

## DESIGN CONSIDERATIONS FOR PIECE (PIE Cells at ESS)

The European Spallation Source (ESS) will deliver the world's highest flux of slow neutron beams for the basic and applied researches investigating the molecular building blocks of matter. The primary neutrons will be produced by bombarding a high-energy proton beam into the solid tungsten target. As the target itself and the surrounding moderator reflector system will be exposed to a large flux of protons and neutrons, the materials used for the engineering of the target-moderator-reflector (TMR) system will be subject to radiation damage. Among others, another system of concern from the radiation damage standpoint is the proton beam window (PBW) that is subject to concentrated proton beam irradiation. For the design and lifetime estimation of the components, it is therefore important to understand the characteristics and behaviour of the engineering materials that are exposed to proton and neutron fluxes.

Unfortunately, there is a scarcity of engineering data for the properties of high-energy hadron irradiated materials. The uncertainty in the radiation damage effects on materials necessitates a high level of conservatism in the component design lifetimes and operation of the ESS target station, which will drive the operational costs upward.

A feasibility study of equipping a PIE (Post Irradiation Examination) facility infrastructure at ESS in the post-construction phase of the project is under consideration. In this paper, the scope, the design requirements and the top-level system architecture of the PIECE (PIE Cells at ESS) facility are presented. The proposed PIECE facility aims at fulfilling the following three objectives: to measure the mechanical properties of irradiated target station structural components for the purpose of estimating component lifetimes, to study new candidate materials for the target station components applications for longer lifetime and higher reliability, and to perform fundamental researches on the irradiated materials in the framework of international collaboration. The presented study provides necessary inputs for currently on-going target station design activities such that the PIECE facility can be readily incorporated into the ESS infrastructure in the post-construction or in the operation phase of the project. Vice versa, the currently base-lined target station design provides the constraints on the scope of the PIECE facility. The roadmap for developing the PIECE plan from the current feasibility study towards the post-construction phase project with dedicated resources is presented.

### Summary

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