

## DCLL TBM Safety Assessment

A key objective for ITER includes integrated testing of blanket concepts suitable for demonstrating fusion power production. Testing in ITER will be accomplished by inserting prototypical blanket modules into designated ports. Because ITER will be a licensed nuclear facility, these test modules will also undergo licensing review and certification. The concept developed in the US is the Dual Coolant Lead Lithium (DCLL) Test Blanket Module (TBM). In order to license this module, a preliminary safety report (PrSR) was completed and submitted for this concept to the ITER International Organization (IO). Work for the PrSR was lead by the Idaho National Laboratory (INL) Fusion Safety Program, with contributions from General Atomics, University of California, Los Angeles, and other members of the US TBM team. The report is available as an INL External Technical Report (INL/EXT-10-18169, Rev. 1), entitled: "US Dual Coolant Lead Lithium ITER Test Blanket Module Preliminary Safety Report".

This PrSR presents a comprehensive view of a US DCLL Test Blanket System (TBS) safety assessment. The DCLL TBS is described in detail, including component level descriptions and classifications for safety, seismicity, regulatory design and quality requirements. Operation procedures were defined, radioactive and chemical hazards identified, occupation radiation exposure (ORE) analyzed, and decommissioning and waste disposal analysis performed. The overall TBS safety philosophy was presented and the inherent safety features of the DCLL TBS described. A DCLL TBS Failure Modes and Effects Analysis was summarized and design basis events based on this FMEA were analyzed with the MELCOR code to determine the safety consequence of coolant leaks from the DCLL TBS into the ITER Vacuum Vessel, inter-space area, port cell, and the Tokamak Cooling Water System vault annex. Ultimate safety margin events were also analyzed. In addition, TBS accidents in the hot cell and tritium building were examined.

As for the overall impact on ITER safety of the DCLL TBS, based on the accidents analyzed the impact is small. However, special consideration must be given to the ORE hazards associated with the PbLi breeding material of the DCLL TBS. The gamma radiation field produced by Pb-203 and ferritic steel corrosion in PbLi must be respected when maintaining systems that confine this PbLi. Of particular concern are the Po-210 and Hg-203 inventories that develop during operation of this system, primarily because of the biological hazards of these radioisotopes.

The initial submittal of PrSRs were delivered to ITER-IO on July 1, 2010. To date, the US is the only ITER Partner to submit their TBM PrSR. The DCLL PrSR is presently under review at ITER. For further information on the DCLL safety assessment, please contact Brad Merrill ([brad.merrill@inl.gov](mailto:brad.merrill@inl.gov)) or Phil Sharpe ([phil.sharpe@inl.gov](mailto:phil.sharpe@inl.gov)).