Target and Dump Proton Beam Imaging Systems CDR

Project Quality Plan

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Approver		

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SUMMARY

This document describes the Project Quality Plan (PQP) for the Oslo in-kind contribution part of the Target and Dump Proton Beam Imaging Systems. The systems consist mainly of commercially procured industrial components. The quality of the system will be ensured by a number of defined reviews and tests.

1. SCOPE

This document describes the Project Quality Plan (PQP) for the in-kind contribution to the ESS accelerator division from the Department of Physics, University of Oslo ("Oslo"). The in-kind contribution is specified in the Oslo-ESS in-kind contract and technical annex [ESS-0044049]. The work specified is the delivery of the proton beam imaging systems (IMS) to the ESS target region and tuning dump, as well as contributions to the luminescent coating development for these profile monitors. The ESS contributions to this joint project are not covered by this PQP.

Some of the information required by the PQP template exists in other project documentation. In these cases the PQP refers to those documents in order to avoid replicated text.

2. INPUT TO THIS QUALITY PLAN

The CHESS document [ESS-0042178] describes the technical specification for the imaging systems.

The CHESS document [ESS-0044049] describes the in-kind contract between Oslo and ESS.

The CHESS documents [ESS-0065484] (PDR) and [ESS-0149761] (CDR) provide a high-level overview of the project at the time of the PDR and CDR, and may serve as additional background for reading this PQP.

A number of other relevant CHESS documents, mostly from the Imaging Systems CDR, are references in the following.

3. QUALITY GOALS

The quality goals of the project are to ensure that the delivered systems fulfill the technical specifications, at the highest possible level, and that the systems are delivered on schedule and with correct interfaces to adjacent subsystem.

4. MANAGEMENT RESPONSIBILITIES WITHIN THIS QUALITY PLAN

The person responsible for the overall quality plan is Prof. Erik Adli, the Oslo in-kind manager.

For the parts of the project being executed by the mechanical workshops at the MN-Faculty, the person responsible is Hans Borg. For the parts of the project executed by the electronics laboratory at the MN-Faculty the person responsible is Ole Rohne.

5. DOCUMENTATION AND STORAGE OF DATA

The documents related to this Quality Plan will be stored in CHESS, and also distributed to partners involved in the project that do not have access to CHESS. Documents and data will be reviewed and approved by ESS Lund.

6. CONTROL OF RECORDS WITHIN THIS QUALITY PLAN

The project documents will be stored in the ESS CHESS database. This includes the full documentation originating from PDR review, CDR review, FATs and SATs.

7. RESOURCES

7.1. Materials

The imaging systems consist of optical systems, photon sources (luminescent material) and software and electronics.

Materials for optical systems: some of the components of the optical systems will be placed in the target region, in areas of high radiation. In this region mirrors will be made of pure aluminum, a material that has tested and proven in other spallation sources, e.g. SNS at Oak Ridge and SINQ at PSI. The mirrors may require a protective coating [ESS-0150766], depending on what will be the final specification of the target atmosphere.

Target systems: cameras and electronics for the target systems will be placed in the AT2AA, which is not a radiation area. Standard industrial solutions for scientific cameras, spectrometers and other electronics will be procured and used. Scientific cameras of the highest sensitivity will be used. See [ESS-0150746**]** for more information.

Tuning dump systems: Scientific cameras of an inexpensive GigE type will be used, as the requirements on resolution and dynamic range are not as stringent as for the target system. Cameras for the tuning dump will be placed in alcoves that minimize the radiation with the target of camera survivability of at least one year. See [ESS-0150756] for more information.

Material for luminescent coating: for the first target, a replica of the Ruby-coating used at SNS will be used. In parallel research in more radiation hard luminescent coating materials will be performed, and improved coatings may be applied to future targets. See [ESS-0150759] for more information.

7.2. Human resources

The Oslo human resources for the project are as follows:

Personnel	**Role**	**Fraction**
Erik Adli	Oslo in-kind manager	
Håvard Gjersdal	Oslo local project leader	100%
Ole Røhne	Researcher, experimental physicist	25%
Grey Christoforo	Researcher, specialist in electronics, optics	50%
Ole Dorholt	Responsible for Electronic lab developments	Part time
David Bang-Hauge	Electronic lab electronics engineer, FPGA	Part time

Maren Lithun	CAD-specialist	Part time

Additional engineers and technical from the Oslo electronics and mechanics workshops will contribute, as needed.

In addition, the following personnel from Cockcroft Institute is subcontracted to Oslo, in order to perform Tuning Dump design work and liaison with the Cockcroft team design the tuning dump vacuum vessel.

Mark Ibison	Researcher, experimental physicist. Sub-contracted from Liverpool University to Oslo.	100%

Future requirement on human resources:

The Oslo-ESS contract covers work up to end December 2019. All deliveries by Oslo to ESS should be completed by then. If Oslo personnel should be involved in the project beyond December 2019, additional contracts between ESS and Oslo (typically from ESS operation/maintenance budget) must be ensured. Alternatively, but less likely to happen at this point, new funding from the Research Council of Norway must be ensured. This issue is documented in [ESS-0153770].

7.3. Infrastructure and work environment

Optical system development: requires laboratory space at Oslo for prototyping of optical systems, mock-up at ESS for final installation of optical systems on the target PBIP. Portable systems for electronics (cameras, spectrometers, illumination systems) are required for test of prototype, at mock-up and during installation.

Electronics and software development: required platforms installed at Oslo with ESS ICS-delivered EPICS platform and FPGA-solutions.

Coating development: The coating strategy and requirements for infrastructure for coating is described in the CDR document [ESS-0150759].

8. REQUIREMENTS

[ESS-0042178] describes the technical specification for the imaging systems. The requirements are reviewed formally at the PDR and CDR, as well as the FAT and SAR.

9. CUSTOMER COMMUNICATION

The main communication channel is weekly Oslo-ESS meetings. Minutes of meeting are recorded. In addition come input to the ESS BI monthly reports, as well as the formal reviews.

10. DESIGN AND DEVELOPMENT PROCESS

10.1. Control of Design and Development changes

Oslo suggests updates to design. All updates and changes must be approved by ESS. The project baseline will be updated at each review (PDR and CDR). Other changed may be reviewed by ESS during defined meetings outside the major reviews. Oslo will implement the changes, after approval by Oslo in-kind manager.

11. PURCHASING

Purchasing will be done from proven commercial vendors, including Thorlabs, Edmund optics, Kugler, Stemmer Imaging, UHV.

11.1. Verification of lead times

Lead time for critical components has been verified just ahead of CDR. The status is as follows:

The maximum lead time for the optical system mirrors (diamond drilled flat or biconic mirrors) is about 6 months. This is consistent with the current schedule; the target mirrors can not be installed until the PBIP has been delivered to ESS. The current PBIP delivery schedule is late 2018.

The estimated lead time for both the Gig-E vision cameras(Allied Vision Manta 235B, for the tuning beam dump) and the high sensitivity scientific cameras planned to be used for target (Hamamatsu Photonics - ORCA-Flash4.0V2) is "currently in stock".

11.2. Lead times for ESS provided software and hardware infrastructure

For cameras (above) it is not sufficient that a camera type is procured in order to utilize it for test, development or production. The camera type must also be integrated with the control system, a significant effort, specified in the in-kind contract to be done by ESS. Experience from other accelerator laboratories (SLAC) has shown that it may take on the order of a year, or more, even with sufficient manpower, to complete the integrate a new camera type with a custom control system. This work has not yet started for the Hamamatsu high sensitivity camera.

Furthermore, the ESS FPGA platform prototype, required for doing design and implementation of beam synchronous functionality, is not yet ready and no lead time has been given. See [ESS-0150753] for more information about these issue,

12. PRODUCTION AND SERVICE PROVISION

The project does not include a significant amount of local production. Components (cameras, spectrometer, mirrors etc.) will be acquired from a number of industrial vendors.

12.1. Installation and post-delivery activities

This is documented in [ESS-0153500] for the target systems.

13. IDENTIFICATION AND TRACEABILITY

The system components (mirrors, cameras etc.) will be installed in their final locations, after which no further traceability is applicable from the point of view of Oslo.

14. CUSTOMER PROPERTY

The systems will be handed over to ESS after a completed FAT and SAR, during which the fulfillment and conformity of the system will be established.

15. PRESERVATION OF PRODUCT

The preservation of the product after delivery and SAR will be the responsibility of ESS.

15.1. Preservation during transportation

Oslo will be responsible for the transportation of the system components to ESS, including packaging and transport. As all components weigh on the order of 10 kg, or less, they can be packed in solid cases by hand and transported by regular car and driven from Oslo to ESS.

16. CONTROL OF NONCONFORMING PRODUCT

All components will be tested for conformity before delivery to ESS.

Full system tests will be performed at ESS, in the PBIP mock-up for the target systems. In the event that single components (for example single mirrors) are damaged between check-out test at Oslo and system tests at ESS, the systems tests will be able to identify this component. The component must then be replaced.

17. MONITORING AND MEASUREMENT

The system performance, including direct verification of alignment, light yield, dynamic range and resolution of the optical systems will be verified by full systems tests, first at Oslo before delivery (FAT) and after delivery and installation at ESS (SAT). At Oslo a prototype of the optical systems has been build and has proven the performance to be very similar to the one expected from simulation [ESS-0149764].

18. AUDITS

The already defined reviews, PDR, CDR, FATs and SATs, will act as audits for the project.

Additional reviews may be defined in agreement between Oslo and ESS.

19. BACKUP

Data backup is important to mitigate schedule risks related to computer failure as well as personnel changes (resignation, long term illness etc.).

All electronic deliveries, including computer models (ZEMAX, CAD etc.), software (software image processing, control system software) and firmware (FPGA algorithms) and documentation will be continuously backed up both while in production, and as separate snapshots after each review and delivery.

All files related to the above will be backed up to a cloud based service provider, chosen to be Dropbox Professional. Dropbox Professional provides a complete file revision control service, in additional to being a backup service. I.e. any previous version of each file can be restored from the cloud. In addition to Cloud storage, at least one local copy of the cloud is at all times continuously stored at a physical computer at the University of Oslo.

The project will utilise a number of operational laptops, typically running ESS ICS EPICS, for testing, verification and commissioning. Even though not a delivery in itself, a failure of an operational laptop is a schedule risk, since a significant amount of manpower is required to install and configure such laptops. Therefore, operational Oslo laptops will also be backed up to local RAID-based backup systems located at the University of Oslo.

20. IMPLEMENTATION AND REVISION OF THE QUALITY PLAN

20.1. Review and acceptance of the quality plan

The first review of the PQP will be at the CDR.

20.2. Implementation of the quality plan

After acceptance of the PQP by ESS, following the CDR, the version of the PQP on CHESS will at all times be the valid version.

20.3. Revision of the quality plan

An update can be initiated by ESS or Oslo. Only the Oslo in-kind manager can update the quality plan. An update of the plan will be announced at the weekly meetings plus dissemination through electronic communication.

20.4. Authorized deviations to this quality plan

Deviations to the plan must be agreed with the Oslo in-kind manager.

21. GLOSSARY

See: https://confluence.esss.lu.se/display/BIG/Abbreviations

DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue (draft only)	Erik Adli	2016-11-24
2	CDR version <<Keep only full number revisions when approving document>>	Erik Adli	2017-10-01