

# WG2 TARGET/MODERATOR

## TARGET ACTIVITIES OF POTENTIAL INTEREST FOR DEVELOPMENT AT ESS

Several concepts of spallation targets have been developed and operated along the years. The peculiar problems of this application and the relative lack of information from the few similar problems require particular attention in the engineering design phase and additional studies for both normal operating conditions and incident scenarios, in particular in the case in which different materials are selected with respect to previous experiences and the ESS reference design.

The engineering design of the target station poses several challenges that require extensive R&D activities. Among the others we mention: the numerical analysis of the flow and temperature peak distribution in the target for the liquid metal target design option; the analysis of the dynamic effect of beam power deposition for the events of liquid metal splashing, cavitation and pressure wave propagation in the circuit, and the possible consequences for the structural containment, the operative life of the target station, and the effect on the neutron production. Other topics considered are in the structural performance of the target and of the beam window, and in particular the cooling with high pressure gases.

The Energy and Environment sector at CNR-CRS4 has gained experience on target simulation and on the liquid metal technologies, through participation of several European projects on Accelerator Driven System (requiring spallation targets with many similar characteristics) together with other major research institutes and technological partners, and designing some of the targets and beam dumps for CERN in the LHC design. It is also part of the target concept selection group for the ESS project.

CNR-CRS4 is a research center devoted to high performance computing. The research group will use commercial and in-house developed software for the numerical simulation, and will use the computing resources of the center: high performance clusters and dedicated parallel machines equipped with GPU and FPGA accelerating hardware.

The design phase and pre-construction of the ESS target station will last for the next three years and will require continuous support from research institutes. CNR-CRS4 is part of the Target Station Concept Selection working group together with the other European partners and has been involved in the target design activities of 2010, participating to the meetings and hosting one in the last September. This was possible since the group is involved in an European project (THINS), whose activities were coherent with the ESS ones. Without any further funding it will be impossible for CNR-CRS4 to continue working on these topics in the immediate future. CNR-CRS4 is currently collaborating with the ESS design team for upcoming activities.

### Objectives

The general objective of the project is to continue the support to the ESS team for the development of the final design of the target station, and to promote the training of Italian researchers in this field.

These activities are the most urgent for the ESS and have to be completed with the aid of the institutes involved in order to proceed to the construction phase.

The research will focus on two main topics:

- the analysis of the dynamic effects caused by the beam deposition on the target, both in the liquid metal, in its pressurized circuit and in the structural container.
- the CFD and structural analysis for the cooling of the target and beam window.

**Expected results**

The main expected results include the set up of simulation and analysis techniques for the design and operation of the target. The emphasis will be on liquid metal dynamics and on the cooling of a solid target and the beam window. Another result is the support of the Italian activities in the Target design team and the training of researchers, also through the continuous collaboration with the other institutes involved, in particular with the Karlsruhe Institute of Technology and the University of Lund.

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