n_TOF spallation Target #3
Production Readiness Review (PRR)
29th May 2019

Charge from the n_TOF Target 3 Project Leader

The Committee is requested to conduct an independent Production Readiness Review (PRR) of the n_TOF Spallation Target #3 Project, which is to be installed during CERN’s Long Shutdown 2 (2019-2020). This review is following up the Preliminary Design Review which took place in June 2017 (INDICO 632653) and an Intermediate Engineering Design Review in May 2018 (INDICO 696196). The Project technical reviews will be complemented with a Target Installation Review during 2020 at the end of the target production which will mark the green light for the installation of the target in the pit.

The n_TOF facility is a world-class installation currently exploited by the n_TOF International Collaboration (composed by about 120 physicists) to carry out cutting-edge neutron induced capture, fission and charge-particle cross-section measurements as well as multidisciplinary measurements with neutrons. The neutrons are currently produced by a PS proton beam sent to a water-cooled bare monolithic pure Pb block (so-called Target #2), moderated by light demineralized water and by a separated borated water circuit. Two experimental areas, located about 200 m downstream and 20 m above the spallation areas, receives the neutrons produced by the target. The current target has been installed in 2008 and has to be exchanged during LS2 due to lifetime constraints and to a number of operational issues appeared in particular during the last 3 years. The new spallation target shall guarantee the physics performances of the installation and solve some of these operational issues.

The main scope of the current Production Readiness Review is to assess the production readiness of the Target #3 and the ability to start the production phase. A review of the design of the components and the functionality falls also within the scope of the review.

The review panel is requested to:

- Analyse the detailed design of the baseline Target #3, constituted by a sliced N2-cooled bare Pb target with fully decoupled moderators to service EAR1 and EAR2;
- Address the recommendations of the Intermediate Engineering Design Review and their appropriate implementation (where applicable) in the baseline design of Target #3;
- Identify any evident showstopper or missing aspect in the current Target #3 design that might hinder the successful operation of the spallation target starting from 2021;

The Committee will make their assessment based on the provided documentation, presentations, drawings and discussions with the Project team.
Review Committee membership
The Review Committee is composed by the following members:

- Maurizio Vretenar (CERN ATS/DO) (chair)
- Alessandro Bertarelli (CERN EN/MME)
- Gilles Favre (CERN EN/MME)
- Leonel Ferreira (CERN TE/VSC)
- Enrique Gonzales (CIEMAT, n_TOF)
- Alexander Huschauer (CERN BE/ABP)
- Leslie Jones (STFC RAL/ISIS neutron source)
- Stefan Roesler (HSE/RP)
- Stefano Sgobba (CERN EN/MME)

Questions to be addressed by the review committee
The list of questions to be addressed by the reviewers is reported here below:

1. Globally assess the appropriateness of the baseline Target #3 (sliced N₂-cooled bare Pb target) with respect to the operational requirements and operational history of the facility, including safety aspects
2. Is the baseline design of the spallation target matching the requirements of the n_TOF Collaboration in terms of physics reach for Run3 and Run4 (i.e. from 2021 to 2030)?
3. Assess whether the current proposed PS beam parameters (intensity, beam sizes, average power) assumed for the target design are realistic for post LS2 operation and whether the target is adapted to these parameters;
4. Do you see any fabrication and production showstoppers or, more generally, feasibility issues in the proposed baseline design (target core, pressurized vessel, moderator assembly, etc.) in view of their production?
5. Is the design of the EAR1 and EAR2 moderator(s) adapted to the requirements of the Target#3 spallation target mechanics and physics? Is there any possible improvement that could/should be implemented before the construction phase?
6. Are the prototyping activities associated to the bimetallic transition for the EAR1 moderator adapted to launch the production of the spallation target? Is there any specific precaution that has to be taken into account which appears not to have been considered during the review?
7. Are the target core & vessel prototyping activities adequate for the challenges associated to the construction and operation of Target#3? Do you see areas of required investigation?
8. Is the design of the anti-cree plate adapted to cope with its stated functions, i.e. retaining the Pb plates while guaranteeing a sufficient wet area for cooling the target for the target predicted lifetime?
9. Do you see any potential showstopper in the executed finite element model / thermo-mechanical calculations, for both nominal and for degraded operational scenarios? Are there specific topics or analyses which have been underestimated and would require further studies before beam operation?
10. Are the performed Target #3 CFD studies appropriate for the current status of the Target #3 design? Are there any other investigations that would need to be performed?
11. Assess whether the HiRadMat tests conducted at the end of 2018 and the resulting investigations (including the focusing on the N₂ static target) are appropriate for the current status. Is there any specific PIE that – compatible with budget – would be useful to execute in the coming months?
12. Are there any specific worries from an electrochemical compatibility point of view or erosion/corrosion problems expected with the proposed baseline target?

13. Is the design and progresses on the design of the N₂ cooling and moderator(s) station adapted to cope with the operational requirements of the new spallation target? Is there any major improvement that would need to be implemented before the tendering phase?

14. Finally, are the any specific concerns that should be addressed before the start of the Target production and before the Target Installation Review to take place during 2020?

The Committee is requested to provide a written report to the n_TOF Target #3 Project Leader and to the EN-STI Group Leader within 1.5 months from the review.