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| Critical Design Review for the RF-LPS Medium Beta -  Charge document |
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| Critical Design Review (CDR)  of AIK 8.4 RF-LPS (MB)  June 28, 2017 |
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| **Charge for the CDR** |
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Purpose of this CDR

The Critical Design Review (CDR) assesses if the activities related to the development of the Radiofrequency Local Protection System Medium Beta (RF-LPS MB) design meet all facility element requirements with acceptable risk and quality and within cost and schedule constraints.

The CDR includes the facility elements for RF-LPS (MB):

* Slow Interlock Systems (SIM)
  + System development of the Program Logic Controller (PLC) of the Slow Interlock Module (SIM), system testing and interface definition of the RF Local Protection System (RF-LPS) prototype deployment.
  + Sub-rack enclosure design review and interface and cabling layout.
* Fast Interlock Systems (FIM)
  + System development of the Field-Programmable Gate Array (FPGA) of the Fast Interlock Module (FIM), signal processing and requirements validation of the fast response time signals.
  + Implementation of the ESS standard platform into the Experimental Physics and Industrial Control System (EPICS) of the FIM, and system compatibility by the Integrated Control System (ICS) to the interfaces.
* Analog and Digital Conditioning Boards
  + Digital and analogue signal conditioning development of the Printed Circuit Board (PCB) and requirements validation.

The CDR demonstrates that the maturity of the design is appropriate to support proceeding with manufacturing drawings and start the procuring process.

The inputs for detailed design may include the following, where applicable and agreed by MTA Atomki and ESS.

* The scope of work described in the Technical Annex AIK 8.4 for the RF-LPS related to Medium Beta (MB).
* Product Breakdown Structure (PBS) requirements for Level 2 (L2) Accelerator, L3 and L4 disciplines including interface requirements. These requirements are managed in the DOORS database, implemented for ESS products.
* Any specifications agreed as inputs for the detailed design of the RF-LPS (MB) facility elements detailed above.
* Any inputs provided during previous workshops, or other technical meetings that have been agreed and accepted as applicable input to detailed design for the RF-LPS (MB).

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

* Detailed design of the SIM, the FIM, including Conditioning Boards (conditioning box).
* Results of performed tests and planned necessary tests of RF-LPS (MB) facility elements.
* List of special tools/equipment for assembly and installation.
* Reports from calculations, analysis, simulation and other design verification activities.

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

**The CDR boundaries and limitations**

The CDR to be performed is limited in its scope and concerns only the scope related to Medium Beta (MB) in the AIK 8.4. The scope is as defined below.

* Included in the CDR are:
  1. Specifications and requirements for the RF-LPS (MB) facility elements;
  2. Space allocations;
  3. Schematics and drawings of RF-LPS (MB) facility elements;
  4. Proof of concept for FIM;
  5. Quality assurance and risk analysis.
* Excluded from the CDR are:
  1. RF-LPS High Beta (HB)

**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.

The Review Committee is asked to:

1. REVIEW: Scrutinize and assess the deliverables listed in Appendix 1, presented through the material 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 (i.e. this will kick off the production of final blue print drawings and allow for tendering processes as needed).

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, that the RF-LPS (MB) design and planned production meet all facility element requirements with acceptable risk and within the cost and schedule constraints, and if the maturity of this system design is sufficient to prepare manufacturing drawings and start procurement of individual components.

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 but 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 WP8, all this due to time constraints in the schedule).

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 MTA Atomki and/or ESS, identifying any further design necessary and other guidance for assisting planning and future success of the activities related to 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 MTA Atomki to accommodate any defined actions in order to meet the schedule constraints. This while awaiting the final report from the CDR review team).

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| Appendix 1  **Scope and Deliverables for Review** |
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Scope for Work Unit RF Local Protection System (LPS)

ACCSYS WBS 11.8.3.1.2 Work Unit (WU) RF local protection system prototyping is led by Rafael Montano, ESS ERIC. The WU is part of ACCSYS WBS 11. Work Package (WP) 8 RF systems, led by Morten Jensen, ESS ERIC. The WU for RF local protection system is split between delivery as In-Kind Contributions (IKC) from ESS Bilbao (NC (Normal Conducting) linac local protection systems) and MTA Atomki (Medium and High Beta Linac Local Protection Systems)

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

* Needed analysis: Signal simulations of the digital and analogue printed circuit boards (PCB) for the signal conditioning
* Verification and validation of the system requirements
* Prototype production and the relevant procurement for this
* Programming of software for the prototype
* Detailed design
* The testing and other verification of the prototype
* The needed QA process

Deliverables for CDR - Information to be reviewed

MTA Atomki is requested to deliver to the CDR secretary (Anders Sunesson) for distribution to the Review Committee and other reviewers, an agreed subset of detailed design information related to the RF-LPS (MB) for pre-review and comments no later than five (5) working days prior to the CDR.

The interlock system is composed of discrete parts with the responsible partner for the information to be provided at the CDR given in brackets.

* SIM (ESS)
* FIM (ESS)
* Conditioning Boards Analogue/Digital (MTA Atomki)

For each system the data package shall include but not be limited to:

* System Requirement Document (ESS)
* System Design Description and related documents and data (drawings, general arrangement drawings, P&ID, FE models, etc.) (MTA Atomki)
* Updated Interface Control Documents
* System Integration Plan
* Component Operation and Maintenance Manual
* System Verification Plan
* Plan for sustainable selection of materials
* Documentation to initiate a competitive tender for the procurement of the facility element and to support the project activities including (MTA Atomki)
* 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
  + SIM (Bill of Materials, system overview (ESS); Procurement documents (MTA Atomki)
  + FIM (ESS)
  + Conditioning Boards (MTA Atomki)
* Project Schedule (ESS)
* Procurement Schedule (MTA Atomki)
* Risk register (MTA Atomki)

Due to relatively short time for preparation, the procedure and timetable before the CDR are shorter than normal:

* CDR documents listed above shall be submitted two (2) weeks before the review.
* Written comments of the review board, one (1) working week before the review.
* Written answers to the board, three (3) working days before the review.
* Agenda of the review meeting, two (2) weeks before the review.

Documents created during the CDR:

* Report on the review process and decision.

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| Appendix 2  **Review Committee and other Reviewers, Presenters and Observers** |
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The CDR Committee conducts this review with the authority of ACCSYS Project Leader, Mats Lindroos, and ESS Director General, John Womersley.

The Committee serves in an advisory capacity to:

* The Work Unit teams for ESS RF-LPS and MTA Atomki;
* The ACCSYS WP 8 Leader and deputy, and
* The ACCSYS management team.

Note that completing a Design Review does not guarantee a trouble free system; it only means the judgement of the committee is that the design is likely to succeed. Any future problems that may develop will have to be addressed by the In-Kind partner and ESS depending upon the scope in which the problem occurs.

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| Name | Organisation | Appointment for |
| Peo Gustavsson | ESS, ACCSYS IK Manager | Chairman of the Review Committee |
| Anders Sunesson | ESS, ACCSYS RF | Review Committee Member, Secretary CDR |
| Timo Korhonen | ESS, ICS/Chief Engineer | Review Committee Member |
| Kent Wigren | ESS, ACCSYS QA/QC Lead | Review Committee Member |
| Håkan Danared | ESS, ACCSYS Deputy Head | Review Committee Member |
| Rafael Montano | ESS, ACCSYS RF-LPS | Presenter |
| Bruno Lagoguez | ESS, ACCSYS RF-LPS | Presenter |
| Daniel Piso | ESS, ICS | Presenter |
| József Molnár | MTA Atomki | Presenter |
| Beáta Király | MTA Atomki | Presenter |
| Mats Lindroos | ESS, ACCSYS Project Director | Reviewer |
| Carlos Martins | ESS, ACCSYS Power Converters | Reviewer |
| Enric Bargalló | ESS ACCSYS Accelerator Reliability | Reviewer |
| Ebbe Malmstedt | ESS, Deputy WU Leader | Reviewer |
| Annika Nordt | ESS, ICS/MPS | Reviewer |
| Morten Jensen | ESS, ACCSYS RF | Reviewer |
| Mate Varga | MTA Atomki | Reviewer |
| Inigo De la Fuente Quintana | ESS, ACCSYS RF | Reviewer |
| Anders Svensson | ESS, ACCSYS RF | Reviewer |
| Christian Amstutz | ESS, ACCSYS RF | Reviewer |
| Rutambhara Yogi | ESS, ACCSYS RF | Reviewer |
| Rihua Zeng | ESS, ACCSYS RF | Reviewer |
| Staffan Ekström | ESS, ACCSYS RF | Reviewer |
| Walther Borg | ESS, ACCSYS RF | Reviewer |
| Anton Lundmark | ESS, ACCSYS WTC | Reviewer |
| Lali Tchelidze | ESS, ACCSYS Safety Lead | Reviewer |
| Pedro Gonzalez | ESS Bilbao | Reviewer |

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| Appendix 3  **CDR Charge Questions** |
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1. Has the project and supporting activities for the RF-LPS (MB) progressed in accordance with the activities and milestones recorded in the ESS ACCSYS project plan?
2. Has the RF-LPS (MB) detailed design been documented appropriately and presented in a suitable format to enable review?
3. Have the correct design options for the RF-LPS (MB) facility elements as well as their verification methods been selected and described?
4. Have all or a sufficient coverage of requirements for the RF-LPS (MB) facility element interfaces been identified and documented by ESS, communicated to and understood by the partner MTA Atomki?
5. Are the signal lists sufficiently well documented and comprehensive enough for detailed design with sufficient margin to accommodate expected changes?
6. Do the design choices follow ESS standards and supported hardware and software platforms?
7. Are the sub-systems and the overall system designed to be adequately flexible to accommodate future machine changes, long term usage and changes to the protection requirements?
8. Does the RF-LPS (MB) assembly detailed design comply with the requirements for the system and its interfaces?
9. Is the RF-LPS (MB) facility elements detailed design sufficient to prepare manufacturing drawings and start procurement of individual components process?
10. Does the partner MTA Atomki require additional input from ESS or the other partners to proceed to the RF-LPS (MB) facility element realization process?
11. Have safety issues and technical risks been identified and eliminated or otherwise mitigated appropriate for in the detailed design?
12. What quality assurance and quality control activities have been planned and how will these be conducted and documented or reported?
13. Are there sufficient staff resources and competence assigned to the MTA Atomki scope of work to allow to progress with work in accordance with activities, durations and milestone dates shown in the ESS ACCSYS Project plan, see Appendix 4?
14. Are the strategy, policies and regulations for procurement, manufacture and assembly sufficiently defined, documented and understood by the partner MTA Atomki, including supplier source(s) and pre-procurement activities and progressed to a sufficient stage?
15. Are there any outstanding agreements to be made or other actions necessary to allow the partner MTA Atomki to achieve the project plan?

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| Appendix 4  **Detailed checklist, can be used as guidance and for clarification** |
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The four (4) main question areas for the RF-LPS (MB) CDR are:

1. The design
   1. Is the design documented sufficiently and presented in a suitable format to enable review at this CDR?
   2. Does the design meet the requirements and specifications?
   3. Does the design meet the ESS needs? (plant integration, testing, operability, maintenance, future changes/upgrades)
   4. Are all or a sufficient coverage of requirements and specifications for the RF-LPS (MB) assembly, including its interfaces with other systems, documented, communicated to and understood by the partner MTA Atomki?
   5. Has the design and supporting activity for the RF-LPS (MB) facility elements progressed and reached a level of technical maturity to start the realisation process?
      1. What open technical questions exist?
      2. What is the path forward to clarify the open questions?
   6. Have a proper safety and risk analysis been performed for this stage of the project?
      1. What safety issues and technical risks have been identified?
      2. Are they documented (signal lists)?
      3. What mitigations have been implemented? Are they documented? What is the result?
      4. Future actions planed? To be eliminated or otherwise mitigated in the realisation process or identified for managing for manufacture, assembly, installation or operation?
   7. Does the partner MTA Atomki require additional input, or seek additional review, decision or approval from ESS to proceed with all work planed?
   8. Are there any outstanding agreements to be made or other actions in the work unit necessary to realize the project plan?
   9. Specific deliverables are at a minimum expected to include:

* Detailed electrical schematics;
* Procedures on manufacturing, soldering, testing, inspection, storage and delivery protection;
* Drawings of the mechanical layout;
* Simulation results and finite element analysis (FEA) reports (if required);
* Complete list of parts;
* Complete list and definition of all signal types and expected connectors;
* A detailed manufacturing, installation (in Suppliers test area) and testing programme with regular milestones to allow progress to be monitored;
* Full details of factory acceptance testing;
* A complete and detailed list of all interfaces to all ESS equipment including all additional devices, power supplies, controls, interlocks and cabling;
* Data sheets of the main components and subsystems including those from third party suppliers;
* Details on the structure of software codes;
* Detailed ordering, manufacturing and delivery schedules.

1. The manufacturing
   1. Is there a strategy and sequence for the realisation process?
   2. How is the technical vendor discussions/agreements for manufacturing documented (applicable for the selected supplier)?
   3. What mechanism is in place to ensure that the vendor have necessary experience and/or prototypes/references from similar work for evaluation by MTA Atomki? What are the conclusions made by MTA Atomki?
   4. Are the strategy, policies and regulations for procurement, manufacture and assembly sufficiently identified, defined, documented and understood by the partner MTA Atomki including supplier source(s) and pre-procurement activities and progressed to a sufficient stage?
   5. Are all needed manufacturing procedures and drawings completed? If not what is open?
   6. Are all needed procedures/inspection plans, including risk analysis for prototyping, performed and planned for mitigating actions? (e. g. bracing, machining, overall manufacturing sequence, procedures, etc.)
   7. Is the manufacturers given sufficient time to perform the work?
2. Time schedule and critical paths;
   1. Is the project planned in sufficient detail?
   2. What top three (3) risks are identified and how are they managed?
3. MTA Atomki resource plan to meet the schedule
   1. Are all resources named?
   2. Is the schedule resource loaded?
   3. Are all resources available and released by management in due time?
   4. Is there any surplus in the critical areas?
   5. Which bottlenecks do exist?