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MONTHLY HIGHLIGHTS

for

April 1980*

PROGRAM: Evaluation of LWR Residual Heat Removal
under Accident Conditions
Technical Assistance, Reactor Projects
Fin No. A-3315

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MONTHLY HIGHLIGHTS

TASK I. PROBABILISTIC ANALYSIS (A. J. Buslik)

Work continued on the problem of the risk reduction that would occur if it were possible to reach cold shutdown using only safety grade equipment. One accident sequence of interest consists of an earthquake, followed by loss of offsite power, failure of a seismically-qualified long-term water storage tank (without failure of a seismically-qualified condensate storage tank) and failure to operate of an auxiliary pressurizer spray valve. This sequence had previously been determined to have a probability of 2×10^{-5}/reactor-year. There might, however, be substantial overlap between this sequence and the sequence in which both the condensate storage tank and the long-term storage tank fail. However, the Cornell-Newmark theory (being used) cannot give a definitive answer to this question, since the procedure used for calculating the probability of failure of a particular component, given a certain peak horizontal ground acceleration, is not accurate above about 3 times the safe shutdown earthquake peak ground acceleration, and accuracy here is required to determine the degree of sequence overlap.

The importance of making those decay heat removal systems required to get to cold shutdown safety grade may well depend on the particular plant design. For example, for Indian Point Unit 3, there is a seismically qualified condensate storage tank, but the secondary water supply for the auxiliary feedwater system is a nonseismically qualified city water storage tank and a long-term supply which is the city water system. There may well be a high probability of failure of the nonseismically qualified city water storage tank and city water supply in a safe shutdown earthquake. This means that, given a safe shutdown earthquake, it is important to reach hot shutdown conditions

(where the residual heat removal system can be used) before the water supply in the condensate storage tank is exhausted. Balancing this, the Indian Point reactors are located in a region of low seismicity.

A small subcontract was let to SAI to review two of the sequences described in the February 29, 1980 memo on this task. One of these sequences involves simultaneous air binding of both residual heat removal pumps, while the steam generators are unavailable because of test and maintenance. A similar incident occurred at Davis Besse on April 19, 1980.

TASK II. NATURAL CIRCULATION (K. R. Perkins)

Test plans for the natural circulation tests in Sequoyah and the boron injection test in Diablo Canyon have been received and are under review. The low power ($\simeq 0.5\%$) injection test in Diablo Canyon will provide a severe test of boron mixing capability, but the Sequoyah tests will also provide useful verification data for BITRAN. A preliminary analysis of the Diablo Canyon test with RETRAN indicates that the thermal head developed at 0.5% will be sufficient to keep the pumps "free wheeling" thus eliminating the stopped rotor resistance.

TASK III. DEGRADED CORE ACCIDENT EVALUATION (W. T. Pratt)

MARCH/CORRAL Codes - Operation and Maintenance (R. D. Gasser)

The BNL Applied Mathematics Department is continuing its work on modification of MARCH which will allow external tapes to be generated without using 1YIELD on the 7600 system.

A meeting was held in Washington to discuss the use of the MARCH code. The meeting was attended by R. A. Bari and R. D. Gasser and representatives of BCL, Westinghouse, Sandia and NRC. BCL intends to provide BNL with MARCH updates developed to model cell-to-cell venting.

MARCH/CORRAL Codes - Evaluation and Testing (S. S. Tsai, W. T. Pratt and R. D. Gasser)

Work is continuing on the review of the hydrogen burning model in MARCH. It was found that the assumption of complete burning of hydrogen in the BURN subroutine is overly conservative in predicting containment pressure and temperature rises due to hydrogen combustion. The oxidation of a steel structure in high temperature steam environments is not modeled in MARCH and the effect of neglecting this potential source of H_2 is being investigated.

J. Carter (NRC) found the predictions of containment pressure and temperature by MARCH to be extremely sensitive to the assumed mesh size in NLSLAB. It was learned from BCL that MARCH uses the numerical scheme in the CONTEMPT code to model transient heat conduction in structures within the containment building. A review of the CONTEMPT manual indicated that an implicit scheme is used and that there are restrictions on the choice of mesh spacing within the material regions. Apparently, the mesh spacing should not change at interfaces of significantly dissimilar materials (e.g., steel and concrete), and also a mesh spacing should not change by more than a factor of three within the same or similar materials. These restrictions are not indicated in the draft version of the MARCH User's Manual and perhaps should be included in the final version.

MARCH/CORRAL Codes - Accident Application (W. T. Pratt and R. D. Gasser)

This month particular attention was directed to an assessment of the desirability of either introducing water or having water initially available in the reactor cavity following a postulated core meltdown in the Indian Point 3 reactor. Four accident sequences (TMLB', AB, S_1 B (6" DIA) and S_2 B (2" DIA)) were used in the initial assessment. Each accident sequence was

modeled with MARCH assuming a dry reactor cavity at the point of head failure. The accident sequences were then repeated, but with the assumption that all of the water available in the sump at the point of head failure was in the reactor cavity. The sump water does indeed quench the core, but the rapid vaporization of water fails containment by overpressurization (without H_2 burns) in all of the sequences considered. However, it is recognized that sequences AB, S_1 B and S_2 B are associated with low probabilities (relative to the TMLB' sequence) and future work will be directed to considering sequences with higher probabilities.

Sacrificial Bed Analysis (W. T. Pratt and R. D. Gasser)

Modeling for the latest version of MELSAC (MELSAC3) has been completed. This version allows separate downward and sideward heat transfer and melting rates and also allows for the formation of a solidified crust at the bottom and sides of the pool. An update for the User's Manual will be forthcoming.

Hydrogen Behavior in LWRs (S. S. Tsai)

A literature survey of existing hydrogen control methods is being conducted. A report on hydrogen behavior and control in LWRs is in preparation.

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