

Interface Control Document-ICD

IS-41-41-003 Interface Sheet between VS3 Power Supply (41.V3) and VS3 Busbars (41.V3.BB / 41.V3.BE) IS-41-41-003

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1 Purpose

The purpose of the present Interface Sheet is to define the interface requirements associated with the interfaces between PBS41 VS3 Power Supply (41.V3), PBS41 VS3 Extension Busbars (41.V3.BE) and PBS 41 VS3 Busbars related to VS3-PS (41.V3.BB).

This Interface Sheet is written based on ICD in reference [AD02].

2 Acronyms

BOS	Bottom Of Steel
BRDC	Building Relative Displacement Compensator
COG	Center Of Gravity
ELM	Edge Localized Modes
FP	First Plasma
FPO	Fusion Power Operation
GBS	Geographical Breakdown Structure
ICD	Interface Control Document
IDD	Interface Definition Document
IP	Interface Point
IR	Interface Requirement
IS	Interface Sheet
NA	Not Applicable
PA	Procurement Arrangement
PBS	Plant Breakdown Structure
PFPO-1	Pre-Fusion Plasma Operation #1
PFPO-2	Pre-Fusion Plasma Operation #2
PS	Power Supply
SRD	System Requirements Document
SSC	System, Structure and Components
TBC	To Be Confirmed
TBD	To Be Defined
TOS	Top Of Steel
UPC	Upper Pipe Chase

3 References

3.1 Applicable documents

[REF] number	Titles	IDM Links	Version
[AD01]	Staged Approach Configuration - PBS Level 3	ITER_D_SNE6G8	4.1
[AD02]	ICD-41-41 Interface Control Document between PBS 41 and PBS 41 systems	ITER_D_FG6CTN	1.0
[AD03]	AB-CMAF CMM for PBS 41 in Assembly Building 13 (SRO, DT1 and DT2)	ITER_D_DQ7W6W	2.0
[AD04]	Technical_specification_for_VS3-PS_extension-busbars_in_B13_and_B11	ITER_D_BZATA4	1.2
[AD05]	Preliminary Signal List of VS3 Busbar temperature sensors and flow switches	ITER_D_EEL8RT	1.2
[AD06]	Preliminary Signal Diagram of VS3 Busbar temperature sensors and flow switches	ITER_D_EEL6A2	1.5
[AD07]	SRD-41 (Coil Power Supply and Distribution (CPSDS))	ITER_D_28B6XQ	6.0
[AD08]	Working Instruction for Interface Management	ITER_D_3L775F	2.0
[AD09]	ITER 41V3IC CBD_002	ITER_D_EEFTXQ	1.1
[AD10]	VS3-PS Load Specification for B13	ITER_D_DF8LDF	2.7

Table 1 Applicable documents

3.2 Reference documents

Ref. Number	Reference	Title	Version
[RD1]	Safe Access for Maintainability	ITER_D_RUGWUK	1.4
[RD2]	Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways	ISO 14122-2	2016
[RD3]	Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard rails	ISO 14122-3	2016
[RD4]	Load Specifications (LS) v6.2	ITER_D_222QGL	6.3

Table 2 Reference documents

3.3 Applicable Codes and Standards

[REF] number		IDM Links	Version
[CS1]	Low-voltage electrical installations	NF C 15 100	2002

Table 3 Codes and standards

4 Interfaces Identification

IP No.	IFP No.	Location	PBS 41				PBS 41			
			Designation	Reference	PIC (Y/N)	Procurement	Designation	Reference	PIC (Y/N)	Procurement
1	41.V3-41.V3.BE-001	13.L1.01	PBS41 VS3 Power Supply	41.V3	N	Task agreement	PBS41 Extension Busbars	41.V3.BE	N	In-cash procurement
2	41.V3-41.V3.BB-001	13.L1.01	PBS41 VS3 Power Supply	41.V3	N	Task agreement	PBS41 VS3 IVC Busbars	41.V3.BB	N	In-cash procurement

Table 4: Interfaces Identification

5 Presentation of the systems

5.1 Layout

5.1.1 Layout of the PBS41-PS

The 3D model of PBS41 VS3-PS system is extracted from the links in §5.3.1 and is shown in the image below.

PBS41 VS3 Power Supply components are installed on the VS3-PS steel structure in B13.

The VS3-PS steel structure is attached to the B13 ground L1 at 600mm from the axis 13.2 and 4800mm from the axis 13.J of the B13 building.

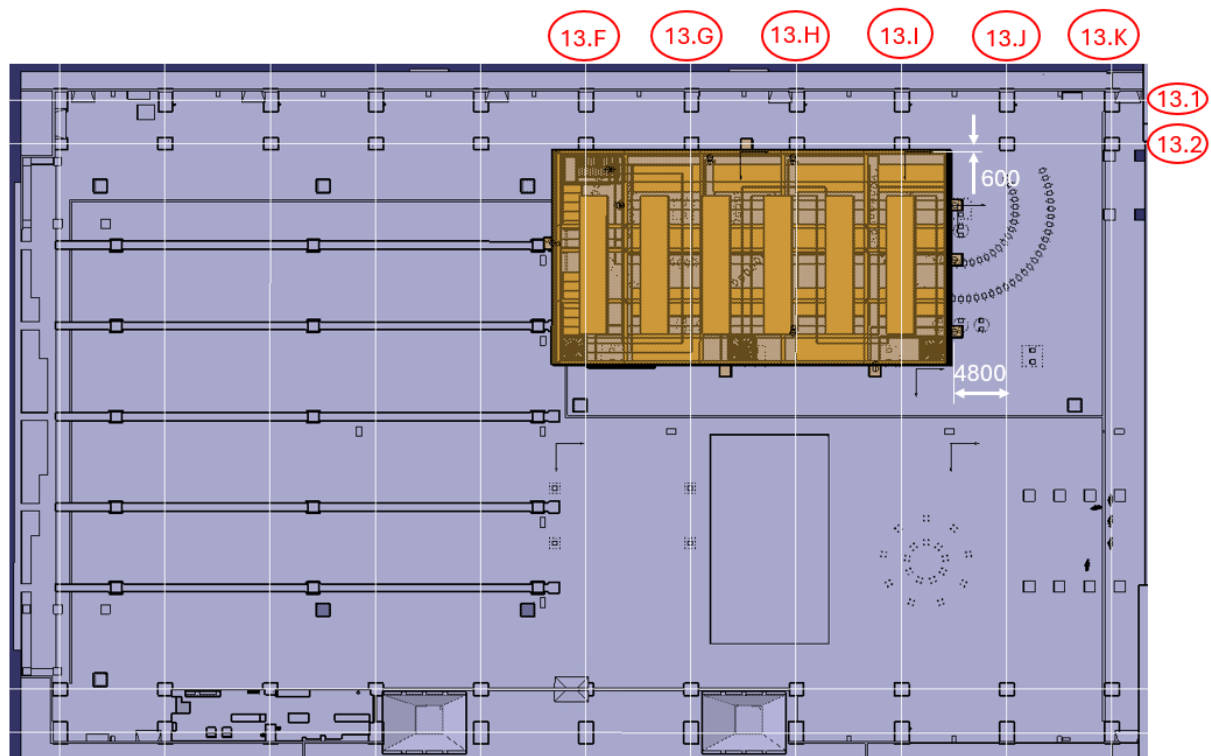


Figure 1: Location of the VS3-PS in the B13

The footprint of the VS3-PS is $\approx 665\text{m}^2$

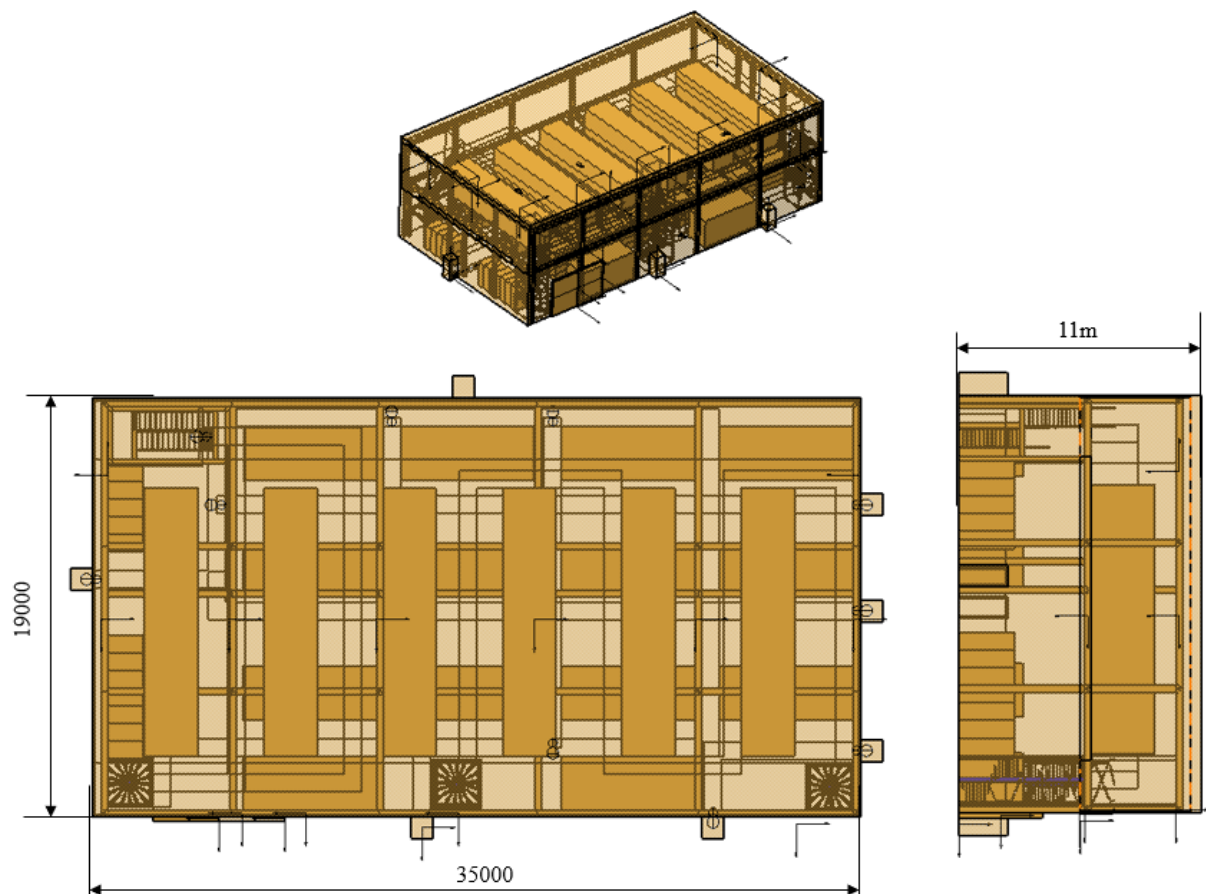


Figure 2: Dimension of the VS3-PS steel structure in the B13

5.1.2 Layout of the VS3-PS Extension Busbars

The two VS3-PS Extension busbars are routed from the linkboard in B11L4 alongside the B13 building structure and down to the PBS41 VS3-PS steel structure in B13.

The current layout of the PBS41 VS3-PS Extension Busbars shown in the image below is extracted from the links in §5.3.2.

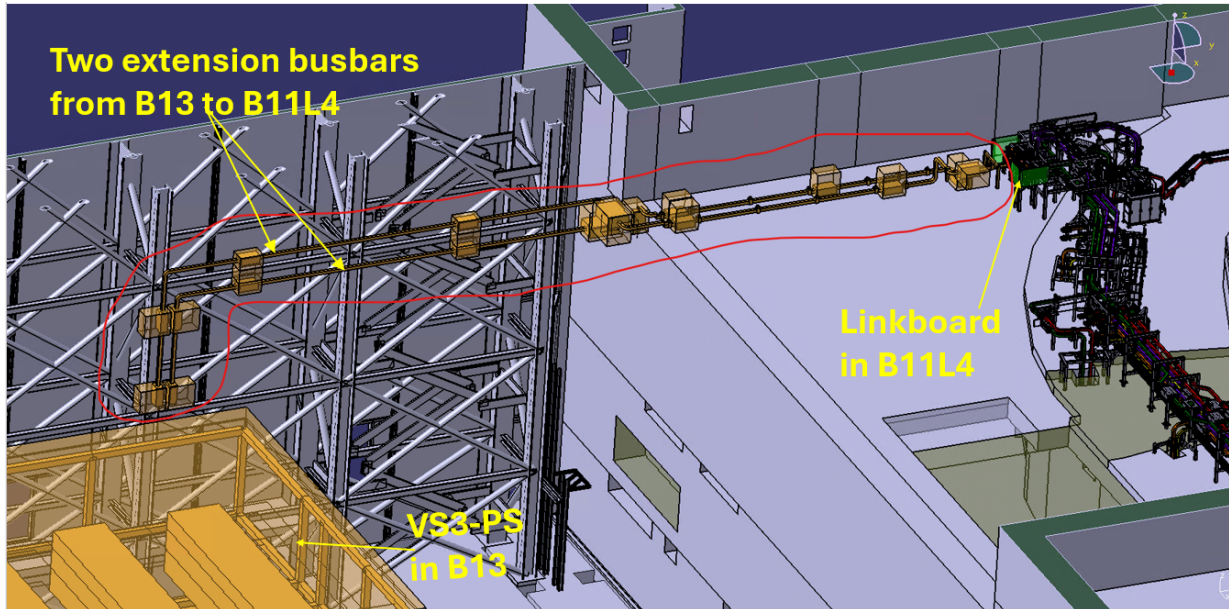


Figure 3. Extension Busbars in B13 and B11L4.

5.1.3 VS3-PS Busbars

The interface between PBS41 VS3-PS and VS3 busbars is related to signals.
The Signal cables between VS3 Power Supply, VS3 Busbars and VS3 Extension Busbars are given in document in reference [AD09].

5.2 Break down three of PBS41 VS3-PS system

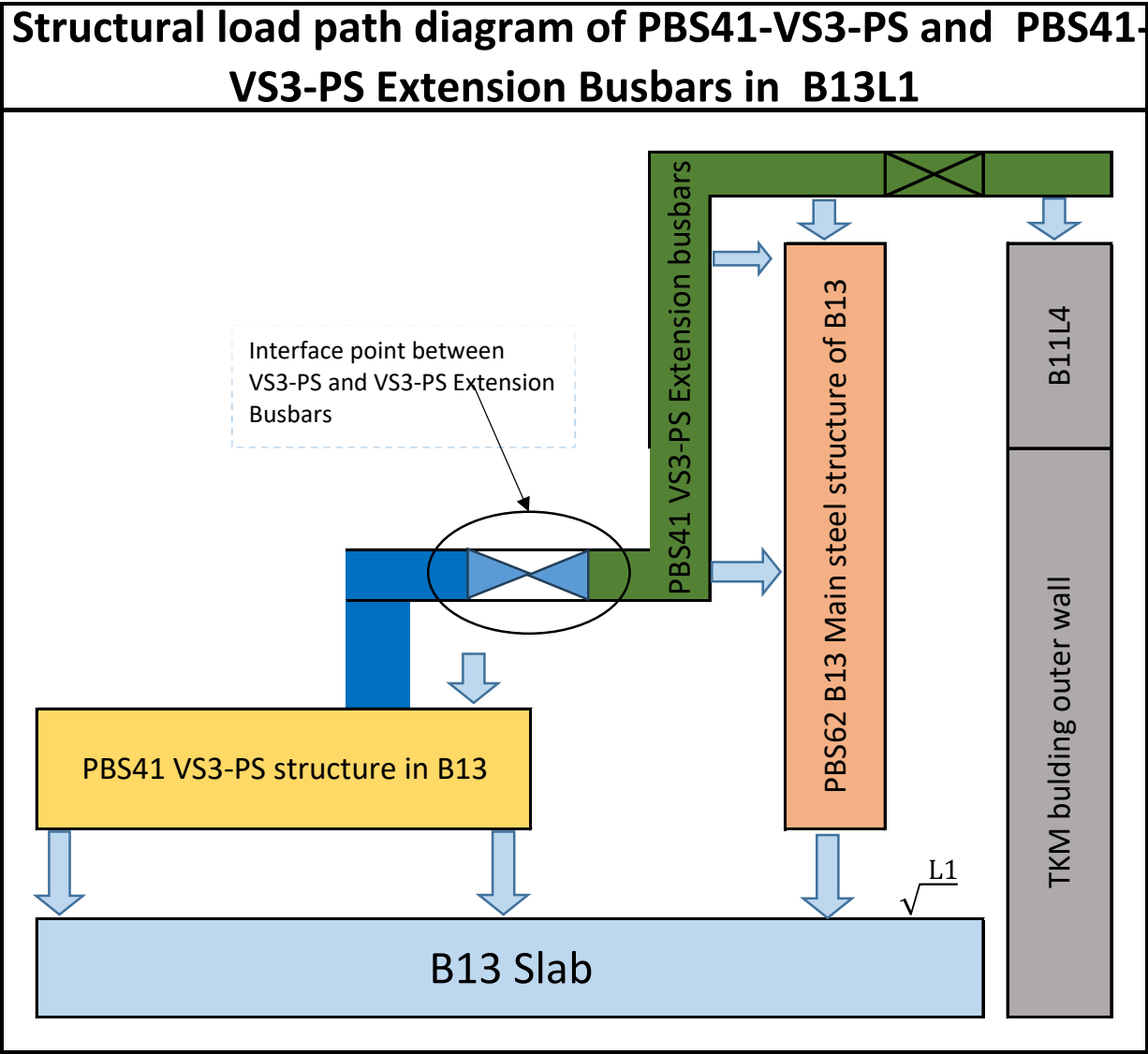


Table 5 Breakdown three of VS-PS system

5.3 3D models of PBS41 components

5.3.1 3D models of PBS41.VS3-PS components in B13

The 3D model considered for this interface sheet is in the link below.

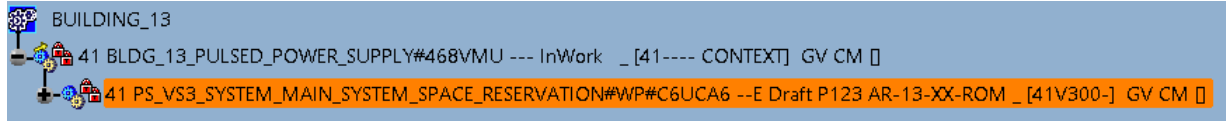


Figure 4. ENOVIA links of the PBS41.VS3-PS concept model in B13

5.3.2 3D models of PBS41 VS3-PS Extension Busbars in B13

The Enovia links for the models of the PBS41 VS3-PS in B13 is given in the links below.

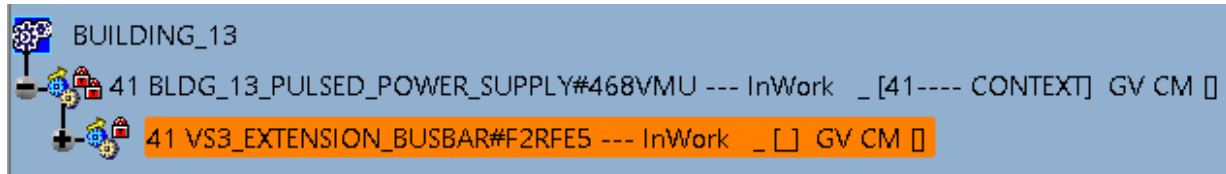


Figure 5. ENOVIA links of the PBS41 VS3-PS Extension Busbars' concept model in B13

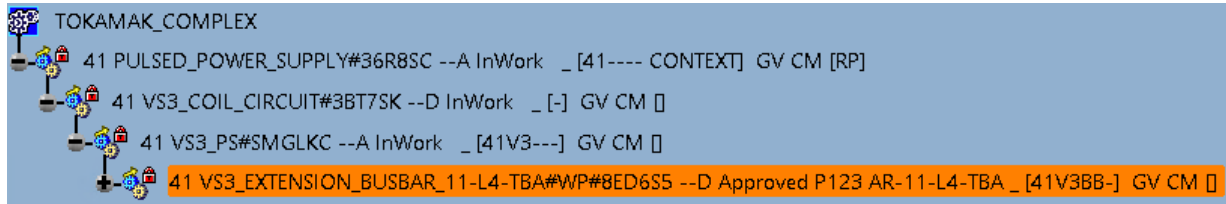


Figure 6. ENOVIA links of the PBS41 VS3-PS Extension Busbars' concept model in B11L4

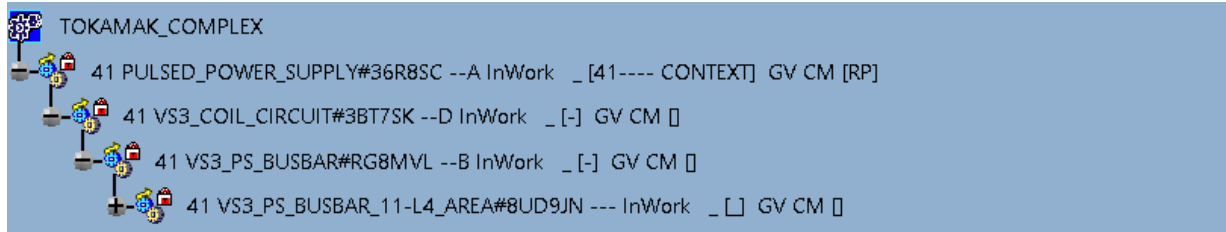


Figure 7. ENOVIA links of the PBS41 VS3-PS Busbars' concept model in B11L4

6 Interfaces Description

Each interface points number provides the requirements from entities PBS41 VS3 Power Supply (41.V3), PBS41 VS3 Extension Busbars (41.V3.BE) or PBS41 VS3 Busbars (41.V3.BB)

6.1 Interface points

The physical interface between the Extension Busbars and the VS3-PS is located at the end of Extension Busbars in B13 equipped with flanges and terminals (Figure 8, Figure 15).

At current design phase, it is not known if the VS3-PS will be connected to the Extension busbars with cable or busbars or other links. This choice will be performed by the Contractor of the VS3-PS.

The Signal cables between VS3 Power Supply, VS3 Busbars and Extension Busbars are given in document in reference [AD09].

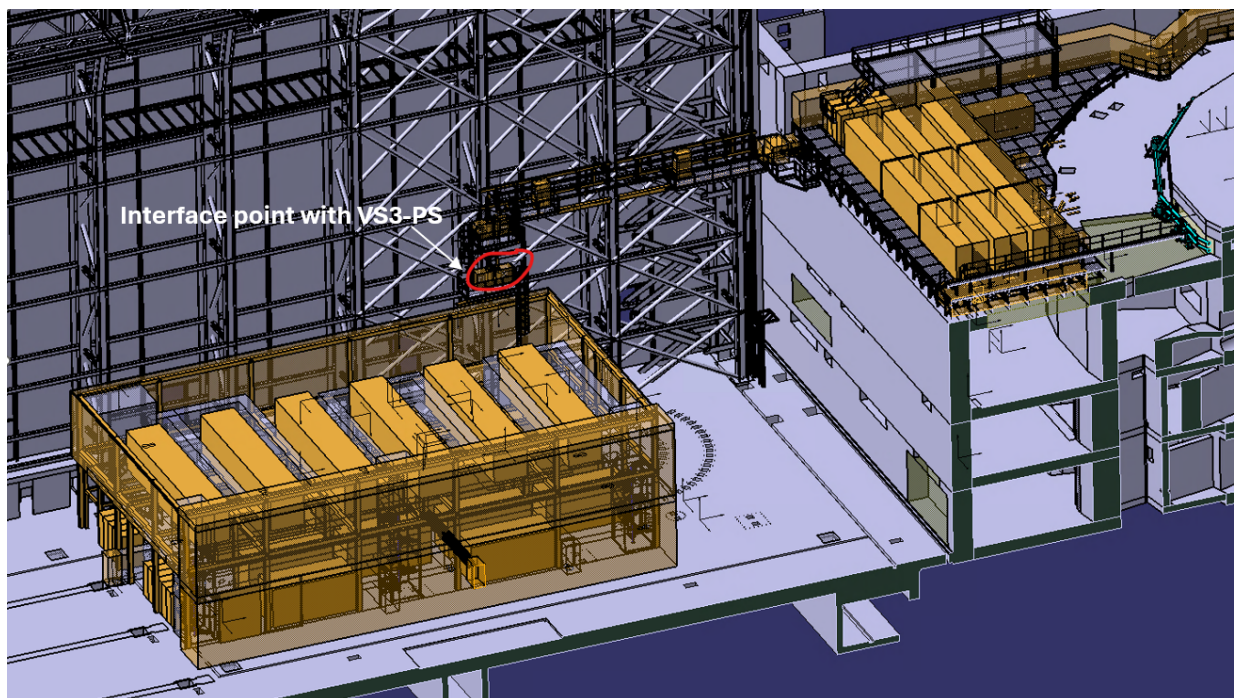


Figure 8. Physical location of interface points between VS3-PS and Extension Busbars.

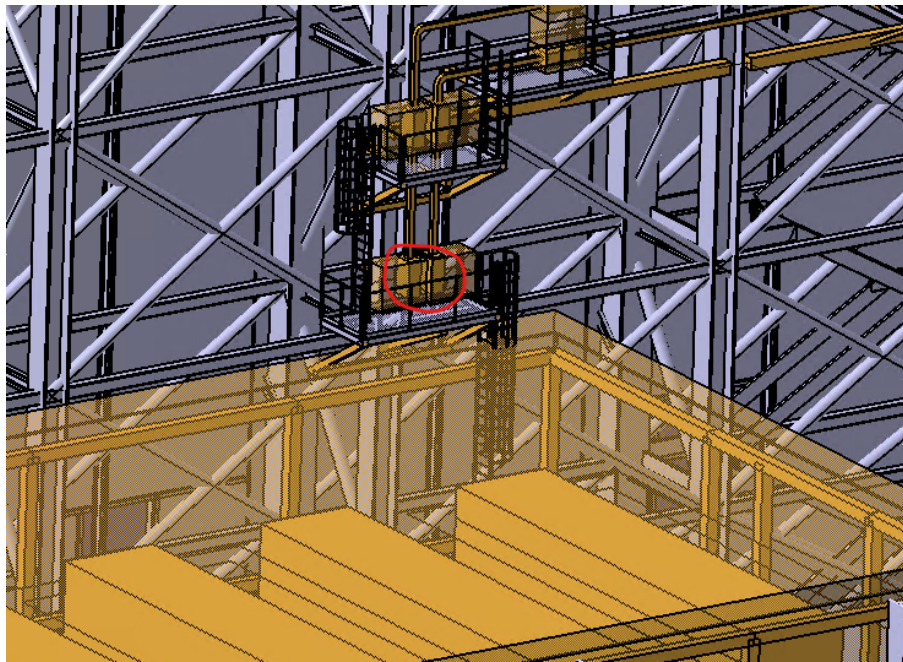


Figure 9. Physical interface points with VS3-PS.

6.2 Interface requirement definition

Each interface point is identified according to [AD08] §5.2 as follows: 4141-003i00x, where:

“003i” in the interface sheet number according to ICD in reference [AD02].

“00x” is the sequential number of the interface points.

For reading simplification, the requirements that PBS41 VS3-PS (PBS41.V3) shall satisfy are in green, the requirements that PBS41 VS3-PS Extension Busbars (PBS41.V3.BE) shall satisfy are in blue and the requirements that PBS41 VS3-PS Busbars (PBS41.V3.BB) shall satisfy are in grey.

6.3 Interface requirements

6.3.1 Requirement that 41.V3 shall satisfy

Interface number	Item	Description	Remark
[4141-003i-001]	Interface point	PBS41.V3 shall design an adaptor to connect to the existing terminals at the interface point with PBS41.V3.BE	The adaptor shall be designed based on detail drawing of terminal provided by PBS41.V3.BE
[4141-003i-002]		PBS41.V3 shall provide PBS41.V3.BE with the mass participation of the PBS41.V3 components between the last support of the Extension Busbars and the first support at VS3-PS side according to Figure 10	This mass is limited to 675kg according to [AD04]
[4141-003i-003]		PBS41.V3 shall use flexible connection solutions at interface point to mechanically decouple both systems in order to transfer no additional mechanical loads to the existing terminals. The	

Interface number	Item	Description	Remark
		flexible connection box is called BDRC in this document. The concept of the BRDC is given in Figure 14	
[4141-003i-004]		If such BRDC (Figure 14) is used, it shall be a closed enclosure with removable trap to permit inspection of components inside the enclosure	
[4141-003i-005]		The BRDCs shall be placed in such a way to permit access for maintenance according to [AD01]	The access space reservation for the maintenance of the BRDC is estimated in Figure 16
[4141-003i-006]		The flexible connection inside the BRDC shall be designed to absorb the relative displacement between the VS3-PS and the Extension Busbar attached to the B13 structure, Figure 14	
[4141-003i-007]		PBS41.V3 shall provide PBS41.V3.BE with the loads generated by internal magnetic field resulting from the operation of the VS3-PS according to the load specification in reference [AD10]. These loads shall be provided by filling the Table 9 where N is the points identified of application of these loads determined. Each of the points 1 to N shall be described and their position in TGCS shall be provided.	
[4141-003i-008]		PBS41.V3 shall provide PBS41.V3.BE with the displacements of the VS3- steel structure in B13 at the closest points to the interface point identified in Figure 8. The displacement shall be provided in Table 10 for each load category according to [AD10].	The displacement will be used by PBS41.V3.BE to estimate the size of the flanges and terminals
[4141-003i-009]	Heat generated	The heat generated by the components from VS3.PS side connected to the terminals shall be limited to keep the maximal temperature imposed by the reference NF C 15 100 in reference [CS1] regarding component surface that can be touched by persons.	
[4141-003i-010]		The temperature inside the connection box shall be controlled and the limit temperature reached shall be determined and justification shall be provided to demonstrate this temperature is acceptable.	
[4141-003i-011]	Signal acquisition and processing	PBS41.V3 shall acquire and process PT-100 RTD temperature signals and flow switch signals (ON/OFF, ON=24 V, OFF=0 V) received from PBS41.V3.BE.	
[4141-003i-012]	Protection	PBS41.V3 shall provide alarm / trip protection for PBS41.V3.BE according to following conditions:	

Interface number	Item	Description	Remark
		<p>Alarm condition: Low flow rate (“Alarm” when flow rate below the set minimum flow.)</p> <p>Trip condition: Low flow rate + High Temperature (“Trip” when the temperature of cooling water returned from the pole exceeds 41°C)</p>	

Table 6 : Responsibilities of PBS41.V3

6.3.2 Requirement that 41.V3.BE shall satisfy

Interface number	Item	Description	Remark
[4141-003i-013]	Scope	PBS41.V3.BE shall provide the flanges and the terminal at the end of the Extension Busbars according to Figure 15	
[4141-003i-014]		PBS41.V3.BE shall provide PBS41.V3 with the definition drawings of the assembly of flanges and terminals	
[4141-003i-015]	Load at interface point	PBS41.V3.BE shall provide PBS41.V3 with the mass participation of the PBS41.V3.BE components between the last support of the Extension Busbars and the first support at VS3-PS side according to Figure 10	This mass is limited to 675kg according to [AD04]
[4141-003i-016]	Location of the BRDC	PBS41.V3.BE shall place the terminals at a height of 13.3m above the B13 slab according to Figure 12	
[4141-003i-017]		PBS41.V3.BE shall place the terminals such a way that maximum out of all distance from the B13 axis 13.2 and the connection box doesn't exceed 1785mm according to Figure 13	
[4141-003i-018]	Supporting	PBS41.V3.BE shall use a fixed supports (ALL DOF) for the last support close to the terminals in order to avoid axial displacement of the Extension Busbar at the interface point, Figure 10	
[4141-003i-019]	Heat in the connection box	As shown in Figure 12, a part of the terminals is water cooled. The temperature of the non-cooled parts shall be kept to the maximal temperature imposed by the reference NF C 15 100 in reference [CS1] regarding component surface that can be touched by persons.	
[4141-003i-020]	I & C signals	PBS41.V3.BE shall provide PBS41.V3 with one temperature signal, 3-wire PT-100 resistance and one flow switch signal, 3 wire ON/OFF signals for each pole of PBS41.V3.BE. There are 4 flow switches and 4 PT-100 RTD temperature sensors.	
[4141-003i-021]	I & C signals interface points	The interface points for the I&C cables from the temperatures sensors and flow switches are located in B11 L4	

Table 7 : Responsibilities of PBS41.V3.BE

6.3.3 Requirement that PBS41 V3.BB shall satisfy

Interface number	Item	Description	Remark
[4141-003i-022]	I & C signals	PBS41.V3.BB shall provide PBS41.V3 with one temperature signal, 3-wire PT-100 resistance and one flow switch signal, 3 wire ON/OFF signals for each pole of PBS41.V3.BB. The I&C signals are listed in [AD05] and [AD06], there are 40 temperatures sensors and 40 flow switches.	
[4141-003i-023]	I & C signals interface points	The interface points for the I&C cables from the temperatures sensors and flow switches are at the signal terminal boxes located in B11 L4, as shown in [AD05].	

Table 8 : Responsibilities of PBS41.V3.BB

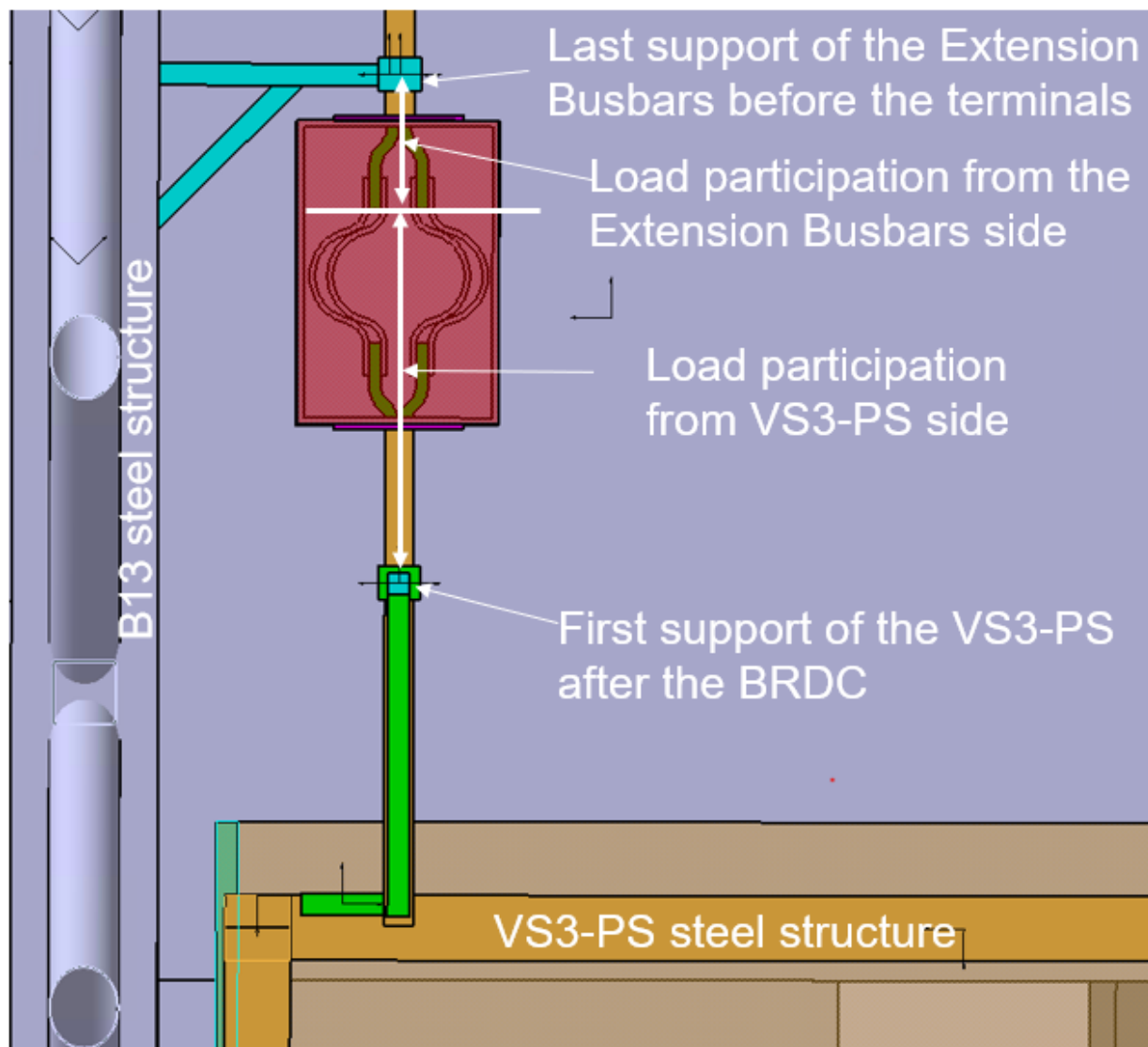


Figure 10. Illustration of interface load between VS3-PS and VS3-PS Extension Busbars

Points	Load set per load cases at attachment points (TBD)					
	F _x [kN]	F _y [kN]	F _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
1						
2						
3						
.						
.						
.						
N						

Table 9: Load sets at attachment points per load combination

Note: N is the number of points identified where the loads are applied

Displacement of VS3 Steel Structure with regard to B13-L1 in TGCS												
Location	Category I loads			Category II loads			Category III loads			Category IV loads		
	dx [mm]	dy [mm]	dz [mm]	dx [mm]	dy [mm]	dz [mm]	dx [mm]	dy [mm]	dz [mm]	dx [mm]	dy [mm]	dz [mm]
Closest point to the Interface point with PBS41 V3.BE												

Table 10: Displacements of the VS3-PS steel structure in B13 (TBD)

6.3.4 Access

Access is managed in the CMAF in reference [AD03]

The access to the connection boxes is illustrated here after.

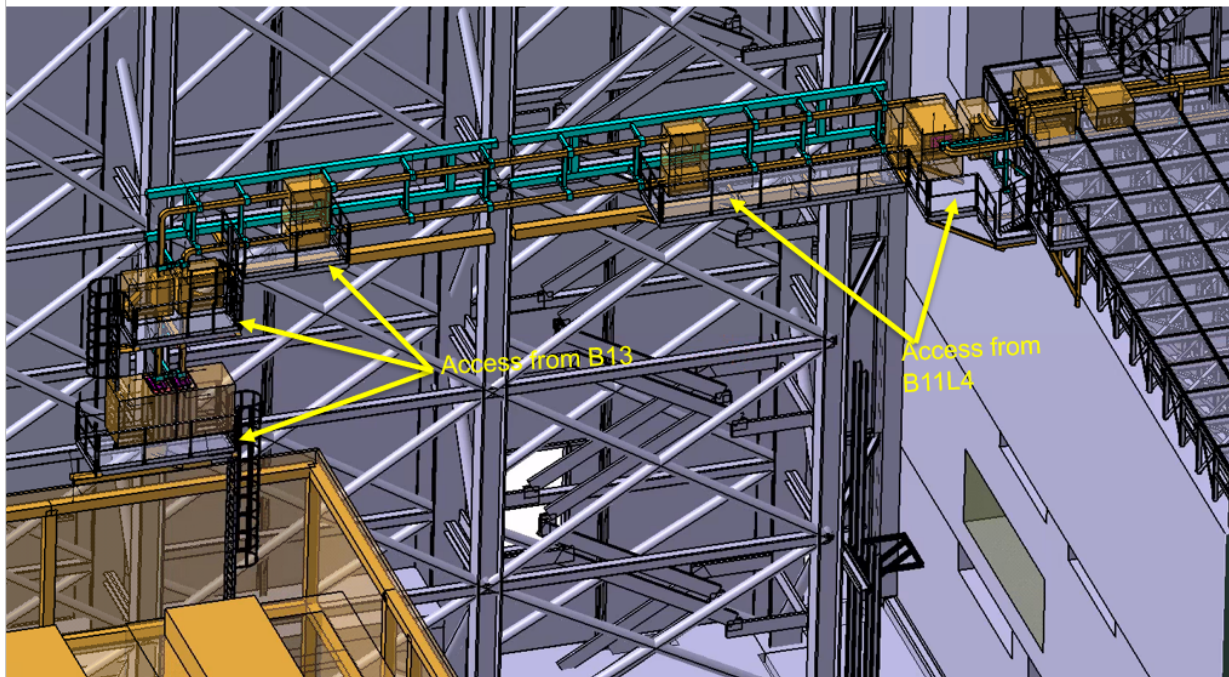


Figure 11. Access to the connection boxes at the interface point

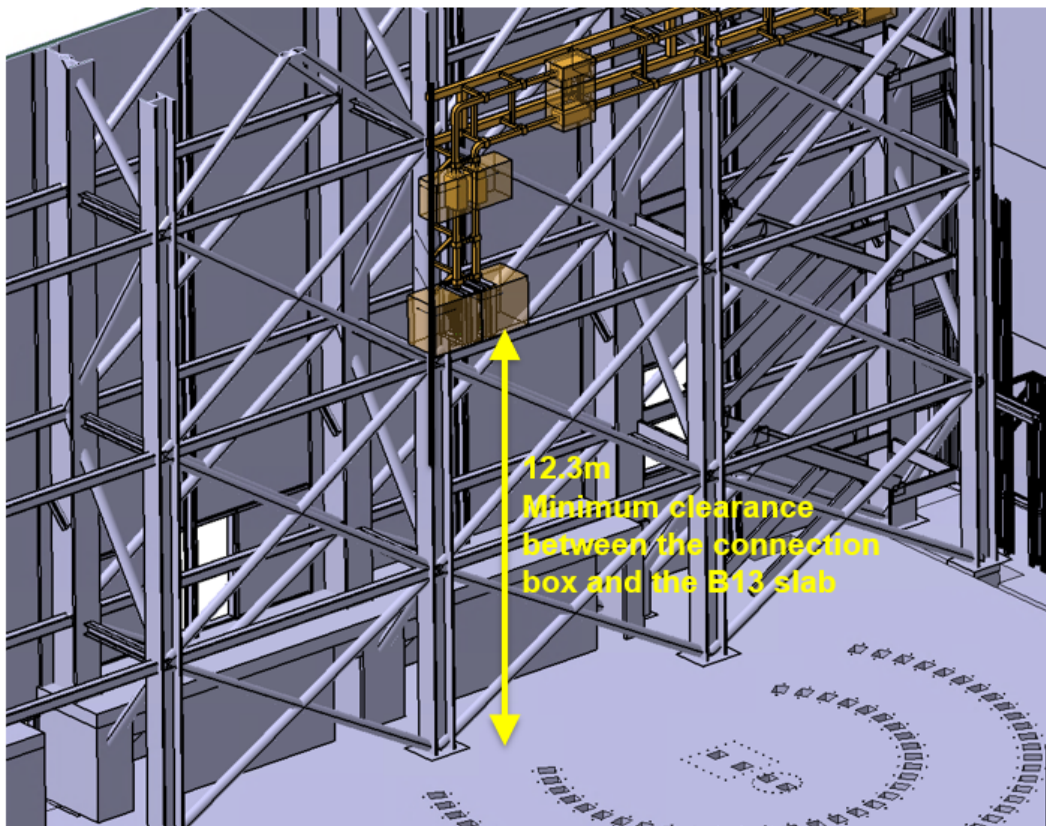


Figure 12. Minimum distance from the connection box to the floor of the upper level of the VS3-PS

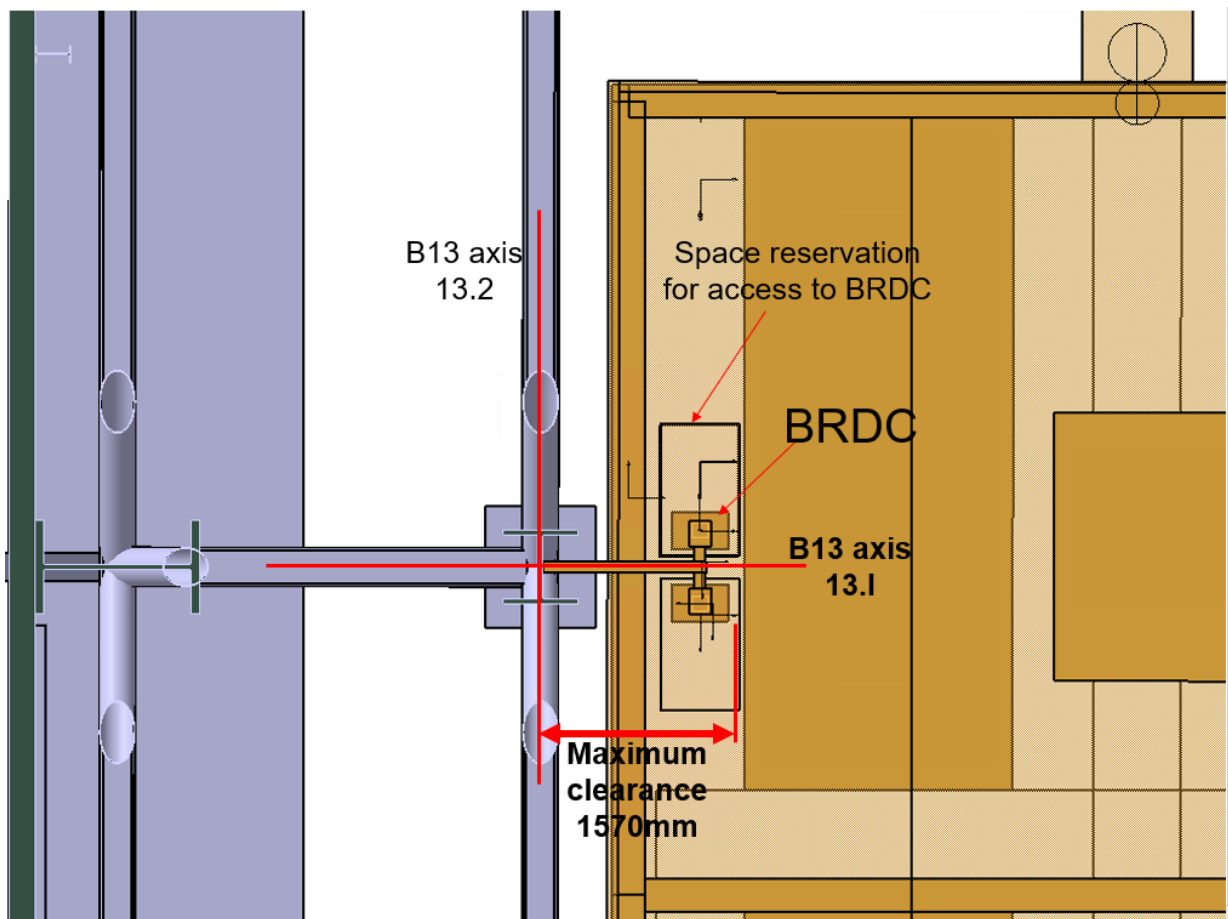


Figure 13. Distance from axes in B13

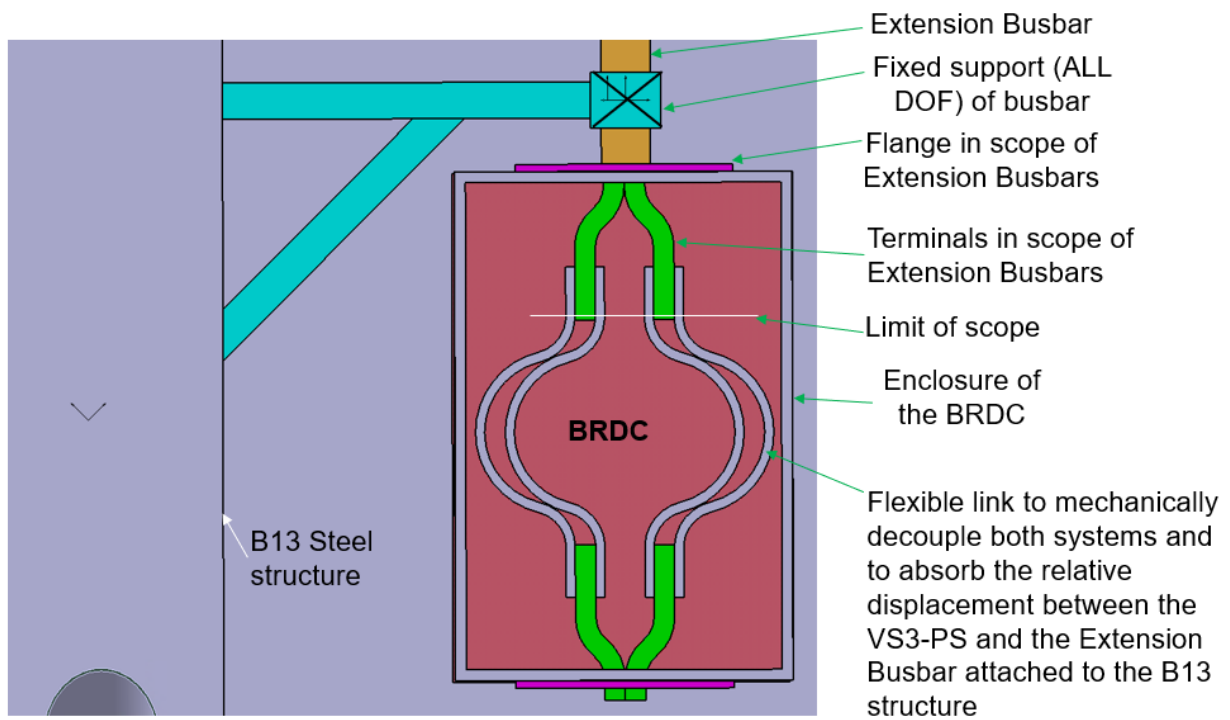


Figure 14. Concept design and connection of the BRDC

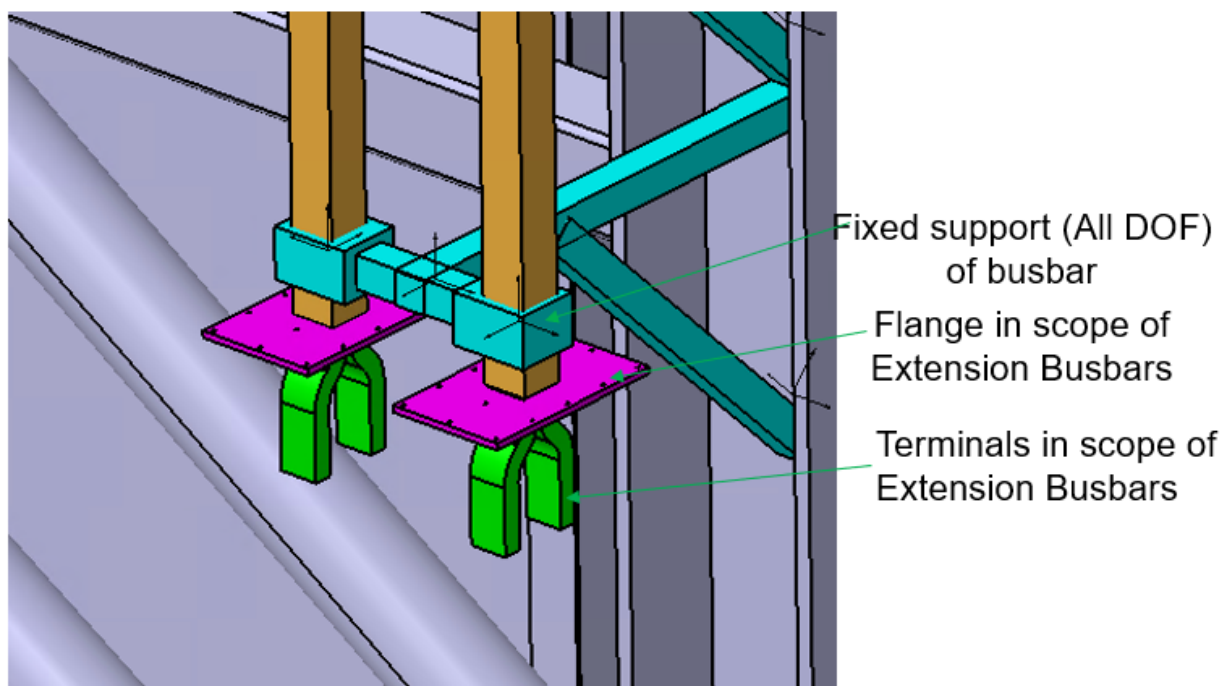


Figure 15. Scope of the Extension Busbars at the interface point

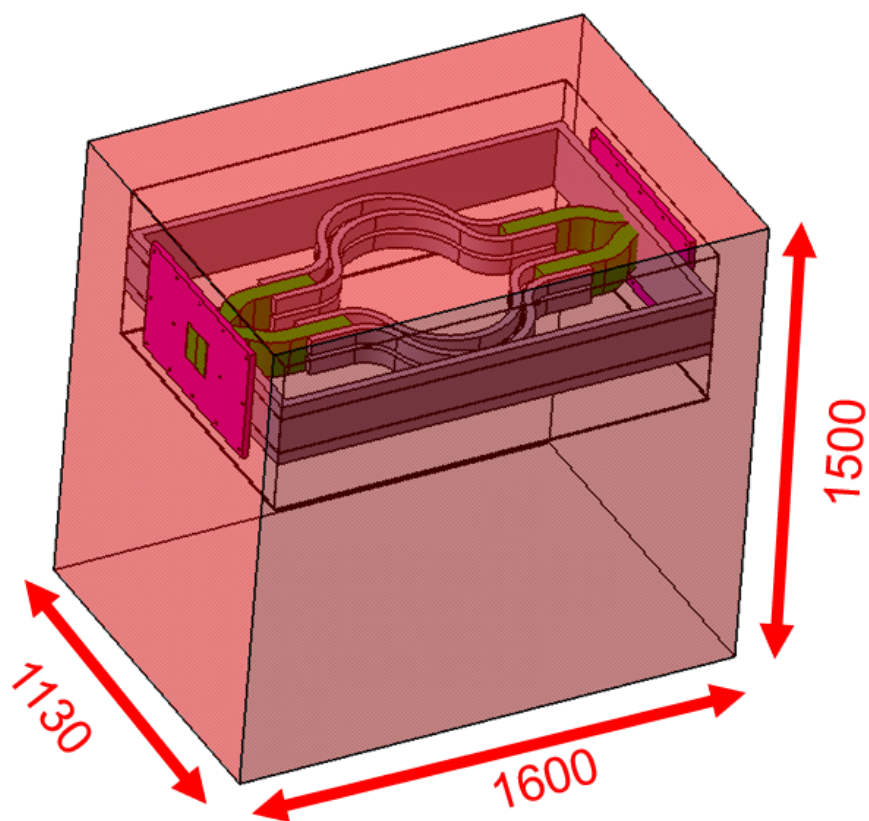


Figure 16. Concept space reservation for the maintenance of a BRDC

7 Division of Responsibilities

PBS 41.V3.BE is responsible for:

- Providing the Extension Busbars and required data for the connection to the terminals and flanges

PBS 41.V3 is responsible for:

- Providing the enclosure and the adaptors to connect to the terminals of the Extension Busbars.
- Providing load data for the design of the Extension Busbars.

PBS 41.V3.BB is responsible for:

- Providing the information for I&C data collection

8 Staged Approach

Interfacing PBS entity		SRO	DT-1	DT-2
Designation	PBS Reference			
PBS 41 VS3-PS	41.V3	X	X	X
PBS 41 VS3-PS Extension Busbars	41.V3.BE	X	X	X
PBS 41 VS3-PS Busbars	41.V3.BB	X	X	X

Table 11: Physical implementation of interfacing PBS entities according to the Staged Approach.