USE OF REAL DATA IN MODEL DEVELOPMENT FOR ACCIDENT ANALYSIS

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ABSTRACT

This paper presents the steps in model development for a MELCOR model of a typical assembly cell found in the DOE complex. The MELCOR 1.8.4 severe accident computer code was chosen to perform these accident simulations because the code contained models for both the thermal-hydraulic processes and the aerosol transport processes and solved the models simultaneously in a fully integrated calculation.

Validation of the data used in the model and of model results was an important part of the model development phase for this effort. As a part of the effort to model the facility accurately, actual flow and pressure measurements were made for the critical areas of the facility. (For this facility, these were the explosive confinement cells). The data from these measurements were reduced into an equivalent set of flow-resistance parameters that could be represented in the model. This allowed for modeling of the flow distribution during real accident situations as accurately as possible. The technique used for these measurements, the reduction of the data, and its input into the computer model are discussed in the paper.

A typical assembly cells uses a gravel roof concept to mitigate the consequences of an explosion. Following a sufficiently large explosion, the gravel bed overlying the cell is designed to lift and vent explosive gases and while filtering the plutonium aerosol from the gas flows. A realistic simulation of the lifting of the gravel roof was essential to adequately predict plutonium releases to the environment; including simulating the explosion, the dynamically changing free volume of the cell, and gas flow through the gavel bed. A 1982 full-scale test of the gravel roof concept was used as a benchmark to validate these models. The pertinent test data included the pressure and temperature within the cell immediately following the explosion, and aerosol transport and release data. The MELCOR model used for this study very accurately predicted the appropriate response from the 1982 test. The method developed for modeling a gravel-roof device assembly cell could be adapted to other facilities employing the gravel-roof assembly cell concept. The results are discussed in the paper.

These analyses were more realistic, yet conservative, than typical safety analyses of this type. Analyses performed using realistic and validated models and with attention paid to detail and thoroughness led to a greater understanding and acceptance of how a facility would respond to postulated accidents. Further, realistic simulations substantially reduced the need for excessively conservative assumptions. This paper provides an illustration of the potential of state-of-the-art analytical tools to perform realistic safety analyses and how they can be enhanced by use of real data and benchmarking.