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| Report of the Test Readiness Review for the Valve Boxes of the Spoke Cryomodule Cryogenic Distribution System |
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|  | Name | **Role/Title** |
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| **Owner** | <<Name>> | <<Role/ Title>> |
| **Reviewer** | <<Name>> | <<Role/ Title>> |
| **Approver** | <<Name>> | <<Role/ Title>> |
| **Distribution list**  | <<Name>> | <<Role/ Title>> |

Report of the Test Readiness Review 1 for the Valve Boxes of the Spoke Cryomodule Cryogenic Distribution System

September 18, 2018

P. Arnold, N. Eke, M. Juni Ferreira, J. Fydrych, F. Rey, K. Wigren, J. G. Weisend II (Chair)

# INTRODUCTION

The Test Readiness Review (TRR1) for the the Valve Boxes of the Spoke Cryomodule Cryogenic Distribution System (CDS-SL) was held in Lery, France on September 14, 2018. The charge and committee for this review are given in Attachment 1.

The valve boxes of the CDS-SL are being produced by Cryo Diffusion under contract to IPN Orsay. Significant production work on the 13 required valve boxes has begun. All the heat exchangers and valves have been procured. A significant fraction of the thermal shields is complete. Six valve assemblies have been started. Cryo Diffusion has sent the production of the three components of the vacuum vessel to 2 subcontractors. Cryo Diffusion has provided them with all ESS requirements and will carry out the radiographic inspection of the welds at Cryo Diffusion. and the procurement of the outer vacuum vessels from two subcontractors is underway.

Overall the committee was quite impressed with both the facilities and the work underway. The assembly facilities are very well organized with good flow between stations. Testing and QC steps are built into the production steps. The documentation is managed well.

The current production & verification schedule is quite detailed and should meet the current ESS installation schedule. The goal is still to be able to start installation of the CDS-SL in August of 2019. At this point, 12 of the 13 valve boxes will be done with the final one completed in September. Cryo Diffusion has 3 assembly teams in parallel during production. They have a total of 6 assembly stations to allow for radiographic inspection and for dealing with nonconformities.

The first cool down of a valve box is scheduled for mid-December 2018.

The team needs to take into account that the higher category (category 1) applies to the lines because of higher sizes of the main process lines (TS supply and TS return lines) at the interface to the CDS-EL and a phase separator in the Ebox (VLP line). This has no real impact on the process since they are already doing all the required tests and processes for category 1. It does mean that Cryo Diffusion will CE mark the applicable pipes. A declaration of conformity for the valve boxes will be issued.

Most of the recommendations from the CDR have been implemented. A few are still to be done.

No significant safety, technical or quality issues were identified in the review. The ESS team does plan to observe various tests during production with the cooperation of IPN Orsay and Cryo Diffusion.

# DECISION

The committee agrees that the procedures of manufacturing tests and supporting personnel are ready for testing the components and sub-assemblies of the CDS-SL Valve Boxes (to be manufactured during the production phases) to meet all the specified requirements. Required test equipment is identified and non-standard components (end cups and test boxes) are already designed.

The recommendations given below should be considered as the manufacturing and testing process continues.

# ANSWERS TO CHARGE QUESTIONS

1. Have all the CDS-SL activities related to preparation to the manufacturing phase progressed in accordance with the activities and milestones for this Work Unit recorded in the ESS ACCSYS Project and been documented sufficiently and presented In an appropriate way to enable review at this TRR1?

 *Yes*

2. Do all the modifications, which were introduced to the CDS-SL designs after the CDRs, support the system requirements?

 *Yes*

3. Have all or a sufficient amount of quality assurance and quality control activities been planned?

 *Yes*

4. Have all the required procedures of the manufacturing tests of the components and sub-assemblies of the CDS-SL Valve Boxes to be manufactured during the production phase been prepared and documented?

 *Mostly Yes, A few procedures still need to be finalized.*

5. Have all the required test equipment been prepared for testing the CDS-SL Valve Boxes’ elements, components and sub-assemblies in the production phases?

 *Yes. This equipment has been designed.*

6. Is the Partner contractor’s personnel ready for testing the CDS-SL Valve Boxes’ elements, components and sub-assemblies to be manufactured during the production phases?

 *Yes. A very strong team has been assembled.*

7. Have safety issues and technical risks been identified and eliminated or otherwise mitigated in the detailed design or identified for managing during the installation and/or operation?

 *Yes.*

8. Does the work unit team require additional input from ESS or its other partners, or seek additional review, decision or approval from ESS to proceed with all work planned?

  *Generally No. Separate discussions on mechanical analysis still need to be held.*

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

*No.*

# RECOMMENDATIONS

1. Cryo Diffusion shall add explicitly the various cleaning procedures into the Inspection Test Plan

2. IPNO should provide to ESS the number of fiducial targets required to be installed on the CDS-SL components

3. Description of dimensional control procedures still needs to be given to ESS.

4. Additional activity (Fiducialization of Valve Boxes) should be added to the ITP

5. IPNO shall update pressure category to Category 1 for appropriate lines

6. RAMI analysis shall be provided to ESS

7. IPNO and ESS shall work together to finalize required cables in the cable database

8. IPNO and ESS shall work together to finalize device names

Attachment 1

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| **Charge** **for Test Readiness Review 1 (TRR1)** **for Cryogenic Distribution System for Spoke Linac (CDS-SL):****Manufacturing of Valve Boxes** |
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**TRR1 meeting place and date** Meeting place: Cryo Diffusion, Lery, France Meeting date: September 14th, 2018 **Purpose of this TRR1**The Cryogenic Distribution Systems for Spoke Linac is in the scope of ACCSYS WBS 11.11.6.3 Work Unit, which include designing, production, installation and commissioning of the system. The design, procurement, production, transportation and installation are delivered by IPNO/CNRS in the scope of the French In-Kind Contribution to ESS ACCSYS project. This delivery includes also all testing related to the production and installation phases. The objective and purpose of this TRR1 is to evaluate if the procedures of the manufacturing tests, test equipment, supporting personnel are ready for testing the components and sub-assemblies of the CDS-SL Valve Boxes to be manufactured during the production phase. In case of any changes in the CDS-SL designs, the TRR1 is also to confirm that all the introduced changes support the CDS’s design to meet all the requirements and are specified in sufficient details for production and assembly of the ESS CDS-SL VBoxes to begin. **Deliverables for this TRR1**The contents of the TRR1 data package shall be provided to the TRR1 review board no later than 3 (three) working weeks before the review. As a minimum the TRR1 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 TRR1 data package and submit written comments to the ESS and IPNO/CNRS no less than 1 (one) working weeks before the review meeting. IPNO/CNRS shall consolidate the comments and provide written answers to the board no less than two working days 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 TRR1 2. ANSWER: The Review Committee is asked to answer the questions listed in Appendix 3. 3. DECIDE: The Review Committee is asked to decide if the procedures of manufacturing tests, test equipment, supporting personnel are ready for testing the components and sub-assemblies of the CDS-SL Valve Boxes (to be manufactured during the production phases) to meet all the specified requirements. 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 TRR1.

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| Appendix 1**Deliverables for Review** |
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The deliverables for this TRR1 are:1. Requirements, agreed or proposed updates to documents comprising the baseline reference design.
2. Design Data, Design documentations of the CDS-SL Valve Boxes to conform with ‘as-built’ configuration, including complete set of CAD manufacturing drawings.
3. Project Plan, updated plan in Gantt chart form, describing in details remaining activities of the CDS-SL project.
4. Risks, Risk Register showing any updates identified project management risks and/or technical risks, needed to reflect the CDS-SL ‘as-built’ baseline.
5. Verification Plan providing verification specifications for each planned verification activity and in particular fabrication and factory acceptance test plan including certified welding procedures, non-destructive test qualifications, pressure and leak tests.
6. RAMI Report, any updates to the report of the estimation of the probability and consequences of failures in equipment as well as main maintenance tasks and proposed spare parts, to reflect the ‘as-built’ configuration baseline.
7. 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).
8. Project Quality Plan, any updates to the plan needed to reflect the ‘as-built’ configuration baseline.

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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 TRR1*

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| Name | Organisation | Appointment for TRR1 |
| John Weisend  | ESS, ACCSYS Deputy Project Leader, and Group Leader, Specialised Technical Services (STS) | Chairman of the Review Committee  |
| Philipp Arnold | ESS, ACCSYS Section Leader Cryogenics and WP11 Leader (Cryogenics) | Review Committee Member |
| Kent Wigren | ESS, ACCSYS QA/QC responsible | Review Committee Member |
| Fabien Rey | ESS, E&IS Group Leader for Survey, Alignment and Metrology | Review Committee Member |
| Marcelo Juni Ferreira  | ESS, ACCSYS Section Leader Cryogenics and WP12 Leader (Vacuum) | Review Committee Member |
| Nicolas Eke  | ESS, Occupational Health & Safety Engineer | Review Committee Member |
| Jaroslaw Fydrych | ESS, ACCSYS WP 11, WU Leader CDS | Reviewer  |
| Philippe Rabis  | ESS, ICS, WP10 manager | Reviewer |
| Enric Bargallo  | ESS, Accelerator Reliability Expert | Reviewer |
| Piotr Tereszkowski | ESS, Design Engineer | Reviewer |
| Patxi Duthil | IPNO/CNRS, Project Leader  | Presenter |
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The TRR1 Committee conducts this review with the authority of ACCSYS Project Leader, Mats Lindroos, and ESS Dierector General, John Womerslay.

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| Appendix 3**Questions**  |
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1. Have all the CDS-SL activities related to preparation to the VBox production phase progressed in accordance with the activities and milestones for this Work Unit recorded in the ESS ACCSYS Project and been documented sufficiently and presented in an appropriate way to enable review at this TRR1?
2. Do all the modifications, which were introduced to the CDS-SL design after the CDR, support to meet the system requirements and specifications?
3. Have all or a sufficient amount of quality assurance and quality control activities been planned?
4. Have all the required procedures of the manufacturing tests of the components and sub-assemblies of the CDS-SL Valve Boxes to be manufactured during the production phase been prepared and documented?
5. Have all the required test equipment been prepared for testing the CDS-SL Valve Boxes’ elements, components and sub-assemblies in the production phases?
6. Is the Partner contractor’s personnel ready for testing the CDS-SL Valve Boxes’ elements, components and sub-assemblies to be manufactured during the production phases?
7. Have safety issues and technical risks been identified and eliminated or otherwise mitigated in the detailed design or identified for managing for manufacture, assembly, installation or operation?
8. Does the work unit team 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?
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