



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SUPPLEMENT TO SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT UNIT NOS. 1 AND 2

DOCKET NOS. 50-317 AND 50-318

MASONRY WALL DESIGN, IE BULLETIN 80-11

In a Safety Evaluation (SE) dated November 21, 1984, the NRC staff concluded that, except for 22 walls (out of a total of 147) qualified by the licensee via the use of the energy balance technique to resist the out-of-plane seismic forces, Items 2(b) and 3 of IE Bulletin 80-11 have been fully implemented at the Calvert Cliffs facility for the remaining walls. The Safety Evaluation also included a staff position on the energy-balance technique and stated that the implementation of this position was required to render the above walls acceptable to the staff.

The licensee met with the staff on April 5, 1985, to discuss its proposed approach to respond to the staff position. The proposed approach was to reexamine the original seismic analysis of the auxiliary building which contains the masonry walls in question and the analysis of the masonry walls themselves to identify existing excessive conservatism above and beyond the current staff acceptance criteria in the area of the seismic analysis. The intent was, then, to account for these excessive conservatisms in the wall analysis and qualify the walls on the basis of linear elastic methodology consistent with the staff acceptance criteria. Based on the information presented at the meeting, the staff found this approach to be acceptable.

By a letter dated June 12, 1985, the licensee has now provided the details and results of its evaluation using the above approach. Based on the recent review of the masonry walls, four of the walls have been reclassified as non-safety related walls. The cause for the reclassification is that the failure of these walls will not have any impact on the safety related equipment.

To qualify the remaining 18 walls using the above discussed approach, the licensee has identified several areas of conservatisms in the original analysis. These areas can be divided into two main categories: (1) which affects the seismic analysis of the auxiliary building; and (2) which affects the analysis of the masonry walls. These areas are as follows:

Seismic Analysis of the Auxiliary Building

- ° Input Time History - the original time history used in the analysis of the auxiliary building exhibit substantial exceedances over the design spectrum in the range of 1 to 10 Hz.

- ° Radiation Damping - The original seismic analysis of structures neglected radiation damping in the soil-structure interaction analysis.
- ° Embedment Effects - The original seismic analysis also neglected embedment effects in the soil-structure interaction analysis.

#### Masonry Wall Analysis

- ° Response Spectra Modification: The response spectra used in the masonry wall analysis were modified such that peak acceleration level was imposed at all frequencies below the peak frequency.
- ° Moment Combination and Beam vs. Plate Analysis - The external moment and maximum seismic inertial moment are combined in the masonry walls analysis as an absolute sum regardless of their location on the wall. Additionally, the walls have been analyzed as vertical strip rather than plate mechanism.
- ° As-Built Strength of Walls - The certified material test reports indicate that the average yield strength of #5 reinforcing bar used in the auxiliary building construction is 50.4 ksi as opposed to the specified strength of 40.0 ksi.

From the list of above areas, the licensee selected only those areas for which a "generic" lower bound level of conservatism can be easily and clearly identified. For other items, a wall-by-wall reanalysis would be necessary to qualify the amount of conservatism. The "generic" items quantified included the following areas:

- ° Radiation Damping
- ° Use of an Improved Time History
- ° Actual Versus Minimum Specified Material Strengths

The use of radiation damping, within the guidelines established by the NRC Senior Review Team (Guidelines for SEP Soil-Structure Interaction, NRC letter dated December 15, 1980, LS05-80-12-035) provided a peak response that was approximately 40 percent of that obtained from the original analysis. In addition, employing a time history that more nearly meets the design spectra requirements resulted in an additional conservatism. In general, a 25 percent reduction in response occurred in the frequency range of interest due to the time history effect. Combining the effects of both the improved time history and radiation damping (with no other changes to the seismic analysis) and allowing some conservatism for variations in response between floor levels and directions of response, the licensee reduced the stress level to 40 percent of the original analysis results. Based on actual mill test data which indicates that the yield strength of the reinforcing steel is at least 115 percent of the minimum specified, the licensee also increased the wall capacity proportionally.

Based on the above qualification of the existing conservatism in the masonry wall analysis, the licensee has determined that all but two of the walls can be qualified on the basis of the elastic criteria (consistent with the staff acceptance criteria) when this conservatism is accounted for. The remaining two walls can also be qualified on the basis of the elastic criteria when a "plate" analysis approach is used rather than "beam" analysis approach.

Based on the review of the above information and discussions with the licensee in the April 5, 1985 meeting, the staff concludes that Items 2(b) and 3 have been fully implemented at Calvert Cliffs and that there is reasonable assurance that all safety-related masonry walls at the Calvert Cliffs facility will withstand the specified design load conditions without impairment of (a) wall integrity or (b) the performance of the required function.

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