

The EVITA program: experimental and numerical simulation of a fluid ingress in the cryostat of a water-cooled fusion reactor (P3-J-209)

Laurent AYRAULT(1), Guy Laffont(1), F. Challet(1), L.B. Marie(2), R. Duc-Jacquet(2)

1. CEA, DEN/DTN Cadarache 13108 St Paul Lez Durance France
2. Technicatome Gif sur Yvette 91191 Saclay France

In the frame of the deterministic approach in the safety analysis of the ITER reactor, it is postulated that a helium cooling line from the cryogenic system and one coolant pipe of the first wall/blanket primary heat transport system are damaged simultaneously in the cryostat.

In the frame of the validation of the computer codes which are used for the assessment of ITER safety, the EVITA experiment has been designed for the simulation of the physical phenomena occurring during a coolant ingress into the cryostat. A simultaneous ingress of water/steam and non condensable gas can be simulated.

The vacuum vessel of the EVITA facility contains a cryogenic plate. One of the main objectives of the experiments is to determine the steam condensation phenomena on this cryogenic plate. Major deliverables of the EVITA experiments are as follows: ice formation kinetics; heat transfer characteristics; condensed water mass; cryogenic surface temperature; dynamic pressure and temperature in vessel. The main data of the tests are initial pressure, temperature of the injected fluid, injected mass flowrate, initial temperatures of internal structures and operating conditions of the cryogenic loop.

The tests are calculated using different computer codes namely PAXITR code. The comparison between calculations and experiments allows the ability of these computer codes to treat the relevant physical phenomena (heat transfer coefficient between walls and fluid, vessel pressurization, ice layer formation) to be assessed.

The latest series of experiments, involving simultaneous water/steam and gas ingress have been performed with different configurations of the facility and different operating conditions. These tests have been carried out to obtain the ice layer formation kinetics. This paper presents the main results of the work done so far, emphasizing the interpretation of the tests and the consequent evolutions of the modelling used in the PAXITR code. They lead to a better evaluation of the pressure evolution in the vacuum vessel and of the ice layer formation.

The EVITA program can provide a good contribution to the validation methodology for fusion safety analysis codes.