RAS M-297

DOCKETED
USNRC

August 12, 2008 (11:00am)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Non-Proprietary Version

BWRVIP-120: BWR Vessel and Internals Project

Radiolysis and ECP Improvements to the BWRVIA V2.0 Model

1008376

Final Report, October 2003

EPRI Project Manager
H. Tang

U.S. NUCLEAR REGULATORY COMMISSION
In the Matter of Entergy Nuclear Vermont Yankee LLC
Docket No. 50-271 Official Exhibit No. E2-34-VY
OFFERED by: Applicant/Licensee Intervenor
NRC Staff Other
IDENTIFIED on 7/21/08 Witness/Panel NEC 2
Action Taken: ADMITTED REJECTED WITHDRAWN
Reporter/Clerk MAC

Template Secy-028

DS-03

13
CONCLUSIONS

A new BWRVIA model has been developed that gives reasonable comparisons with plant chemistry recirculation and steam oxidant data. This has been achieved by adjusting a number of input parameters in the model within their levels of uncertainty. The model was fitted to chemistry data for one plant and then the revised model compared with chemistry data from six other plants. The comparison of the model with steam and recirculation oxidant data was adequate and as good as the current BWRVIA model. The advantage of the new model is that all chemistry parameters are defensible, whereas this is not the case in the original model.

A computer model has also been developed for the prediction of the corrosion potential of 304 or 316 stainless steel in typical LWR conditions, based on the 'mixed potential' method described by Macdonald[25]. In the model, the calculated value of the corrosion potential depends upon the H_2, O_2 and H_2O_2 concentrations in the water, the temperature, the pH, the Reynolds number of the flow and the pipe diameter. Values for the model parameters (exchange current densities, standard potentials and corrosion current) were derived by fitting the model to relevant laboratory measurements of corrosion potential available in the literature. This method was adopted because only limited experimental data could be found on the model parameters themselves. Comparison of the various corrosion potential measurements showed that the extent of preoxidation of the steel surface had a significant effect on the corrosion potential, with the corrosion potential tending to increase with increasing preoxidation, especially in low oxidant concentrations. Hence, the experimental data were divided into three categories - no preoxidation, low preoxidation and high preoxidation - and the model parameters fitted separately to each category. The model parameters were also fitted to the complete experimental data set. The extent of surface pre-oxidation will have consequences when calculating the ECP at a location in the plant since the ECP will depend in general on the history of pre-oxidation within the plant, and this may depend on location. This may provide some explanation for the lower plenum behavior observed at in that a highly pre-oxidized surface may give high ECP at low peroxide concentrations (high FWH). However, this is probably not the whole story and the observations at still need to be resolved. Two reasons why the model may under predict the lower plenum oxidant levels are (a) inaccurate downcomer dose rates and (b) no account being taken of mixing in the downcomer. The latter arises because the model assumes that the flow through the downcomer and jet pump occurs along a set of flow paths each moving with the same velocity (but different for the jet pump compared to the downcomer), none of which mix. In reality the flow next to the downcomer wall will be slower than in the center of the region and there would be continuous mixing of these flows along the flow path. Since the gamma and neutron dose rates next to the shroud wall are significantly

different than next to the RPV wall this mixing may influence the downcomer chemistry significantly.

It is worth noting that both the old model and the new model arising from this work give similar chemistry behavior at the bottom of the lower plenum region and improvements in ECP comparisons with plant data in this region are largely a result of changing the ECP model. Further improvements in this region could be achieved if the levels of oxidant at the bottom of lower plenum could be increased for high FWH and these concentrations are highly sensitive to the details of the downcomer dose rate.

A mixed potential model based on a selection of plant data has also been developed and, as expected, gives a better comparison with all plant ECP data compared to the laboratory based ECP model. All these mixed potential models have now been implemented in the BWR FACSIMILE model developed by AEA Technology. The implementation of the model allows the user to investigate the whole set of mixed potential model parameters for their application. Alternatively, it is also possible to calculate the corrosion potential using the values of the model parameters given by Macdonald[25].