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mitigation of an ingress coolant event in ITER vacuum vessel by means of steam pressure suppression

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An Ingress of Coolant Event (ICE) is postulated to occur in the ITER Vacuum Vessel (VV) due to a breach on the first-wall cooling channels. The pressure raise in the VV is limited by means of a Vacuum Vessel Pressure Suppression System (VVPSS), consisting of relief lines connected to the VV and discharging the steam to four Vapor Suppression Tanks (VST) partially filled with water: one managing small water leaks and three together managing large water leaks).
The ITER vapor suppression system operates at sub-atmospheric pressure. Since no detailed information has been found in the technical literature for similar operating conditions, a specific study has been launched at the University of Pisa to investigate the performance of the vapor suppression process in the VSTs.
Both an analytical-numerical analysis and an experimental activity were carried out on a 1:21 scale apparatus, simulating the VVPSS.
Scaling studies were first performed in order to calculate the transient of steam mass flow rate occurring during the ICE IV event in the scale apparatus, starting from the thermal hydraulic study performed at ITER. Subsequently, a quite extensive experimental campaign was carried out on the scale apparatus in order to study the influence of the main thermal hydraulic parameters that characterize the steam condensation efficiency in sub-atmospheric conditions.
This paper illustrates the results obtained from the experimental transient simulating the Ingress of Coolant Event in the VST Tanks.
The experimental results confirm the determined scale predictions and the capability of the VVPSS tank to condense the injected steam at sub-atmospheric pressure, matching the safety goal to limit the VV pressurization.

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