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| Title | In-vessel Coolability and Steam Explosion in Nordic BWRs |
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| Abstract | <p>The INCOSE project is to reduce the uncertainty in quantification of steam explosion risk and in-vessel coolability in Nordic BWR plants with the cavity flooding as a severe accident management (SAM) measure. During 2009 substantial advances and new insights into physical mechanisms were gained for studies of: (i) in-vessel corium coolability – development of the methodologies to assess the efficiency of the control rod guide tube (CRGT) cooling as a potential SAM measure; (ii) debris bed coolability – characterization of the effective particle diameter of multi-size particles and qualification of friction law for two-phase flow in the beds packed with multi-size particles; and (iii) steam explosion – investigation of the effect of binary oxides mixture’s properties on steam explosion. An approach for coupling of ECM/PECM models with RELAP5 was developed to enhance predictive fidelity for melt pool heat transfer. MELCOR was employed to examine the CRGT cooling efficiency by considering an entire accident scenario, and the simulation results show that the nominal flowrate (~10kg/s) of CRGT cooling is sufficient to maintain the integrity of the vessel in a BWR of 3900 MWth, if the water injection is activated no later than 1 hour after scram. The POMEKO-FL experimental data suggest that for a particulate bed packed with multi-size particles, the effective particle diameter can be represented by the area mean diameter of the particles, while at high velocity ($Re > 7$) the effective particle diameter is closer to the length mean diameter. The pressure drop of two-phase flow through the particulate bed can be predicted by Reed’s model. The steam explosion experiments performed at high melt superheat (>200oC) using oxidic mixture of WO₃-CaO didn’t detect an apparent difference in steam explosion energetics and preconditioning between the eutectic and non-eutectic melts. This points out that the next step of MISTEE experiment will be conducted at lower superheat.</p> |
| Key words | severe accident, debris coolability, steam explosion |