EUROPEAN SPALLATION SOURCE

Critical Design Review for Medium Beta Cryomodules Charge Document

Critical Design Review (CDR)
Medium Beta Cryomodules
April 3 – 4, 2017

Charge for the CDR

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 for Medium Beta Cryomodules on the cold LINAC is likely to meet all requirements with acceptable risk and within the cost and schedule constraints and is specified in sufficient detail to proceed to the next stage of procurement and manufacturing. The final design for production may still be affected by the results of prototype tests.

The CDR should confirm the detailed design output shall be traceable to design inputs from ESS for the Cryomodules which have been received, understood and agreed by CEA Saclay. The design for the cryomodules on the cold LINAC should demonstrate that agreed design inputs have been fulfilled or achieved i.e. that the requirements are verified by the design.

The inputs for detailed design may include the following, where applicable and agreed by ESS and CEA Saclay:

- The scope of work described in the HoA/In-kind agreement for cryomodules technical specifications /appendix.
- Facility Breakdown Structure (FBS) requirements for Level 2 (L2) Accelerator, L3 cryomodule sections, L4 disciplines, including interface requirements applicable for the cryomodules at various PBS Levels. These requirements are managed in the IBM® Rational® DOORS® database, implemented for ESS products.
- Any specifications agreed as inputs for the detailed design of the cryomodules.
- Any conceptual or preliminary design descriptions or other inputs provided during previous reviews, workshops, or other technical meetings, which have been agreed and accepted as applicable input to detailed design for the Cryomodule.

In general terms, the expected outputs of detailed design, which should be presented and reviewed in the CDR, are:

- CAD models, prototypes, mock-ups and simulations,
- Specifications and other descriptions resulting from detailed design activities,
- Reports from calculations, analysis, simulation, prototype testing and other design verification activities,

The specific information, which should be reviewed in the CDR, is listed as Deliverables. See Appendix 1.

The CDR boundaries and limitations

The CDR to be performed is dedicated to the Medium Beta Elliptical Cavity Cryomodules. It will stress the design, assembly studies and prototype results.

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.

The Review Committee is asked to:

1. REVIEW: Scrutinize and assess the deliverables listed in Appendix 1, presented through the material presented and discussions, at the CDR. Note that the presentations themselves are means of communication only, and it is the design and design documentation which must be reviewed. The crucial point for the reviewers is to scrutinize the intersection points between the different interfaces and organizational

responsibilities and how the work is documented to the component. “Is the design and documentation mature enough to start the next stages of prototyping and procurement for production”?

2. ANSWER: Answer each question listed in Appendix 3.

3. DECIDE: The Review Committee is to elaborate and deliver at the conclusion of this CDR, a clear recommendation to ESS and to CEA Saclay about proceeding with procurement of components for manufacture and procurement of manufacture services for the Medium Beta Cryomodules.

Suggested forms for the decision are:

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

  (If the committee rules for “Approved with recommended actions” or “Not approved” of the CDR, it is of essence that the actions/comments requested are very precise in their formulation and that the fulfilment decision is transferred to CEA Saclay, all this due to time constraints in the manufacturing schedule and sequence).

4. REPORT: The Review Committee is to document in a short report to be delivered as soon as possible after the CDR, its recommendation and any specific actions for CEA Saclay for the Medium Beta Cryomodules identifying any further design necessary, and other guidance for assisting planning and future success of the Work Unit in for its scope and deliverables.

(If the CDR is “Approved but with recommended actions”, at the CDR, there shall be a summary list of requested actions defined and who is responsible to perform needed work. In order to facilitate the actions ESS will work with CEA Saclay to accommodate any defined actions in order to meet the schedule constraints. This while awaiting the final report from the CDR charge review team).

Appendix 1

Scope and Deliverables for Review

Scope

The scope for the review includes:

- Presentation of main Cryomodules requirements (including Licensing requirements for ESS CM and ESS CM components)
- Cryomodules design : choice of design and justifications
- Assembly studies
- Description of expected design changes between the M-ECCTD and the Series Elliptical cryomodule
- Development plan including procurement plan & preliminary high level tests plan
- Cryomodules interfaces files: internal and external
- Quality Assurance and Quality Control Organisation
- Safety aspects of cryomodules
- Reliability of cryomodules

The WU is responsible for the following scope relevant for this CDR:

- Analysis and simulations e.g.
  - Heat Leak analysis
  - Support and vibration analysis
  - Reliability Availability Maintainability and Inspectability (RAMI) analysis
- Detailed mechanical and engineering design
- Definition of the interfaces with relevant systems
- Prototyping
- Procurement
- Construction and assembly
- Leak test, residual gases analysis and pressure measurement of the assemblies and associated components to demonstrate their full compliance with the requirements
- Quality assurance and contract follow-up
- Documentation concerning design, construction, tests and measurements

Deliverables for CDR - Information to be reviewed

The information identified below is to be described and communicated through presentation at the CDR, and the source information is to be available to reviewers for reference during the CDR.

CEA Saclay is requested to deliver to the CDR Chairman for distribution to the Review Committee and other reviewers, an agreed subset of the following information for pre-review and comments no later than Five (5) working days prior to the CDR.

Reviewers should assess the design, manufacturing processes and the verification methods, which secure performance, functionality and future operation as defined through the relevant requirements.

Technical Data Package

The contents of the technical data package for each CDR shall be specifically agreed in each charge, and should include but not be limited to:

- Requirements, agreed or proposed updates to documents comprising the baseline reference design, such as [REQ] , [SPN] etc.
- Design Reports, including reports of prototyping and other design-related analyses, tests, simulations.
- Design Data, (detailed design level) including 3D CAD models and CAD drawings, general arrangement drawings, P&ID, FE models, etc., and detailed interface descriptions including interface identification and definition for controlling interface design.
- Hazard analysis Report, an initial version of a report including identified hazards and evaluation of the likelihood of incidents occurring during operation and maintenance and severity of potential consequences on personnel, as well as the list of control measures). Examples of hazard analysis studies can be made available upon request.
- Verification Plan, (including planned FAT and any SAT activities)
- [PQP], updates for the Project Quality Plan applicable for the systems and components for each particular CDR, including identification of Standards applied in design, procurement, manufacture and assembly, and planning for compliance testing and inspection.

Where applicable, a CDR technical data package shall also contain documentation to initiate a competitive tender for the procurement of the systems or components whose design is the subject of the CDR. In such cases, the CDR data package should additionally include but not necessarily be limited to:

- 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
- Project Plan , updated plan in Gantt chart form, describing in detail remaining Stage 1 activities, describing in detail Stage 2 Realisation & Verification activities, and an outline of any Stage 3 Installation, Commissioning and Initial Operations activities for the Partner.

. Risks, Risk Register, showing identified project management risks and/or technical risks.
- verified results

Safety

Conventional Hazards

Present on any identified modes of operation or maintenance tasks for medium beta cryomodules, which could expose personnel to conventional hazards (e.g. high voltage hazards, magnetic field hazard, pressure etc.).

Quality

Quality Planning

Describe planning for Quality, or provide a Project Quality Plan for LWU scope. Use ESS-0037830 as guidance (not mandatory) for the planning of activities for Quality assurance and control.

Standards

List the standards used for engineering design, construction and verification of the vacuum and support systems. Note that ESS-0001515 Operating Procedure "Standards & Norms applicable for ESS" identifies radiation protection Standards, namely ICRP, IAEA, Erratum standards, and also more general engineering Standards, such as SIS, CEN and ISO, which ESS considers would be applicable for the design and construction of ESS systems and components. The ESS vacuum handbook also makes specific reference to applicable standards.

Appendix 2

Review Committee and other Reviewers, Presenters and Observers

The CDR Committee conducts this review of design with the authority of ACCSYS Project Leader, Mats Lindroos, and ESS Chief Executive Officer, John Womersley.

The Committee serves in an advisory capacity to:

- the Work Unit team for Cryomodule and for its parent CEA Saclay
- the ACCSYS WP 5 Leader, and
- the ACCSYS management team

Name	Organisation	Appointment for CDR
John Weisend II	ESS, ACCSYS Deputy Project Leader	Chairman of the Review Committee
Matthew Conlon	ESS, ACCSYS QA Lead	Review Committee member
Duy Phan	ESS, ACCSYS Safety Group	Review Committee member
Rongli Geng	Jefferson Lab	Review Committee member
TBD External Expert	TBD	Review Committee member
Daniel Piso[1]	ESS, Integrated Controls Systems	Review Committee member
Jarek Fydrych[1]	ESS, Cryogenics Section	Reviewer
Marcelo Ferreira[1]	ESS, ACCSYS Vacuum Systems Section Leader	Reviewer
Enric Bargalló[1]	ESS, ACCSYS Accelerator Reliability	Reviewer
Christine Darve	ESS, WP4/5 Deputy Work Package Leader	Reviewer
Nuno Elias	ESS, Cryogenic Engineer	Reviewer
Wolfgang Hees[1]	ESS, WP10 Leader	Reviewer
		presenter
		presenter
		presenter

[1] Denotes attendances remotely from ESS ERIC, Lund

Appendix 3

CDR Charge Questions

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1. Has design and supporting activity for Medium Beta Cryomodule 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 Medium Beta Cryomodule, including for its interfaces with other systems, documented by ESS, communicated to and understood by the Work Unit team?

3. Does the design meet these requirements and specifications?

4. How does the series Medium Beta Cryomodule differ from the M-ECCTD?

5. 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 and installation?

6. What quality assurance and quality control activities have been planned and how will these be conducted and documented or reported?

7. Is there sufficient staff resources assigned to the Work Unit team by its parent CEA Saclay to allow to progress with work in accordance with activities, durations and milestone dates shown in the ESS ACCSYS Project plan?

8. Is the design information and information on procedures required for the operation of the Medium Beta Cryomodule delivered and presented at CDR sufficient? (This includes operational modes and Medium Beta Cryomodule functionality including adjacent systems and interfaces).

9. Are the strategy, policies and regulations for procurement, manufacture and assembly sufficiently identified, defined, documented and understood by the Work Unit team or its parent CEA Saclay Laboratory, including supplier source(s) and pre-procurement activities and progressed to a sufficient stage?

10. Is the schedule for delivery of materials, components and for the manufacture of Medium Beta Cryomodule sufficiently understood and in accordance with activities, durations and milestone dates shown in the ESS ACCSYS project plan? (This includes the time schedule and technical risk evaluations)

11. Does the Work Unit team or its parent CEA Saclay require additional input from ESS or its other partners, or seek additional review, decision or approval from ESS to proceed with all work planed?

12. Are there any outstanding agreements to be made or other actions necessary to allow the work unit to achieve the Plan?

Appendix 4

Detailed checklist, can be used as guidance for clarification

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The 5 main question areas for the Medium Beta Cryomodule CDR are:

1. The design:
    a. Is the design documented sufficiently and presented in a suitable format to enable review at this CDR?
    b. Does the design meet the requirements and specifications?
    c. Does the design meet the ESS needs? (Plant integration, testing, operability, maintenance, future changes/upgrades)
    d. Are all or a sufficient coverage of requirements and specifications for the Medium Beta Cryomodule, including its interfaces with other systems, documented, communicated to and understood by the Work Unit team?
    e. Has the design and supporting activity for Medium Beta Cryomodule progressed and reached a level of technical maturity to start prototyping/manufacturing?
        i. What open technical questions exist?
        ii. What is the path forward to clarify the open questions?
    f. Have a proper safety and risk analysis been performed?
        i. What safety issues and technical risks have been identified?
        ii. Are they documented?
        iii. What mitigations have been implemented? Are they documented? What is the result?
        iv. Future actions planed? To eliminated or otherwise mitigated in the detailed design or identified for managing for manufacture, assembly, installation or operation?
    g. Does the Work Unit team or its parent CEA Saclay require additional input from ESS or its other partners, or seek additional review, decision or approval from ESS to proceed with all work planed?
    h. Are there any outstanding agreements to be made or other actions in the work unit necessary to realize the Plan?
2. The manufacturing:
    a. Is there a Manufacturing strategy and sequence?
    b. Are the strategy, policies and regulations for procurement, manufacture and assembly sufficiently identified, defined, documented and understood by the Work Unit team or its parent CEA Saclay, including supplier source(s) and pre-procurement activities and progressed to a sufficient stage?
    c. Are all needed manufacturing procedures and DWG completed? If not what is open?

d. Are all needed procedures/inspection plans including risk analysis for manufacturing performed including plan for mitigating actions? (E.g. lamination stamping, construction of the coils, overall manufacturing sequence, procedures, etc.)
e. Is the manufacturer given sufficient time to perform the work?

3. Scope split:
    a. Is the scope split clear between CEA Saclay, INFN Milan and ESS?
    b. Are the responsibilities clear and agreed?
    c. Is the requirement verification/validation agreed and understood?

4. Time schedule and critical paths:
    a. Which critical paths exist?
    b. What Top 3 risks are identified and how are they managed?
    c. Is the schedule for delivery of materials, components and for the manufacture of LWU sufficiently understood and in accordance with activities, durations and milestone dates shown in the ACCSYS project plan?

5. CEA Saclay Resource plan to meet the schedule:
    a. Are all resources named?
    b. Is the schedule resource loaded?
    c. Are all resources available and released by management in due time?
    d. Is there any surplus in the critical areas?
    e. Which bottlenecks exists?