IFERC Newsletter

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International Fusion Energy Research Centre, Rokkasho, Aomori 039-3212, Japan

Status of DEMO Design Activity

Highlights on Safety Studies

In Task 5, Safety, which is carried out to ensure the safety of fusion DEMO reactors in JA and EU, the activities were carried out in 2023 to update the Radioactive Source Terms (RST) leading to performing the comparative studies in Task 5-1, and to analyze Postulated Initiating Events (PIEs) leading to sorting out the safety characteristics of DEMOs in Task 5-2.

In Task 5-1, the amount of Activated Corrosion Products (ACPs) in the cooling system was evaluated in JA. In the primary cooling line for the JA DEMO, the in-vacuum vessel components are made of ferritic steel (F82H), and the other auxiliary equipment is mainly made of austenitic steel (SS316L). The water quality was considered with the experiences of light water reactors and was determined from the viewpoint of preventing Stress Corrosion Cracking (SCC) and Flow-Assisted Corrosion (FAC) etc. in the auxiliary systems. Therefore, the assumption is that the cooling water quality is adjusted with pH of 7, DO < 5 ppb, and Dissolved Hydrogen (DH) < 3.5 ppm. In the water quality with a low DO (<5ppb), the corrosion rate of F82H is high, which is two orders of magnitude higher than that of SS316L.

In EU, the working group on RST has completed the revision of the work done, particularly for the tritium inventory map, for in-Vacuum Vessel (in-VV) dust and ACP assessment and model validation. R&D necessary to narrow down the uncertainties of such inventories has been launched.

In Task 5-2, safety analysis in the primary cooling system was performed by JA against the Loss-Of-Flow Accident (LOFA) and Loss-Of-Heat Sink (LOHS) as shown in Fig.-1

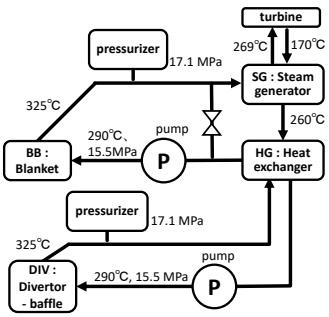

Fig.-1: Schematic picture of primary cooling system

The decay heat of the Breeding Blanket (BB) can be removed by natural convection as long as the heat removal capacity on the steam generator side is operating. To remove the decay heat of the divertor-baffle, it is necessary to operate the pumps in the cooling line. Redundancy is required for pumps in the SG and divertor-baffle cooling line.

Safety analysis for Design Basis Analysis (DBA) and Design Extension Conditions (DEC) scenarios was performed by EU. The effects (pressure and releases) of an Ex-Vacuum Vessel Loss Of Coolant Accident (Ex-VV LOCA) were investigated by using the MELCOR system code with different number of relief panels, among the various expansion volumes of the tokamak building, avoiding reaching the design pressure and uncontrolled releases. The effectiveness of a passive recombination system in the Vacuum Vessel Pressure Suppression System (VVPSS) has been assessed by the MELCOR system code following an in-VV LOCA.

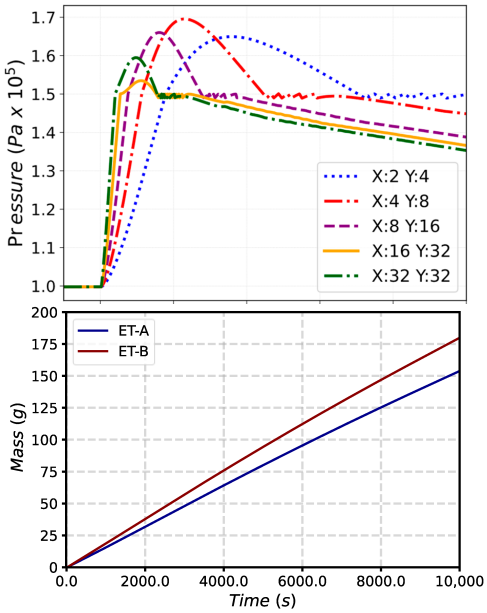

Fig.-2: Examples of MELCOR calculation

(DEMO Design Task-5 TROs)