134 Condition Report P-99-22089

Event Description: Potential Seismic Deficiencies (Block Walls)

Discovery Date: May 28, 1999

Plant: D.C. Cook, Units 1 and 2

134.1 Event Summary

IE Bulletin 80-11, "Masonry Wall Design," (Ref. 1) required that all licensees (except Trojan, Sequoyah Unit 1, North Anna Unit 2, and Salem Unit 2) identify and re-evaluate the design adequacy of masonry walls. Cook calculation #DC-D-3050-24-SC was prepared to address this bulletin. This calculation addressed 122 safety-related block walls and one non-safety-related block wall. As a part of the Calculation Reconstitution Program, the licensee began updating this calculation. According to Reference 2, during this calculation update effort, the licensee discovered that the existing calculation treated the junction between the block walls and the in-place concrete wall as simply supported, or in some cases, fixed supports. Such treatment is not justified since, at these locations, all that is provided are dovetail anchors. Dovetail anchors cannot provide any out-of-plane support for the block walls. As a result, during seismic events, these walls could fail easily.

The licensee is still evaluating this issue. As a result of this evaluation, if additional data become available about (a) the actual strengths of individual block walls in their as-found condition, and (b) which equipment or systems may fail as a result of failure of each of the 122 safety-related block walls , the core damage frequency (CDF) increase will be reassessed. [(note: Based on a conversation with the licensee on 3/1/00, at the present time hardware modifications that entail adding out-of-planar support to these block walls are in progress (Ref. 4)].

Since seismic fragilities of the block walls in their as-found condition were unavailable at the time this issue was analyzed, the seismic CDF associated with this issue could not be calculated. However, as indicated in IE Bulletin 80-11, block walls that are not properly anchored can easily fail during earthquakes whose magnitudes are below the design basis earthquake (DBE). For the Cook site, the DBE is 0.2g. A bounding calculation was performed to determine the potential significance of this issue, assuming that the median capacity of the block walls in their as-found condition is less than 0.2g. That calculation indicated that the seismic CDF associated with this issue can be greater than 1×10^{-5}/year.

134.2 Event Description

The issues associated with the Cook plant were identified for evaluation of their risk significance by a review of licensee event reports (LERs) and inspection reports. However, several condition reports were included in the review since they related to open operability evaluations (as of December 28, 1999). Twelve condition reports were selected for detailed analysis after a review of 243 condition reports with

open past operability evaluations. This document addresses one of these 12 condition reports relating to potential seismic design deficiencies in 122 safety-related masonry block walls at the Cook plant.

The 122 safety-related walls have safety-related equipment (e.g., piping) attached to them. Some walls may be adjacent to safety-related equipment. Therefore, if the walls cannot withstand a seismic event, the plant may not be able to safely shut down.

The block walls whose out-of-planar support capability was questioned are located inside the containment, the auxiliary building, the turbine hall, and the screen house building. Therefore systems, structures, and components (SSCs) located in these building could be potentially affected by this degraded condition. According to Reference 2, the identity of each and every one of these SSCs has not yet been documented.

The block walls serve several functions, such as:

- Provide an enclosure for certain areas/rooms within the plant;
- Provide a radiation barrier; and
- Provide support for plant components.

The failure of block walls could lead to failure of some SSCs, since they are attached to the block walls. Other SSCs may fail, since they would be impacted by walls that could collapse during an earthquake. As stated above, each and every component affected by the SSCs has not yet been identified. However, according to Reference 2, the components which would be impacted due to the block wall failures include:

- Unit 2 residual heat removal (RHR) pumps;
- Unit 2 containment spray pumps;
- Unit 1 containment sump pumps;
- Unit 2 emergency diesel generators (EDGs);
- Unit 2 boron injection tank;
- Unit 2 transformers TR11A, TR11B, TR11C, and TR11D;
- Unit 2 turbine-driven auxiliary feedwater pump;

134.3 Modeling Assumptions

There are 122 safety-related block walls at the D.C. Cook plant. The seismic fragilities of individual block walls in their as-found condition is unknown. All of the systems which could be affected due to their failure of these walls are also unknown. However, due to the large number of walls and the commonality of the nature of the deficiency (i.e., an earthquake that is capable of failing one block wall due to lack of out-of-plane support will most likely fail other block walls without that type of support), it is reasonable to assume that failure of these walls could lead to the failure of all trains of safe shutdown equipment and eventually to core damage.

The seismic fragility of block walls can be significantly affected by the adequacy of reinforcement or anchorage. For example, a properly anchored/reinforced block wall may have a seismic fragility (median capacity) of 0.5g. The seismic fragilities of the block walls at the Cook plant in their as-found condition are not known. However, if a block wall is not properly reinforced or does not have the proper anchorage, the fragility of such a wall may be well below the design basis earthquake. The DBE for Cook has a magnitude of 0.2g. A block wall whose median capacity is below the DBE may easily fail due to a low to moderate intensity earthquake.

For the Cook site, based on Figure 4-1 of Reference 3 (See attached Figure 1), the median value of the annual frequency of earthquakes whose median peak ground acceleration exceeds 200 cm/sec^2 (0.2g) is greater than 2.0×10^{-5}/year. If the median capacity of degraded block walls is less than 0.2g, then at earthquakes whose magnitude is 0.2g or higher, the block walls have a failure probability of 50% or greater. The product of 2.0×10^{-5}/year and a probability equal to or greater than 50% provides a frequency of at least 1.0×10^{-5}/year.

134.4 Analysis Results

As stated in Section 134.3, for the Cook site, based on Reference 3, the frequency of earthquakes whose magnitudes are capable of failing block walls with fragility less than 0.2g can be greater than 1.0×10^{-5} /year. There are 122 block walls, and the strengths of individual block walls or the systems which could be affected due to their failure is unknown. Due to the large number of walls and the commonality of the nature of the deficiency, it is reasonable to assume that failure of these walls can lead to failure of both trains of safe shutdown equipment and eventually to core damage. Therefore, assuming that the median capacity of the block walls in the degraded condition is 0.2g or lower, the CDF associated with this issue is greater than 1.0×10^{-5} /year.

134.5 References

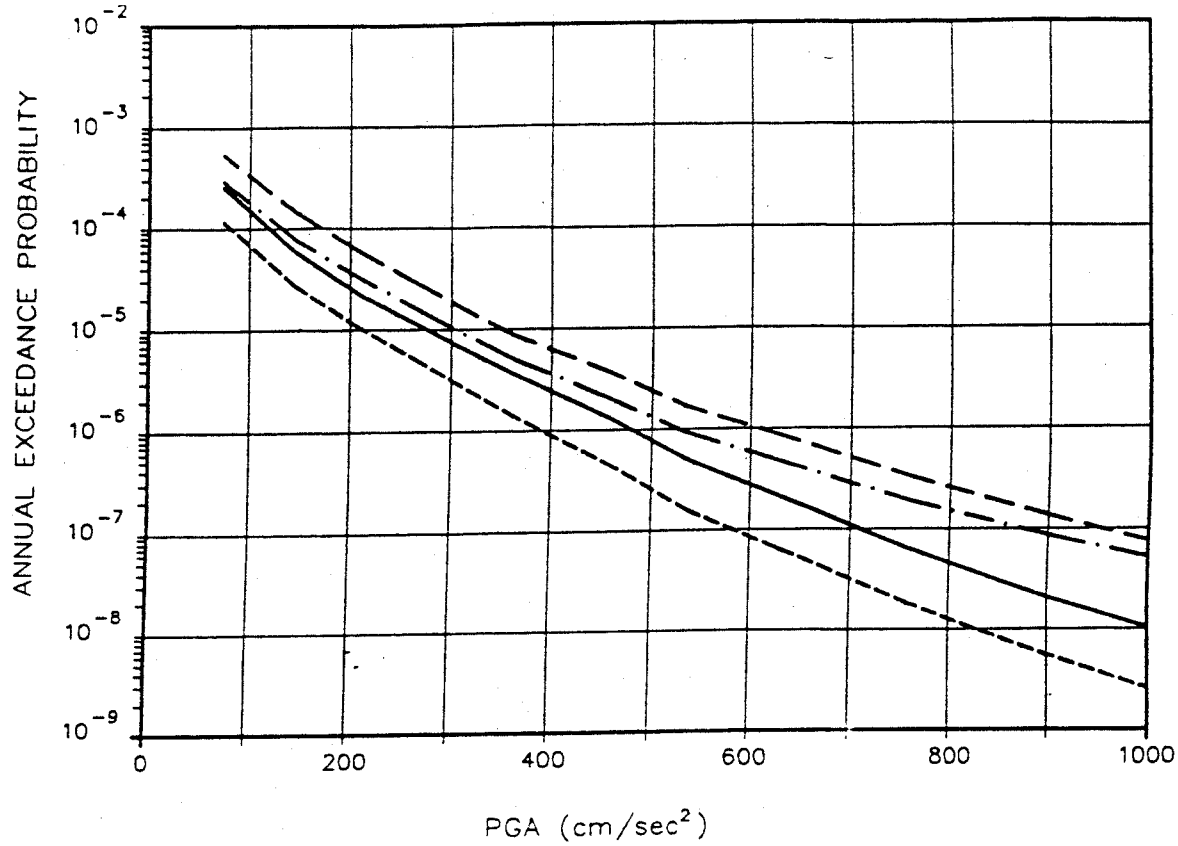
1. USNRC, IE Bulletin No. 80-11, "Masonry Wall Design," May 8, 1980.

2. Condition Report P-99-14004, "Discrepancies with the Calculation and Physical Condition of the Block Walls," May 28, 1999.

3. *Donald C. Cook Nuclear Plant Units 1 and 2, Individual Plant Examination of External Events.*

4. Personal Communications between Amiya Sen, American Electric Power, and Sunil Weerakkody, U.S. Nuclear Regulatory Commission, March 1, 2000.

Figure 1 (Issue No. 134): Seismic Hazard Curve



15th PERCENTILE
MEDIAN
MEAN
85th PERCENTILE

NOTE:
– PGA's PRESENTED IN THE TABLE REPRESENT THE MEAN OF THE PGA RANGES USED IN THE PRA CALCULATIONS.

PGA (g's)	ANNUAL EXCEEDANCE PROBABILITIES FOR MEAN, 15th, 50th AND 85th PERCENTILES			
	15	50	MEAN	85
0.175	1.84E-5	3.97E-5	5.45E-5	9.93E-5
0.380	1.24E-6	3.29E-6	4.71E-6	8.18E-6
0.630	7.18E-8	2.36E-7	5.06E-7	9.21E-7
0.880	7.49E-9	2.78E-8	1.05E-7	1.69E-7
1.130	1.20E-9	5.19E-9	3.29E-8	4.31E-8

FIGURE 4-1

CONSTANT PERCENTILE SEISMIC HAZARD CURVES USING ALL EXPERTS

SEISMIC HAZARD ANALYSIS
DONALD C. COOK NUCLEAR PLANT

PREPARED FOR

WESTINGHOUSE ELECTRIC CORP.
PITTSBURGH, PENNSYLVANIA

Paul C. Rizzo Associates, Inc.
CONSULTANTS

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