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25 March 1981

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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Draft Report on Technical Bases for Estimating Fission Product Behavior During LWR Accidents (NUREG-0772 Draft dated March 6, 1981)

Dear Mel:

The following comments regarding the above referenced document are intended to amplify and emphasize the verbal comments which were offered at the Peer Review in Washington, DC last week. Most of the comments are critical in nature, but each is presented in an attempt to improve the usefulness of the document and to help clarify the status of the technical subject being addressed.

(1) While the report contains an impressive amount of information and data, it does not represent a comprehensive or final treatment of this important subject. Such a treatment can only be achieved through more deliberate study and through development of additional data and analyses to reduce uncertainties. The preliminary nature of the present evaluation needs to be plainly stated up-front without speculation that further effort would not materially alter "the overall conclusions."

(2) A significant limitation in the evaluation results from the failure to seriously consider information available from past reactor accident experience, other than from TMI-2. The value of such an effort should not be dismissed lightly, but rather should be identified as an item for future work. Past accidents, even though poorly documented in some instances, provide a benchmark for testing the realism of certain elements of current accident analysis practice.

(3) Another significant limitation of the evaluation results from the lack of containment failure mode analysis and the qualitative manner in which fission product deposition along leak paths is dismissed. Although effort in these areas may have been outside the scope or resources of the study, their potential importance should be specifically stated, particularly when conclusions regarding reactor system attenuation factors for iodine release to the environment are made. The report should identify these sources of uncertainty and indicate the need for further work.

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(4) The fission product release rate expressions presented in Section 4.3 and Appendix B are taken from results of small scale experiments, which cause a high bias. Both these expressions and the fractional release rates for fuel, clad, and structure (adapted from SASCHA air data) are functions of temperature only. Thus, they are quite empirical in nature and may not apply to conditions beyond those covered in the referenced experiments. For example, using these expressions to define release rates at system total pressures of 100-150 bar may result in considerable overestimates since the experimental work was done at system pressures of 1-2 bar. These particular expressions also contain no surface area or superficial gas flow rate terms and hence are strictly applicable only to the range of values used for these parameters in the experiments. A more complete discussion of the limitations involved in the use of the release rate expressions should be incorporated in Section 4 and also clearly acknowledged in the report conclusions.

(5) The conclusions in Section 5 regarding the high temperature vapor phase chemistry of fission products indicate that $TeO_2$ would be the predominant tellurium species. This conclusion appears to disagree with the results of thermodynamic calculations published in Appendix E of Appendix VII of WASH-1400, and also with indications of chemical vapor species that can be obtained from the compilation of Bedford and Jackson in UCRL-12314. The apparent lack of agreement between analyses should be noted and either resolved by showing the different results are indeed compatible or identified as an unresolved issue.

(6) In Section 6 and Appendix D, the method and assumptions used to generate the thermal-hydraulic input data for the TRAP-MELT calculations should be provided. In addition it should be stated in the conclusions that the results presented in Section 6 are obtained entirely from computer code analysis, the outcome of which depends on the validity of the models and mechanisms that make up the code. In Section 7 the major input data used in CORRAL-2, HAARM-3, NAUA-4, and QUICK code calculations should be provided so a serious technical user of the information presented in the text is appraised of its bases and possible limitations.

(7) In Section 4 equation 4.5, which is intended to represent a vaporization reaction for liquid molecular iodine, actually indicates vaporization with dissociation. In order to maintain consistency with the other reactions presented here, liquid molecular iodine should be shown vaporizing to gaseous molecular iodine, and an equation added to the set of dissociation reactions which shows gaseous molecular iodine dissociating to two gaseous iodine atoms.

(8) Even though portions of the evaluation discuss fission product behavior for "degraded core accident sequences" in which overheated fuel is subsequently quenched with water, there is no mention in either Sections 4 or 5 of aqueous leaching as a potential mechanism for fission product release from the fuel. While this should not create a significant gas phase source of radioactivity, the process will promote redistribution of the fission products (hence the heat source) and introduce additional complexities to the description of aqueous phase chemistry. Since inadequate leaching data currently exist, it is suggested that the data base limitations discussed in Subsection 1.4 should include a recommendation for experimental work on aqueous leaching of fuel material at elevated temperatures and pressures.

(9) This reviewer generally concurs with most of the data needs that are identified in the Subsection 1.4 discussion on data base limitations. Particularly important is the need for additional and improved thermal-hydraulic analyses for predicting the distribution of fluid and surface temperature within the reactor coolant system and the containment. It could be emphasized that the lack of information and models in this area led to an inability to examine some potentially important radioactivity attenuation factors such as capture of transported species in the "quench tank" of pressurized water reactors during accidents involving fluid discharge through relief or safety values.

(10) The analysis and discussion of aerosol material generation, transport, coagulation, and deposition in Sections 4, 6, 7, and associated appendicies represents only a beginning. The empirical mass release rate (vaporization) expressions are based on very limited data, the TRAP-MELT calculations in Section 6 include no particle coagulation dynamics (results from QUICK code analyses presented at the Peer Review illustrate their potential significance), and the containment behavior calculations described in Section 7 apparently assumed large well-mixed volumes which tend to limit coagulation rates and deposition rates. In the latter case, the effect of steam condensation on aerosol removal could not be properly treated because of inadequate thermal-hydraulic conditions predictions. Accordingly, the conclusions reached, which depend on the results of these incomplete analyses, should be identified as tentative and subject to change as the technology of severe accident consequence analysis undergoes improvement.

I trust that the above comments will be of help in completing the report. If questions arise or clarification of any particular point contained in these comments is needed, please contact me.

Very truly yours,

Robert L. Ritzman
RLR/imp