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| Charge  for Critical Design Review (CDR)  for Cryogenic Distribution System for Spoke Linac (CDS-SL) |
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**CDR meeting place and date**

Meeting place: IPN, Saclay, France

Meeting dates: April 19-20, 2017

**Purpose of this CDR**

A CDR is scheduled as a milestone event for approving the transition from detailed design to manufacture (or to material or component procurement, to software coding, to construction etc.). The design is reviewed against all design inputs, including technical and interface requirements.

A successful CDR gives confidence that the proposed design will meet all technical requirements and interface properly with all relevant accelerator subsystems. The completion of a CDR fixes the baseline design of the component being reviewed.

The objective and purpose of this CDR is to confirm that the design of the Cryogenic Distribution System for Spoke Linac is likely to meet all requirements and is specified in sufficient details for production and assembly of the ESS CDS-SL to begin.

The Cryogenic Distribution System for Spoke Linac is in the scope of ACCSYS WBS 11.11.5.3 Work Unit, which includes designing, production, installation and commissioning of the system. The design, production, installation and all related testing are delivered by CNRS in the scope of the French In-Kind Contribution to ESS ACCSYS project.

The CDR should confirm that the detailed design output is traceable to design inputs from ESS for the CDS-SL that have been received, understood and agreed by CNRS. CNRS’s design for the CDS-SL should demonstrate that all the agreed design inputs have been fulfilled or achieved, i.e. that the CDS-SL detailed design developed by CNRS is verified to all the requirements for the CDS-SL and its interfaces. The inputs for detailed design include:

* Technical Specification of the Cryogenic Distribution System for the Spoke Linac (ESS-0017178 Rev 1) and its appendixes:
  + Interface sheet for the interface between the Cryogenic Distribution System for the elliptical linac and for the Cryogenic Distribution System for the spoke linac (ESS-0011308)
  + Interface sheet for the interface between the CDS for spoke linac and the CDS vent line (ESS-0034245)
* Conceptual 3D models of the Cryogenic Transfer Line and Cryogenic Distribution Line (ESS-0027404)
* L4 requirements for the CDS-SL (as L5 component belonging to CRYO discipline, which is at L4 of the ESS PBS) including interface requirements applicable for the CDS-SL at various PBS Levels. These requirements are managed in the DOORS database, implemented for ESS products.
* any other inputs provided during previous reviews or other technical meetings which have been agreed and accepted as applicable input to detailed design for the CDS-SL.

**Deliverables for this CDR**

The contents of the CDR data package shall be provided to the CDR review board no later than 5 (five) working weeks before the review. As a minimum the CDR data package shall contain all deliverables specified in Appendix 1. The review board includes the review committee members and other reviewers identified in Appendix 2.

The review board will review the documentation provided in the CDR data package and submit written comments to the ESS and CNRS no less than 3 (three) working weeks before the review meeting. CNRS shall consolidate the comments and provide written answers to the board no less than 1 (one) working week before the review meeting.

The agenda of the review meeting will be communicated to the Parties no less than 1 (one) working week before the review meeting. The review meeting shall include in depth presentations by the Partner of the work undertaken and responses to the review findings.

**Charge to the Committee**

The Review Committee is composed of the Chairman and members as identified in Appendix 2. This list also shows reviewers, who provide comments and review but are not on the formal committee, and presenters as well.

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., presented via the talks at the CDR (Note: the presentations themselves are means of communication only, and it is the CDS-SL design which must be reviewed)

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

3. DECIDE: The Review Committee is asked to decide if the CDS-SL design meets all facility element requirements with acceptable risk and within the cost and schedule constraints, and if the maturity of the CDS-SL design is appropriate to support proceeding with full-scale fabrication, assembly, integration, site acceptance test, and future operation. The decision should have one of the following forms:

* Approved, without qualifying comments or further actions.
* Approved, but with recommended actions.
* Not approved, but with recommended further actions and inputs, and with a proposal for a follow-on review.

4. REPORT: The Review Committee is asked to document its decision and recommendations on any specific actions and inputs for the Work Unit in a short report to be delivered as soon as possible after the CDR.

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| Appendix 1  **Deliverables for Review** |
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The deliverables for this CDR are:

1. CDS-SL requirement lists for the system itself and its interfaces
2. CDS-SL detailed design verified to requirements including 3D models of the cryogenic transfer line, cryogenic distribution line and auxiliary process lines and all their supports, and jumper connection test boxes for acceptance tests as well
3. Technical documentation of the CDS-SL detailed design required by the Pressure Equipment Directive 97/23/EC and all applicable construction codes and standards. The documentation shall include but not be limited to:

* detailed design 3D model of the CDS including all its components and parts
* complete set of the assembly drawings of all components including bills of materials, indicating the materials used with important details, main dimensions and weights
* pipe and instrumentation diagrams indicating all equipment, instrumentation, interfaces, valve and pipe sizes etc.
* list of instruments and valves
* stress and flexibility analysis for all piping

1. RAMI Report, a report of the estimation of the probability and consequences of failures in equipment as well as main maintenance tasks and proposed spare parts.
2. Safety Report, safety risk assessment report including identifying hazards and evaluating likelihood of incidents occurring and severity of potential consequences, also list of existing control measures.
3. Certificate of Conformity for Hazardous Materials and Sustainability, if applicable.
4. Verification Plan, (including planned FAT and SAT activities)
5. Project Quality Plan describing Quality Assurance and Quality Control activities for realisation (procurement, manufacture, assembly, installation) and for verification (including inspections and testing). The plan should include lists of the engineering standards applied and also describe the procedures for confirming compliance with CDS-SL Requirements and with these Standards (Please see ESS-0037830 ESS template for Project Quality Plan for suggested guidance)
6. Procurement Package, a complete documentation package for the procurement of the facility element including as a minimum a statement of work, manufacturing follow-up description, applicable and reference documentation
7. Project Plan, updated plan in Gantt chart form, describing in detail remaining Stage 1 activities, describing in detail Stage 2 Realisation & Verification activities for the Partner.
8. Risk Register, showing identified project management risks and/or technical risks.
9. Technical reports, notes or documents on:

* heat load and pressure drop calculations
* thermo-acoustic oscillation analysis
* valve sizing calculations including vacuum jacket safety devices
* multilayer insulations to be installed on process lines and radiation shields
* electronic racks space required for valve positioners, pressure and temperature signals conditioners, etc.
* types and design of all bellows to be installed in process lines and external envelope

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| Appendix 2  **Review Committee and other Reviewers, Presenters and Observers** |
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*List to be finalised and names confirmed prior to CDR*

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| Name | Organisation | Appointment for CDR |
| John Weisend | ESS, ACCSYS Deputy Project Leader, and Group Leader, Specialised Technical Services (STS) | Chairman of the Review Committee |
| Matthew Conlon | ESS, ACCSYS QA/QC responsible | Review Committee |
| Wolfgang Hees | ESS, ACCSYS Deputy Group Leader STS, WP 10 Leader, and cryogenics engineer | Review Committee |
| Daniel Piso | ESS, ICS Group Leader Hardware and Integration | Review Committee Member |
| Duy Phan | ESS, ACCSYS Safety Engineer | Review Committee Member |
| Jaroslaw Fydrych | ESS, ACCSYS WP 11, WU Leader CDS | Reviewer |
| Philipp Arnold | ESS, ACCSYS Section Leader Cryogenics and WP11 Leader (Cryogenics) | Reviewer |
| Christine Darve | ESS, ACCSYS WP4 Deputy Leader (Spoke Cryomodules) | Reviewer |
| Marcelo Juni Ferreira | ESS, ACCSYS Section Leader Vacuum System and WP12 Leader (Vacuum) | Reviewer |
| Fabien Rey | ESS, E&IS Group Leader for Survey, Alignment and Metrology | Reviewer |
| Frithiof Jensen | ESS, ACCSYS, WP15 Leader, Power System Engineer | Reviewer |
| Evangelia Vaena | ESS, ACCSYS Power System Engineer | Reviewer |
| Enric Bargallo | ESS, ACCSYS Accelerator Reliability Expert | Reviewer |
| Benedetto Gallese | ESS, ICS Control System Engineer | Reviewer |
| Nick Gazis | ESS, ACCSYS Mechanical Integration Lead Engineer | Reviewer |
| Sebastien Bousson | CNRS/IPNO, Project Leader and ACCSYS WP4 Leader (Spoke Cryomodules) | Presenter |
| Patxi Duthil | CNRS/IPNO, Local Technical Coordinator | Presenter |
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The CDR Committee conducts this review of design with the authority of ACCSYS Project Leader, Mats Lindroos, and ESS Chief Executive Officer, Jim Yeck.

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| Appendix 3  **Questions** |
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1. Has design and supporting activity for CDS-SL progressed and reached a level of technical maturity in accordance with the activities and milestones for this Work Unit recorded in the ESS ACCSYS Project and been documented sufficiently and presented in a suitable format to enable review at this CDR?
2. Are all or a sufficient coverage of requirements and specifications for the CDS-SL, including for its interfaces with other systems, documented by ESS, communicated to and understood by the Work Unit team?
3. Does the CDS-SL design meet these requirements and specifications?
4. Have safety issues and technical risks been identified and eliminated or otherwise mitigated for in the detailed design or identified for managing for manufacture, assembly, installation or operation?
5. What quality assurance and quality control activities have been planned and how will these be conducted and documented or reported?
6. Is the design information and information on procedures required for the operation of the CDS-SL delivered and presented at CDR sufficient to define the controls interfaces and allow the start of the controls system design?
7. Is the schedule for delivery of materials, components and for the manufacture of CDS-SL sufficiently understood and in accordance with activities, durations and milestone dates shown in the ACCSYS project plan?
8. Does the work unit team or its parent CNRS require additional input from ESS or its other partners, or seek additional review, decision or approval from ESS to proceed with all work planed?
9. Are there any outstanding agreements to be made or other actions necessary to allow the work unit to achieve the Plan?