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Interface Sheet-IS

IS-43-41-501 Interface between LV Class IV Power Supply of SSEN and In-vessel coil power supply

Interface between LV Class IV Power Supply of SSEN and In-vessel coil power supply

Approval Process			
<i>Author</i>	<i>Name</i>	<i>Action</i>	<i>Job Title / Affiliation</i>
	Pince L.	01 Jul 2025:signed	Nuclear System Integration Engineer
<i>Co-Authors</i>	Kharichkin D.	07 Jul 2025:signed	Electrical Engineer
	Lagier T.	03 Jul 2025:signed	Electrical Engineer, Power Conversi...
	Van kessel R.	01 Jul 2025:signed	Electrical Engineer
<i>Reviewers</i>	Beltran D.	07 Jul 2025:recommended	Project Leader
	Rodriguez I.	31 Jul 2025:recommended	F4E
	Shen H.	15 Jul 2025:recommended	Project Leader
<i>Approver</i>	Vanpoperynghe Y.	04 Aug 2025:approved	Section Leader
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<i>Change Log</i>			
IS-43-41-501 Interface between LV Class IV Power Supply of SSEN and In-vessel coil power supply (M2WS9P)			
<i>Version</i>	<i>Latest Status</i>	<i>Issue Date</i>	<i>Description of Change</i>
v0.0	In Work	29 Nov 2013	
v1.0	Approved	29 Nov 2013	This is a first issue Of IS for class IV power requirement of Invessel coil power supply system of PBS 41. Load list is given at latest updated ELL template.
v2.0	Approved	21 Apr 2015	1) One more DB added, was five, now six DBs of identical ratings in total. 2) Physical locations of the six DBs updated
v2.1	Signed	02 Dec 2016	Power consumption from each SSEN feeder increased from 51kW to 57kW, because of predicted air ventilation system to control cubicles.
v2.2	Approved	07 Dec 2016	1. Update of automatic calculation formulas; 2. Tag numbers added; 3. Room number updated according to Room Book.
v2.3	Approved	21 Jul 2020	Updated to include the latest PBS41 design details.
v3.0	Approved	08 Dec 2022	Technical update consistent with and limited to PCR-001297 IS fully reshaped in consistency with the latest PBS 43 IS template for LV (35WP5A v4.3)
v4.0	Approved	01 Jul 2025	Update to implement PCR-001640 (1ST STEP UPDATE) Update in consistency with latest version of the IS template (35WP5A v4.4) Note: complete reshuffling of PBS 41 power demand, therefore no track change is given for the ANNEX table Explanation of the 2 steps update strategy: - 1ST STEP UPDATE: first IS update to modify the PBS client power request and to close PBS client PCR(s) as soon as possible - 2ND STEP UPDATE: if needed, second IS update to modify PBS 43 data (consecutively to PBS client updated power request), supported by a global PBS 43 PCR raised for reconciliation with all 1st step updates

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1 Purpose

The purpose of the present IS is to define the interface requirements between PBS 43 and PBS 41 for the LV Class IV OL power supply of the In-vessel coil power supply, part of the Coil Power Supply & Distribution System in agreement with ICD-41-43 [AD1].

2 Acronyms and definitions

2.1 Acronyms

AC/DC	Alternating Current/Direct Current
BD	Board, Distribution
CPSD	Coil Power Supply & Distribution
DT-1	Deuterium Tritium phase 1
DT-2	Deuterium Tritium phase 2
EDH	Electrical Design Handbook
EE	Electrical Enclosure (TTT code = BD, BP, BJ, CMC, CNP, CR, CU, PSU, VFD)
ICD	Interface Control Document
IP	Investment Protection
IR	Interface Requirement
IS	Interface Sheet
LV	Low Voltage
NA	Not Applicable
PA	Procurement Arrangement
PBS	Plant Breakdown Structure
PCR	Project Change Request
SRD	System Requirements Document
SRO	Start of Research Operation
TBD	To Be Defined
TKC	ToKamak Complex

2.2 Definitions

All terminologies and acronyms related to the present IS are defined in [AD4] (EDH part2)

3 Applicable Documents

Reference	Title	UID	Version
[AD1]	ICD-41-43 Interface Control Document for Steady State Electrical Network (PBS 43) and Coil Power Supply and PPEN (PBS 41)	35BQZA	1.4
[AD2]	SRD-43 (Steady State Electric Power Supply Networks) from DOORS	28B6Y9	3.6
[AD3]	SRD-41 (Coil Power Supply and Distribution) from DOORS	28B6XQ	5.0
[AD4]	Electrical Design Handbook (EDH)	2DSPT6	Folder
[AD5]	Staged Approach Configuration - PBS Level 3	SNE6G8	4.0

4 Reference Documents

Reference	Title	UID	Version
[RD1]	TEMPLATE of PBS 43 Electrical Interface Sheet for LV	35WP5A	4.4
[RD2]	Definition of Important Electrical Terms in the PBS43 Interface Sheet Annexure	5CZWB2	1.0
[RD3]	EDH Standardisation Guides	2N45UN	Folder
[RD4]	LV electrical calculation methodology. Standard cable sizing and short-circuit breaker	5KQGZV	5.4
[RD5]	3D Extract of Electrical Enclosures in Tokamak Complex	2U6RJP	2.14
[RD6]	PBS 41 (Except PP) - Coordinates of equipment (except EE in the TKC)	CRM2SE	1.6

5 Interface Description

5.1 PBS 43 (Steady-State Electric Network)

The main function of the Steady-State Electric Network (SSEN) is to transform AC power received from the French 400 kV transmission grid and distribute it to the ITER plant components (SSEN clients) that require steady state electric power.

The SSEN provides electrical power to PBS clients according to the following classification:

- Class I-Safety: Uninterruptible DC for components classified as PIC
- Class II-Safety: Uninterruptible AC for components classified as PIC
- Class II-IP: Uninterruptible AC for components classified as “Investment Protection”
- Class III-Safety: Emergency AC power (temporarily interruptible) for components classified as “Safety Important Class” PIC
- Class III-IP: Emergency AC power (temporarily interruptible) for components classified as “Investment Protection”
- Class IV: AC grid power (indefinitely interruptible).

5.2 PBS 41 (Coil Power Supply & Distribution System)

The CPSD consists of the following subsystems:

- Pulsed Power Electric Network (PPEN) which receives AC power from the HV grid and distributes it at intermediate voltage (IV) and medium voltage (MV) to the pulsed loads of ITER, comprising of the CPSS and H&CD PS.
- Reactive Power Compensation and Harmonic Filtering (RPC&HF) System connected at intermediate voltage (IV) compensates the reactive power and reduces harmonic distortion caused by AC/DC Converters and Heating power supply to level acceptable system operational requirements.
- Coil Power Supply System (CPSS) which receives AC power from the PPEN and supplies controlled DC power to the TF, PF, CS, CC, ELMs, and VS3 coils and stabilizing feedback loops VS1 and VS2 (the decision can be taken at a later stage).

The present IS applies for the LV Class IV OL power supply for the In-vessel coil power supply, which is part of the CPSS

The In-vessel coil power supply provides controlled voltage/current for stabilization of plasma vertical displacements, varying current in the VS in-vessel coils (stabilizing feedback loop VS3).

5.3 Interface between PBS 43 and PBS 41

The present IS defines the interface requirements associated to the PBS 41 LV Class IV OL power demand of the In-vessel coil power supply to PBS 43.

5.3.1 Physical interface

The physical interfaces between the Steady State Electrical Network (PBS 43) and the Coil Power Supply & Distribution System (PBS 41) take place at the connection between PBS 43 cables coming from the LV Class IV OL (main and sub) distribution boards and the PBS 41 components terminal block.

Notes: PBS 43 cable routing is performed through IS-43-44 where PBS 43 specifies the components' FROM / TO coordinates (x, y, z). When the "TO" component belongs to PBS 41, coordinates are taken:

- From [RD5] for Electrical Enclosures (EE) in the TKC
- From [RD6] for all other components (i.e. EE out of the TKC and non EE)

5.3.2 Functional interface

The Steady State Electrical Network (PBS 43) provides the requested LV Class IV OL power to PBS 41.

6 Interface Requirements (IR)

[4341-501i1-R] PBS 43 shall provide PBS 41 electrical components with the power requested in the ANNEX of the present IS.

[4341-501i2-R] PBS 41 shall design its components terminal block in consistency with the number and maximum cross sections of PBS 43 cables specified in the dedicated columns of the ANNEX of the present IS.

7 Division of Responsibilities

7.1 PBS 41 responsibilities

PBS 41 must demand low voltage electrical power to PBS 43 using the Excel file template in attachment of [RD1].

PBS 41 must refer to [RD2] to properly fill the Excel file template.

PBS 41 must ensure that the coordinates (x,y,z) of its electrical enclosures (EE) located in the TKC specified in [RD5] are correct.

PBS 41 must ensure that the coordinates (x,y,z) of its EE out of the TKC and non-EE specified in [RD6] are correct.

PBS 41 can use relevant guideline in [RD3] to develop its electrical design.

PBS 41 is responsible to ensure that information filled in its allocated cells are correct and up to date.

7.2 PBS 43 responsibilities

PBS 43 must complete the PBS 41 power request Excel file, in particular the information necessary for PBS 41 design, among others:

- The PBS 43 distribution board allocated to each PBS 41 load
- The number and maximum cross sections of PBS 43 cables connected to each PBS 41 component terminal block
- The protection devices characteristics

PBS 43 is responsible to ensure that information filled in its allocated cells are correct and up to date.

7.3 Shared responsibilities and understanding

7.3.1 Interface sheet steps

The allocation of PBS 43 distribution boards as well as the number and cross sections of PBS 43 cables depend on the PBS client load class, power and location. It is therefore understood that the completion of the present IS is the result of an iterative process:

1. PBS 41 requires power to PBS 43 using the Excel file template [RD1] and provides the coordinates (x,y,z) of its electrical loads to PBS 43
2. PBS 43 performs its electrical distribution design to meet PBS 41 power request and completes the Excel file accordingly
3. PBS 43 and PBS 41 approve the IS

Both PBS 43 and PBS 41 perform their design in consistency with specifications agreed in the completed Excel file of the approved IS.

7.3.2 PBS 43 and PBS 41 voltage drops

This section is applicable only if PBS 41, from its components interfacing with PBS 43 cables, further distributes power to downstream component(s) with the same voltage (400V or 230V)

The voltage drop requirements apply to the cable “chain” from the power source up to the final consumer. Therefore, it is shared between PBS 43 and PBS 41 cables. It is agreed that:

- Both PBS 43 and PBS 41 perform their design with the objective to respect the voltage drop sharing described in [RD04].

- PBS 41 must calculate the voltage drop for each of the cables of its scope and provide the values to PBS 43.
- PBS 43 will use voltage drop values provided by PBS 41 to verify that the overall voltage drop in the cables (from the source up to the final consumer) complies with the requirements: [43s718-R] and [43s370-R] of [AD2].
- Should the voltage drop requirements not be met, both PBS must discuss to find the best solution.

7.3.3 PBS 43 and PBS 41 circuit breakers

The selectivity is the coordination of overcurrent protection devices so that a fault in the installation is cleared by the protection device located immediately upstream of the fault. Therefore, the compliance with selectivity requirements relies on the “coordination” of PBS 43 and PBS 41 protection devices, if any.

The relevant characteristics of PBS 43 protection devices are specified in dedicated columns (P to X) of the Excel file template [RD1].

PBS 41 must take into account PBS 43 protection devices characteristics specified in the ANNEX of the present IS to design its own protection devices so as to comply with selectivity requirements.

Should the design of PBS 41 protection devices not be compatible with the selectivity requirements, both PBS must discuss to find the best solution.

7.3.4 Interface sheet update process

PBS 41 electrical power demand can evolve as its design matures. However, as PBS 43 electrical distribution already passed its FDR, any change in the PBS client power demand must be supported by a PCR.

Should PBS 43 not be able to meet the “new” PBS 41 power demand within its current design, both PBS must discuss to find the best solution.

Note: PBS 43 configuration will be updated on a regular basis embarking relevant PCR raised since the previous baselined configuration.

8 Staged Approach

This section aims at defining at which phase of the Staged Approach the physical and functional interfaces identified in this IS are required.

PBS 41 specifies the phase from which the power is needed in the column “When is the power needed?” of the Excel file attached to this IS

PBS 43 identifies the (main and sub) distribution boards distributing the power to PBS client components in the column “From Equipment' Functional Reference” of the Excel file attached to this IS. The related phasing of these boards – of their PBS level 3 node - is specified in [AD5].

Green	To be provided by PMS-VV (PMS client)
Orange	To be provided by PMS-K2 (K5GN)
Red	Calculated fields
Yellow	To be filled by either PMS, if needed
Blue	Cells modified or added as compared to previous version (deletions do not appear)