NextEra Energy Seabrook, LLC

(Seabrook Station, Unit 1)

License Renewal Application

NRC Staff Answer to Motion for Summary Disposition of Contention 4B

ATTACHMENT 4B-D

NEA/CSNI/R (91) 12

OECD

NEA

IN-VESSEL CORE DEGRADATION IN LWR SEVERE ACCIDENTS:

A STATE OF THE ART REPORT TO CSNI
JANUARY 1991

NOVEMBER 1991

bundle section (0.6 m/s). The need was recognised to improve the modelling of the ejection of absorber material, the chemical interaction between molten absorber material and Zircaloy, and the melt oxidation during slumping.

6.2.6.4 Hydrogen Generation

The comparison of calculated hydrogen generation with measured data was not possible for the earlier tests due to lack of qualified experimental data. Qualified data for the later tests have only recently been produced.

6.2.6.5 In-Vessel Natural Circulation

Natural convection takes place in the test section during the pre-test conditioning phase as indicated by ATHLET-SA analysis, but comparison with the existing flow pattern against qualitative data is not possible, since flow distribution measurements are not within the scope of the test series.

6.2.6.6 Fission Product Release

Not simulated.

6.2.6.7 Fission Product Transport

Not simulated.

6.2.6.8 Conclusions

Post-test simulations have been performed including sensitivity studies to verify the thermal-hydraulics, core heatup, cladding oxidation and deformation models of the codes as well as to understand the processes of eutectic formation, melting, relocation and resolidification in the early stage of core degradation. The code simulations show that the core heatup and oxidation is reasonably well predicted, but for deformation and relocation processes there is a need of further modelling improvement. The simulations are restricted to tests typical for PWRs, but excluded the reflood phase. The simulation of this phase is one of the main objectives of ISP-31. A further potential for code verification exists with the many CORA tests modelling BWR configurations.

6.2.7 NSRR-RIA Experiments

Post-test analysis of high temperature reflood experiments (tests 952 and 954) has been performed by JAERI with SCDAP /6.34/. The objective of the computer simulation was to understand physical and chemical phenomena during heating and quenching of fuel rods in these tests, e.g. oxidation, hydrogen generation and cladding deformation. Since these tests had been terminated before severe fuel damage took place, the comparison is not discussed further here.

6.2.8 TMI-2 Accident

In order to focus TMI-2 studies within the OECD, the OECD in collaboration with the US DOE established a Joint Task Group /6.35/, /6.36/, /6.37/. The objectives of the group were to assess the capability of the severe accident analysis methods (e.g. benchmark the relevant codes) and by way of calculations of the accident sequence, to improve understanding of the accident. The participants in this analysis exercise are listed below with the accompanying computer codes and simulated accident phases:

Organisation	Code(s)	Version	Phase
GRS, FRG	ATHLET	1.0C	1
VTT, Finland	MAAP	3.0	1 - 2
CEA, France	CATHARE/ICARE	M1	1 - 2
ENEA, Italy	SCDAP/RELAP	M0.47	2
JAERI, Japan	THALES		1 - 3
JINS, Japan	SHAPE, MACRES		2 - 4
ECN, Netherlands	MARCH	M3	1 - 3
UPM, Spain	MARCH	M3	1 - 3
AEA, UK	MELPROG	M1	2
BCD, US	MARCH	3.195	1 - 3
EPRI, US	MAAP	3.B12	1 - 2
FAI, US	MAAP	DOE	1 - 3
INEL, US	SCDAP/RELAP5	M1.5	1 - 3
SNL, US	MELCOR		1 - 2

The main phenomena analysed in this accident were the thermal-hydraulic system response, the core heatup and core degradation processes.

6.2.8.1 Thermal-Hydraulics

One group of codes (ATHLET, CATHARE, RELAP, MAAP, MARCH, MELCOR) simulates the entire primary reactor coolant system (RCS) including the pressuriser and steam generator secondary side. The other group (MELPROG, SCDAP, SHAPE) use the conditions at the reactor vessel (RPV) boundaries as boundary conditions.

During phase 1 the thermal-hydraulic system response is determined by the flow rates into and out of the RCS and the heat transfer to the steam generator. The quality of the simulation of the system pressure and coolant inventory depends on the correct description of these boundary conditions. Missing measurements were replaced in some cases by trend data and by recommended simplified boundary conditions such that the correct overall system response was calculated. This yielded reasonable results for the system pressure and coolant

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