SAFETY ANALYSIS FOR THE EUROPEAN HCPB TBM SYSTEM USING PEDIGREED MELCOR182

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Abstract

In order to study the accidental behavior of the Helium Cooled Pebble Beds (HCPB) Test Blanket Module (TBM) and its combined Helium Cooling System (HCS), a particular sequence has been selected for deterministic analyses in the frame of the EFDA (European Fusion Development Agreement) licensing task for ITER (International Thermonuclear Experimental Reactor). As Postulated Initiating Event (PIE) ex-vessel LOCA (Loss Of Coolant Accident) with failure of the plasma shutdown system was selected. Various assumptions and code-dependent modeling (RELAP5, MELCOR and ANSYS) are investigated for the study of this sequence. The accident evolution is divided in three phases: 1. He blow-down, 2. delayed plasma shutdown and 3. long term behavior. Here the most severe case in phase 3 investigated by the pedigreed MELCOR182 is presented. In this case it is assumed that simultaneous failures of the vacuum vessel (VV), TBM box and water cooled component of ITER taken place, so that Be pebbles contained in the Blanket Box can react with air and steam. The resulting transients by MELCOR show the temperature trend in the ceramic and Be pebble bed due to the conflicting effects of heat extraction and chemical heat production. During the transient the VV pressure can exceed the atmospheric pressure and cause Tritium, dust and active corrosion products (ACP) transport from the VV to the TCWS (Tokamak Cooling Water System) vault via TBM piping. MELCOR calculation for this transport process is accomplished as well.