CHARGE FOR THE INTEGRATED CRITICAL DESIGN REVIEW FOR THE WELDS OF PORT TUBES ON MONOLITH VESSEL

iCDR meeting place and date

Meeting place: ESS Office and Remote via Zoom Lund, Sweden
Meeting date: March 15-16, 2021

Purpose of this iCDR

A CDR is usually scheduled as a milestone event for approving the transition from detailed design to manufacture. The design is reviewed against all design inputs, including technical and interface requirements from the relevant sub-projects. A successful CDR gives confidence that the proposed design will meet all technical requirements. The completion of a CDR fixes the baseline design of the component being reviewed.

The present CDR is an "iCDR", "integrated" CDR, meaning that a wide spectrum of parameters are integrated, from functional and spatial to technical and organisational, going beyond the strict definition of the corresponding work package. This is motivated by the fact that the connection between the monolith vessel tank and the port tubes is crucial for long term operation and performance of ESS.

The activity subject to the present review is taking place in the framework of the agreement (TIK 4.5 revision 2) signed between ESS ERIC (Lund) and ESS Bilbao on December 11, 2017:

"*The division of responsibilities and tasks for the installation of the Monolith Vessel (all components included) is the following: […]*

- *ESS ERIC is responsible for the installation and placement of each part of the Monolith Vessel including the PBW port block, in its final location, meeting the alignment requirements needed for the final welding*
- *ESS-Bilbao will be responsible for the final welding of each of the pieces of the Monolith Vessel and the in-situ welding test, including the Neutron beam port block welds.*"

The objective and purpose of this iCDR is to confirm that

- the requirements on the activities are sufficiently well defined and complete, with clearly stated acceptance criteria;
- the design of the welding of the port tubes to the monolith vessel tank is likely to meet all these requirements and is specified in sufficient details to allow preparation of the installation phase details.

This iCDR will then trigger the preparation of an IRR, Installation Readiness Review, that will tackle all practicalities of the activities on site.

Deliverables for this CDR

The contents of the Welds of Port Tubes to Monolith Vessel data package shall be provided to the CDR review board two weeks in advance. As a minimum, the CDR data package shall contain all deliverables specified in Appendix 1.

Charge to the Committee

The Review Committee conducts this review with the authority of the ESS Technical Director Kevin Jones. It is composed of the Chairman and members as identified in Appendix 2.

The Review Committee is asked to undertake the following tasks:

1. REVIEW: The Review Committee is asked to scrutinize and assess the deliverables listed in Appendix 1, sent to the committee and presented at the CDR.

2. ANSWERS: The Review Committee is asked to answer the questions listed in Appendix 3.

3. RECOMMEND: The Review Committee is asked to recommend to the ESS Technical Director if the welds of port tubes to MV meet all requirements with acceptable risk and within the cost and schedule constraints, and if the maturity of the design is appropriate to support proceeding with preparation of the full-scale execution, site acceptance test, and future operation. The recommendation should have one of the following forms:

- Endorsed, without qualifying comments or further actions.
- Endorsed, but with recommended actions.
- Not endorsed, but with recommended further actions and inputs, and with a proposal for a follow-up review.

4. REPORT: The Review Committee is asked to document its conclusions as recommendations as input for the Work Package in a short report to be delivered as soon as possible after the CDR.

Appendix 1
Deliverables for Review

The deliverables for this CDR are:

Regarding ESS ERIC Requirements

1) Interface and functional requirements described in the relevant interface control documents and the system requirement documents (including the tolerance budget), and the related functional drawings;
2) Requirements coming from the Applicable Law, including but not limited to: European Directives, relevant standards, and Notified Body.
3) Reminder on the choice of the welded solution against other design variants for the connection between port tubes and monolith vessel.

Regarding ESS Bilbao Activities

4) Global procedure and installation scheme, including port tube installation sequence and alignment strategy, and fastening method
5) Project schedule
6) Update of the Safety Analysis Report
7) Results and analysis from the welding on the two prototypes at ENSA
8) Preparation: bevel preparation, WPS (Welding procedure specification), PQR (Procedure Qualification Records), production coupons, protection gas
9) Execution: welding process order and realisation scheme
10) Verification and validation plan, including inspection plan
11) Estimation of the deformations produced during the welding process, and of the compliance with tolerance budget
12) Detailed Risk Analysis

Appendix 2
Review Committee and other Reviewers, Presenters and Observers

Name	Organisation, Title	Appointment for CDR
Masatoshi Arai	ESS, Technical Coordinator	Reviewer
Gilles Favre	CERN, Senior welding engineer, Engineering Dept	Reviewer
Juan Knaster	F4E, Deputy Head of ITER Programme Department	Reviewer
Rikard Linander	ESS, Head of Target Division	Reviewer
Frederic Lobinger	ITER, Welding supervisor, Vacuum vessel	Reviewer
Bertrand Nicquevert	ESS, Advisor of the Technical Director	Secretary
Björn Rundcrantz	ESS, QC and welding expert	Reviewer
Peter Rådahl	ESS, Chief Engineer	Chairman
Krister Blomberg	ESS, Installation Package Leader, Target Division	Presenter
Sara Ghatnekar Nilsson	ESS, WPM Monolith Systems, Target Division	Presenter
Fabien Rey	ESS Project Directorate, integration Services	Presenter
Pablo Ortiz	ENSA	Presenter
Mario Samperez	ENSA	Presenter
Fernando Sordo	ESS Bilbao	Presenter
Anders Andersson	ESS, WUL Monolith Vessel, Target Division	Observer
Mikael Beise	ESS, QC Target	Observer
Adrien Besson	ESS, Vacuum	Observer
Christine Darve	IK management, Quality Interface	Observer
Nick Gazis	ESS, EIS Department	Observer
Stig Jörstad	ESS, Monolith Systems, Target Division	Observer
Marc Kickulies	ESS, WPM Extraction, Target Division	Observer
Gabor Laszlo	ESS, NSS Division	Observer
Tobias Lexholm	ESS, Installation Coordinator, Target Division	Observer
Ebbe Malmstedt	ESS, IK Management	Observer
Mattias Skafar	ESS, ESH&Q Quality Division head	Observer
Iain Sutton	NSS, NSS Division	Observer
Robert Svensson	ESS, WUL Neutron Beam Port Blocks, Target Division	Observer

For information

ESS Project Directorate
Mark Anthony
Andrew Kimber
Rafal Rudnicki
Mikael Jakobson

ESS Technical Directorate
Kevin Jones
Carlo Bocchetta
Garry Trahern
Marcelo Juni Ferreira
Shane Kennedy

IK Associate Directorate
Dimitri Argyriou
Mark Robinson

ESS Bilbao
Mario Perez

ENSA
Sofia Coriño

Appendix 3
Questions

Specific questions that the committee should address:

Global project questions

1) Is the plan complete, consistent, and in line with the scope of the TIK 4.5 rev.2?
2) Have risks been properly identified, analyzed, and appropriately addressed?
3) Are the mitigations well defined in case of major Non-Conformity?
4) Are the quality assurance and quality control activities properly planned?
5) Does the design satisfy all functional, performance and safety requirements?

Specific technical questions

1) Is the welding process specification sufficiently defined and documented in order to provide a sufficient technical basis to start the preparation of the on-site welding?
2) Are the estimations on welds deformation and vessel shrinkage realistic?
3) Is the way to proceed in order to minimize deformations satisfactory?
4) Are the residual stresses in the welds a concern, is the configuration too constrained?
5) Are the defined non-destructive inspections considered enough to ensure the quality of the welding?

Appendix 4
Tentative agenda

Two subsequent half-days (afternoon / next morning) **2021 March 15th and 16th**

March 15th 2021

12h30 – 13h30 **Committee session**
(Committee members only) Call for experts, round table and summary of the charges: Peter

13h30 – 17h30 **1st open session**

13h30: General context and scope of ESS Bilbao contribution (Sara / ESS Target dept)
14h00: Integration, installation and alignment constraints (Fabien + Krister / ESS)
14h30: SAT and acceptance criteria (Sara / ESS Target dept)
14h45: Overall project plan, global operation strategy (Fernando / ESS Bilbao)

15h15: break

15h30: Scope of supply of ENSA contract (Fernando / ESS Bilbao)
15h45: Results of the prototype welds (ENSA)
16h00: Welding process definition: preparation, execution, material certification, (ENSA)
16h30: Welding control and risk mitigation (ENSA)
17h00: Qualification of welders and welding procedures, documentation (ENSA)
17h15: Assessment of the adequateness of ENSA's proposal to satisfy ESS requirements (Sara)

17h30: End of the open session

18h – 19h **Committee session**
(Committee only): preparation of Q&A session

March 16th 2021

8h – 9h30 **2nd open session**
Discussion time (Questions & Answers)

9h45 – 11h15 **Closed session**
(committee only) Preparation of draft recommendations

11h15 – 12h **Close-out open session**
11h15 Answer to charges and draft recommendations (Peter)
11h45 Concluding remarks (Kevin)