
3	Linear Placement

2.1.2 ES Test description and results

Test Completion (Specify level of completion and if reserves/punchlist opened, additional TS works….)

1. According to the breakdown of energy domain, create the 3D models of OCS components, mainly including foundation, pole, cantilever assembly, overhead contact line and other equipments in microstation(Bentley modeling platform).
2. Import the alignment and other civil reference model to complete the layout of poles, catenary, equipments based on the design standard of OCS system.
3. Establish the mapping relationship between all components in the model and IFC4.3 standard, and prepare the schema file.
4. Export ifc 4*3 file of .dgn model from microstation by standard mapping plug-in according to the schema file.
5. Check the validity of BIM files by KIT IFC Checking tool.
6. Open the .ifc file in open BIM SW, such as BIM vision or usBIM(ACCA) and check the integrity of model and Psets.
Take the cantilever assembly as an example:

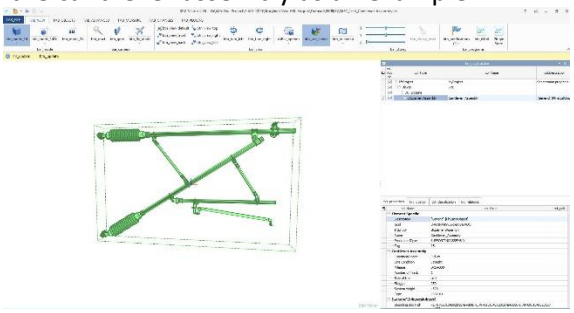


Figure 1: Cantilever Assembly-BIM Vision

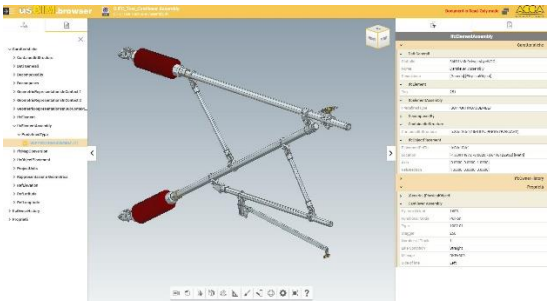


Figure 2: Cantilever Assembly-usBIM

Test Team and Test Leader Satisfaction

(Specify the Box/Github links to find the test results or documents….)

1. The export of components was completed successfully without informations loss, And the mapping with IFC4.3 is correct.
2. Due to the large volume of the whole model, it takes a long time to import and export the ifc files. Therefore, the detailed design model is simplified and only one section of the model is selected for the test. The exported detailed design model is complete without information loss.
The test team are satisfied with the test.

Tests and Results Archives

(Specify the Box/Github links to find the test results or documents….)

BOX link:

- Cantilever Assembly:
  https://app.boxcn.net/s/8nstk8wn8390zrfrkntw0pto0jy7mmdk
- Insulator:
  https://app.boxcn.net/s/46s89lpld4l2t1n4n9shrlqchd0lg32z
- Switch:
  https://app.boxcn.net/s/dkqkn45lw9383zz88vlnifczmonp2vbz
- OCS Foundation:
  https://app.boxcn.net/s/yzzkporjrswv29tre2msttgmhr0w9k2g
- Clamp:
  https://app.boxcn.net/s/k3zfo0bycwaepsiwg7zf3cs529pfne1z
- Tensioning Equipment:
  https://app.boxcn.net/s/gctv6wub20vobi95x1gutfy8a4a80kpn
- Pole:
  https://app.boxcn.net/s/97g3gqk46fxb5lz7xasy7taywtw8ms0b
- Dropper:
  https://app.boxcn.net/s/gztxtgfr8kv08refeu71r5x0o8umsno0

• Convert Video(DGN to IFC): https://app.boxcn.net/s/lxga2ybydulqe6ar6o312jwzldxujkr6 Github link: https://github.com/IFCRail/IFC-Rail-Unit-Test/tree/master/8_Storylines%20Test%20(SL)/SL05_Design%20a%20new%20HS%20Line%20-%20Energy/IFC%20files%20from%20implementers

2.2 Updated Exchange Scenario: SLNHLT-DD-ICM-ES2

2.2.1 Updated Exchange Scenario

Id	**SLNHLT-DD-ICM-ES2**
Exchange Scenario Description *[please describe the ES and define In/Out of Scope topics]*	
During the design of OCS system, there is a lot of interferences and coordination between energy domain and other domains. In this SL, we mainly focused on collision detection which is based on the assembly model to identify and coordinate the potential conflicts during the construction phase. • ICM between OCS pole, contact line and rail of bridge. • ICM between OCS pole and alignment/track panel.	
Geometry and positioning requirements *[General description / concepts => specific on Excel sheets]*	
• OCS model and other domain models. • Key location informations and reference models of related domains, such as alignment, track and bridge, etc.	
Spatial requirements *[General description of spatial element requirements => specific on Excel sheets]*	
Linear/Point placement, spatial structure, domain equipment position informations.	
Physical and functional requirements *[General description of physical elements, functional elements and important information => specific on Excel sheets]*	
Line requirements: • Line name/ID, speed (limit and commercial), key Line characteristics, etc. Data/Model requirements: • Alignment data • Reference model and key location informations of alignment, signal equipment and track, etc. • The clearance/installation requirements	
Covered Unit Test: to be filled by Technical Expert(s)	
ID	Unit Test
1	Energy elements breakdown
2	Railway Spatial structure

2.2.2 ES Test description and results

Test Completion (Specify level of completion and if reserves/punchlist opened, additional TS works….)
1. Create the models of OCS components, mainly including foundation, pole, cantilever assembly, overhead contact line and other equipments in microstation(Bentley modeling platform). 2. Import the models of other domains, complete the integration of track, signal, catenary and other domain models based on the standards and requirements of this project. 3. Export ifc 4*3 file of .dgn model from microstation by standard mapping plug-in according to the schema file.

4. Check the validity of BIM files by KIT IFC Checking tool.
5. Verify the accuracy of model and check the problems such as component collision, and merge the collision detection report.

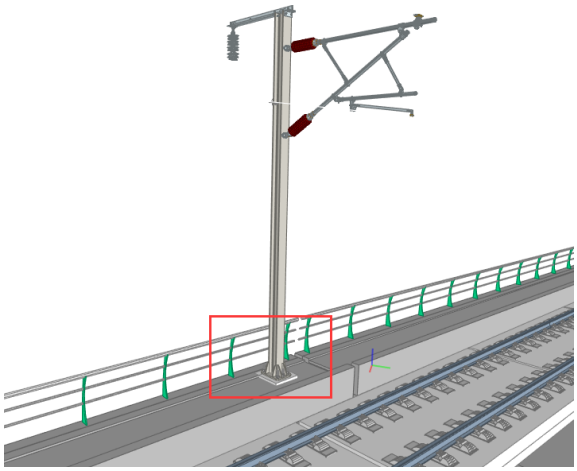


Figure 3: ICM between OCS pole and rail of bridge –usBIM

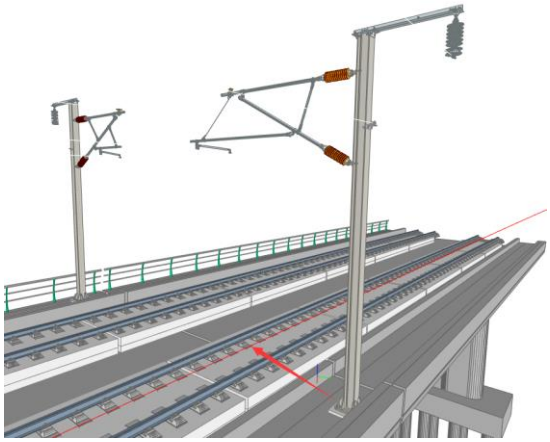


Figure 4: validity test between OCS pole and alignment –usBIM

Test Team and Test Leader Satisfaction

(Specify the Box/Github links to find the test results or documents….)

According to the model integration including two or more domains, complete the collision detection based on models and Psets, then we can improve the design accordingly.
For example, change the position of OCS pole or signal equipment to satisfy the requirements.
The test team are satisfied with the test.

Tests and Results Archives

(Specify the Box/Github links to find the test results or documents….)

BOX link: https://app.boxcn.net/s/ss9o2b65vagrtf03e9o915cxe2wbd020
Github link: https://github.com/IFCRail/IFC-Rail-Unit-Test/tree/master/8_Storylines%20Test%20(SL)/SL05_Design%20a%20new%20HS%20Line%20-%20Energy/IFC%20files%20from%20implementers

2.3 Updated Exchange Scenario: SLNHLT-DD-QTO-ES3

2.3.1 Updated Exchange Scenario

Id	**SLNHLT-DD-QTO-ES3**
Exchange Scenario Description *[please describe the ES and define In/Out of Scope topics]*	
In the detailed-design phase, quantity take-off should be calculated based on the model/data. The Quantity Take-Off will provide: 1. The classification statistics of different elements and equipments according to the requirements of energy domain. 2. Cost or budget of OCS system.	
Geometry and positioning requirements *[General description / concepts => specific on Excel sheets]*	
Spatial requirements *[General description of spatial element requirements => specific on Excel sheets]*	
Physical and functional requirements *[General description of physical elements, functional elements and important information => specific on Excel sheets]*	
• The related informations which used for calculating quantities and cost. • The cost informations of different type of different elements and equipments according to the requirements of energy domain.	

Quantity Take-off

ID	Object	Quantity
1	Cantilever Assembly	8
2	OCS Foundation	8
3	Pole	8
4	Overhead Contact Line	420

Figure 5: Take-off result

Covered Unit Test: to be filled by Technical Expert(s)	
ID	Unit Test
1	Energy elements breakdown

2.3.2 ES Test description and results

Test Completion (Specify level of completion and if reserves/punchlist opened, additional TS works….)
Calculate the quantity and the cost of OCS system, such as foundation, pole, cantilever assembly, overhead contact line and other equipments according to the breakdown of system and Psets of elements.
Test Team and Test Leader Satisfaction (Specify the Box/Github links to find the test results or documents….)
The quantity of all the OCS components can be accurately taken off. The scenario of QTO has been completed. The test team are satisfied with the test.
Tests and Results Archives (Specify the Box/Github links to find the test results or documents….)
BOX link: https://app.boxcn.net/s/ss9o2b65vagrtf03e9o915cxe2wbd020

Github link: https://github.com/IFCRail/IFC-Rail-Unit-Test/tree/master/8_Storylines%20Test%20(SL)/SL05_Design%20a%20new%20HS%20Line%20-%20Energy/IFC%20files%20from%20implementers

2.4 Updated Exchange Scenario: SLNHLT-DD-3DV -ES4

2.4.1 Updated Exchange Scenario

Id	**SLNHLT-DD-3DV-ES4**
Exchange Scenario Description *[please describe the ES and define In/Out of Scope topics]*	
This 3DV could be necessary for issuing a overview of the project in 3D within GIS environment by integrating domain models(Bridge, subgrade, energy, signal etc.). Such 3D dossier can be useful to financing contributors, project owner manager, operation and maintenance managers.	
Geometry and positioning requirements *[General description / concepts => specific on Excel sheets]*	
• Alignment: Horizontal Alignment, Vertical Alignment, Cant Alignment, … • Linear Reference • Swept Area Solid Geometry/GIS data • Model of all domains	
Spatial requirements *[General description of spatial element requirements => specific on Excel sheets]*	
Linear/Point placement, spatial structure, Domain equipment position and reference	
Physical and functional requirements *[General description of physical elements, functional elements and important information => specific on Excel sheets]*	
Data/Model requirements • Alignment data • Reference model of bridge, subgrade, track, etc. • Model of energy domain	
Covered Unit Test: to be filled by Technical Expert(s)	
ID	Unit Test
1	Energy elements breakdown

2.4.2 ES Test description and results

Test Completion (Specify level of completion and if reserves/punchlist opened, additional TS works….)
1. Complete the 3D model of the detailed design in microstation (bentley modelling platform) which include the OCS and civil elements. 2. Exported ifc 4*3 file of .dgn model from microstation by standard mapping plug-in according to the schema file. 3. Check the validity of BIM files by KIT IFC Checking tool. 4. Finally, browse the .ifc model in BIM Vision and render the model with GIS data/model.

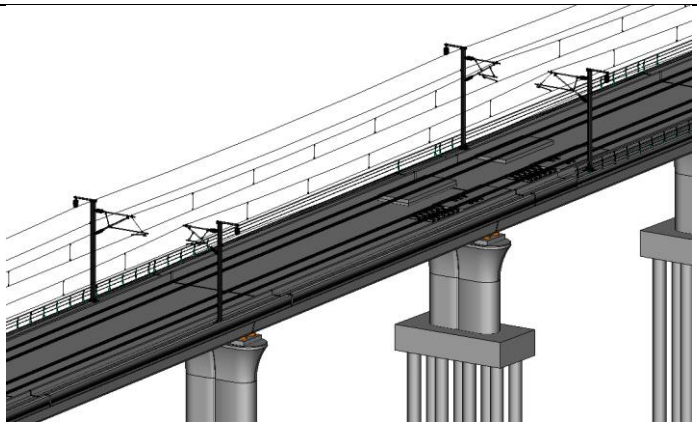


Figure 6: OCS and Civil reference model(.dgn)-Bentley

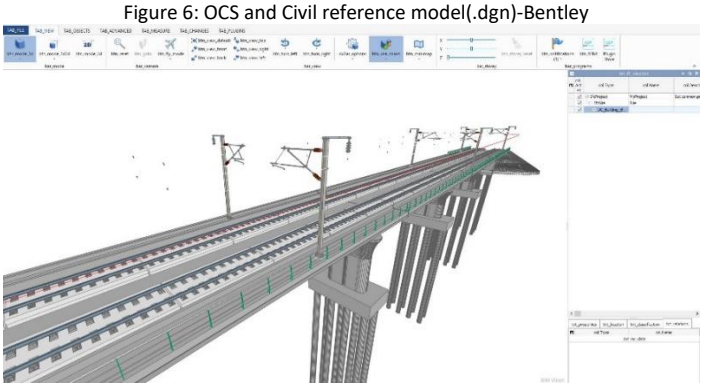


Figure 7: OCS and Civil reference model(.ifc)-BIM Vision

Test Team and Test Leader Satisfaction

(Specify the Box/Github links to find the test results or documents….)

The exported detailed design model is complete without information loss.

The test team are satisfied with the test.

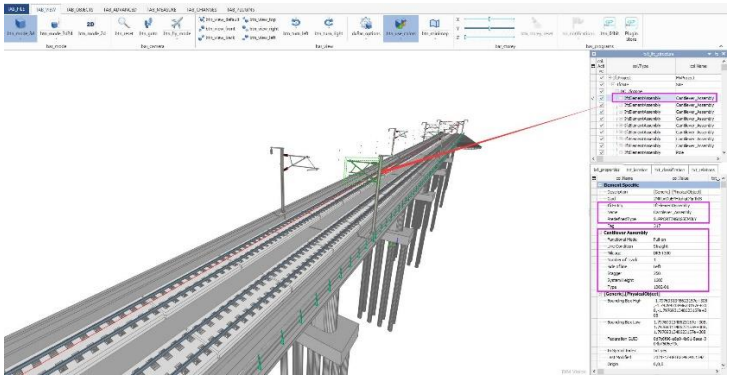


Figure 8: The definition and Psets of cantilever assembly in the model(.ifc)-BIM Vision

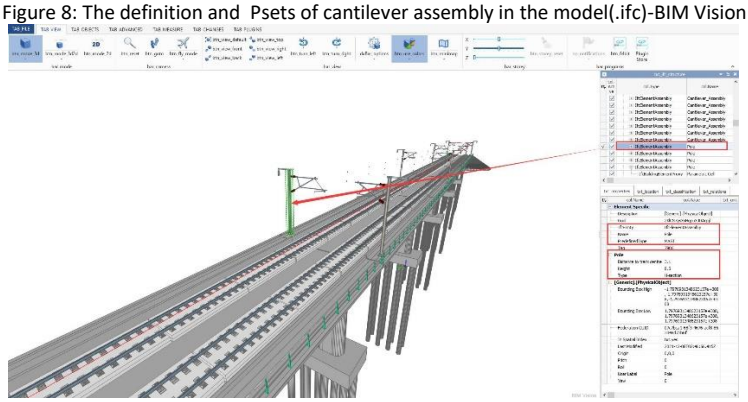


Figure 9: The definition and Psets of pole in the model(.ifc)-BIM Vision

Figure 10: The rendering result of 3DV (Bentley)

Tests and Results Archives

(Specify the Box/Github links to find the test results or documents….)

BOX link:

- DGN Files:

https://app.boxcn.net/s/5y9kw6e39j18gdyj8ula71o03eo6uym2
https://app.boxcn.net/s/tufsc22mcuqtp1z84he6fq6pf7gcncsp

- IFC Files:

https://app.boxcn.net/s/4dkmhhw0rv1o1e1b63gqcwjjxusajqpl
https://app.boxcn.net/s/d0a2p8y6fozwen8vto5g8l9c6b85ue0d

- Test Result(jpg):

https://app.boxcn.net/s/6te3t0te64jrpm2usntqg710jqcncbrd
https://app.boxcn.net/s/9bf3kqzgstvjjyxu05uxtya8p6loucys
https://app.boxcn.net/s/x02b2katfm02z77pijo16usqut2hwgxw
https://app.boxcn.net/s/ivvqbeefwwak96wbem94wwpqoydcmmph

- Rendering Result(jpg):

https://app.boxcn.net/s/tsjg70n8x619mo9uwuuyakro871xvwq1

Github link: https://github.com/IFCRail/IFC-Rail-Unit-Test/tree/master/8_Storylines%20Test%20(SL)/SL05_Design%20a%20new%20HS%20Line%20-%20Energy/IFC%20files%20from%20implementers

3 Supporting Files and Storyline Archives

3.1 Exchange Requirements (ER)

The Exchange Requirements are available in BOX at the following link:
BOX link: https://app.boxcn.net/s/uvz8md3c60b10dppt1bnk9zlyckus8ej

3.2 SL Data archives

All files and Data are archived in:

- BOX directory:

https://app.boxcn.net/s/aj2cwpg11j4kwrpgt84ja90wq30z1ozz

- GITHUB:

https://github.com/IFCRail/IFC-Rail-Unit-Test/tree/master/8_Storylines%20Test%20(SL)/SL05_Design%20a%20new%20HS%20Line%20-%20Energy/IFC%20files%20from%20implementers

3.3 Test Dataset(s)

All the Test Datasets utilized in this Storyline to achieve the SL Tests.

Dataset Title
Dataset for storyline of Energy
Dataset description
The datasets are provided to describe the process and details of design in energy domain. The team mainly provided the support for the linear placement and breakdown of energy domain, especially OCS system which located along the railway line. Also including the parameters of alignment in excel format and the 3D representation of the civil elements (track, bridge, etc.) in IFC, dgn, pdf and dwg formats.
Dataset links
BOX link: https://app.boxcn.net/s/aj2cwpg11j4kwrpgt84ja90wq30z1ozz

4 Appendices

4.1 Storyline Documentation

The storyline documentation for High Speed Line Energy are available in the following BOX directories:
Storyline Report: https://app.boxcn.net/s/kraxsvxuie1mk7nedqh42pxp69o1ht0y
IFC validation of storyline: https://app.boxcn.net/s/ss9o2b65vagrtf03e9o915cxe2wbd020
Storyline datasets: https://app.boxcn.net/s/aj2cwpg11j4kwrpgt84ja90wq30z1ozz
Storyline Implementation Report: https://app.boxcn.net/s/rora2me85nqk2zewn78fjj0gcgwqgmyr