EFFECT OF THE REEVALUATION OF MASONRY WALLS ON THE DIABLO CANYON PROBABILISTIC RISK ASSESSMENT

April 1991

Pacific Gas and Electric Company

Diablo Canyon Power Plant
Long Term Seismic Program

EFFECT OF THE REEVALUATION OF MASONRY WALLS ON THE DIABLO CANYON PROBABILISTIC RISK ASSESSMENT

BACKGROUND

PG&E has undertaken a reevaluation program of the safety-related masonry walls in the Plant, in accordance with the reevaluation criteria described in PG&E's Masonry Wall Reevaluation Program (PG&E, 1991a). This reevaluation effort and the wall modifications will result in revised seismic fragility capacities for these walls. Based on the revised capacities, an analysis has been performed to evaluate the contribution to core damage frequency due to seismically induced failure of masonry walls.

Estimate of Seismic Fragility

The seismic fragility of the modified masonry walls has been established (PG&E, 1991b) as follows:

$$\begin{aligned} \text{HCLPF} &= 2.375\ g \\ \check{S}_a &= 6.39\ g \\ \beta_R &= 0.30 \\ \beta_U &= 0.30 \end{aligned}$$

where, both $\check{S}_a$ and HCLPF are expressed in terms of the average ground spectral acceleration in the frequency range of 3 to 8.5 hertz.

The median capacity, $\check{S}_a$, was derived from the calculated value of the HCLPF capacity of the wall and an estimate of the variabilities β_R and β_U. To assess the effect of the estimate of the variabilities, we performed a sensitivity study by calculating the contribution to seismic risk of two types of walls: one having the above fragility estimate, and the other having a median capacity, $\check{S}_a$, of 4.60 g derived by assuming values of β_R and β_U equal to 0.20. Both wall types have HCLPF capacities of 2.375 g.

The sensitivity study showed that the contribution to core damage frequency of the walls having variabilities of 0.30 and 0.20 are 3.82E-6 per year and 3.44E-6 per year, respectively. Thus, if we keep the HCLPF values constant and change the variabilities by as much as about 30 percent, core damage frequency is changed by less than 10 percent. This is because the seismic risk at Diablo Canyon, as well as at other plants in similar seismic areas, is dominated by seismic events in the range of the HCLPF (that is, the HCLPF is the most important fragility descriptor). By assigning high values of variabilities, and consequently a high value of median capacity, we have overpredicted the contribution of masonry walls to seismic risk.

PROBABILISTIC RISK ASSESSMENT

Treatment of Correlation. In assessing the significance of masonry wall failure, it is necessary to consider the degree of correlation between walls and wall groups. In general, seismic probabilistic risk assessment studies model seismic failures as either uncorrelated or completely correlated. Any degree of correlation between these two extremes is difficult to quantify. Seismic probabilistic risk assessments performed for various nuclear power plants have treated masonry walls as completely correlated, which means that if one wall fails, all other walls are assumed to fail. This treatment is based on the fact that masonry walls, in general, have similar material properties, construction details, and reinforcing steel arrangement.

In our Evaluation of Safety-Related Masonry Walls (PG&E, 1991b), we noted that the four walls selected for deterministic evaluation were among the critical walls in the Plant. Also, these four walls represent variations in terms of span, boundary condition, and modification scheme. The results of the evaluation of these selected walls showed that they fell into two groups of frequency of vibration: 8 to 12 hertz, and 12 to 18 hertz. Thus, it is appropriate to model two wall groups, where all walls within a group are considered to be completely correlated, but wall groups are uncorrelated.

Seismic Risk Model. The logic model described in the Probabilistic Risk Assessment (PG&E, 1989), was used to evaluate the contribution of masonry walls to the frequency of core damage due to seismic events. Two independent wall groups were added to the logic model, using *or* logic, as direct contributors to the core damage risk. We made a conservative assumption that failure of a masonry wall results in failure of all equipment, conduits, and piping attached to or located in the vicinity of the wall. This assumption, together with the two independent wall groups, provides a reasonable approximation of the effects of the seismic failure of masonry walls.

Results. As described above, the frequency of core damage due to seismic failure of masonry walls is approximately 3.8E-6 per year when a conservative assumption is made in the estimate of seismic fragility of the walls. The contribution of the masonry walls represents approximately 2 percent of the overall core damage frequency of 2.0E-4 due to all causes, including seismic, internal events, fires, floods, and other external events.

CONCLUSIONS

By maintaining a constant HCLPF capacity of masonry walls, if significant changes are made to the variabilities (and consequently, the median capacities), the resulting change in the frequency of core damage is considerably smaller than the change in the variabilities. This study and other seismic probabilistic risk assessment studies for nuclear plants in similar seismic areas show that seismic risk is governed by seismic levels at or near the HCLPF value. Thus, HCLPF is the best descriptor of seismic risk. We have also shown that the safety-related masonry walls in the Plant contribute approximately 2 percent to the overall frequency of core damage from the combined effects of all causes.

REFERENCES

Pacific Gas and Electric Company, 1988, Final report of the Diablo Canyon Long Term Seismic Program, U. S. Nuclear Regulatory Commission, Docket Nos. 50-275 and 50-323.

Pacific Gas and Electric Company, 1989, Letter No. DCL 89-283 to U. S. Nuclear Regulatory Commission: Long Term Seismic Program - Probabilistic Risk Assessment.

Pacific Gas and Electric Company, 1991a, Letter No. DCL 91-026 to U. S. Nuclear Regulatory Commission: Masonry Wall Reevaluation Program.

Pacific Gas and Electric Company, 1991b, Letter No. DCL 91-086 to U. S. Nuclear Regulatory Commission: Deterministic Evaluation of Masonry Walls.

April 30, 1991

Docket Nos. 50-275
and 50-323

Mr. J. D. Shiffer
Senior Vice President
Nuclear Power Generation
Pacific Gas and Electric Company
77 Beale Street, Room 1451
San Francisco, California 94106

Dear Mr. Shiffer:

SUBJECT: CLOSEOUT OF GENERIC LETTER 89-19, "REQUEST FOR ACTION RELATED TO RESOLUTION OF UNRESOLVED SAFETY ISSUE A-47 'SAFETY IMPLICATION OF CONTROL SYSTEMS IN LWR NUCLEAR POWER PLANT' PURSUANT TO 10 CFR 50.54(f)" (TAC NOS. 74935 AND 74936)

Your letter dated March 19, 1991, responded to Generic Letter (GL) 89-19 for Diablo Canyon, Unit Nos. 1 and 2. Your response confirms that your plant already provides a satisfactory design for steam generator overfill protection and also has the Technical Specifications addressing all the concerns identified by the GL. A detailed technical review has not been performed. However, your confirmation provides an adequate basis to consider NRR's review of your response complete. Further NRC review, if any, will be performed either by inspection or audit.

This completes the NRC staff's action on this issue and closes TAC Nos. 74935 and 74936. If you have any questions regarding this matter, please contact me.

Sincerely,

Original signed by

Harry Rood, Senior Project Manager
Project Directorate V
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

cc: See next page

DISTRIBUTION

Docket Files	NRC & LPDRs	PD5 r/f	BBoger	MVirgilio
DFoster	EJordan	PD5 p/f	OGC	ACRS (10)
RZimmerman, RV	AFitzgerald	HRood	KJabbour	

OFC	:LA/PD5/DRPW	:I/PD5/DRPW	:PM/PD5/DRPW	:D/PD5/DRPW	:	:
NAME	:DFoster	:AFitzgerald	:HRood	:JDyer	:	:
DATE	:4/29/91	:4/29/91	:4/30/91	:4/30/91	:	:

OFFICIAL RECORD COPY Document Name: DC CLOSEOUT 8919

MA

NRC FILE CENTER COPY

Mr. J. D. Shiffer
Pacific Gas and Electric Company

Diablo Canyon

cc:
NRC Resident Inspector
Diablo Canyon Nuclear Power Plant
c/o U.S. Nuclear Regulatory Commission
P. O. Box 369
Avila Beach, California 93424

Dr. Richard Ferguson, Energy Chair
Sierra Club California
6715 Rocky Canyon
Creston, California 93432

Ms. Sandra A. Silver
Mothers for Peace
660 Granite Creek Road
Santa Cruz, California 95065

Ms. Jacquelyn C. Wheeler
3303 Barranca Court
San Luis Obispo, California 93401

Managing Editor
The County Telegram Tribune
1321 Johnson Avenue
P. O. Box 112
San Luis Obispo, California 93406

Chairman
San Luis Obispo County Board of
Supervisors
Room 370
County Government Center
San Luis Obispo, California 93408

Richard F. Locke, Esq.
Pacific Gas & Electric Company
Post Office Box 7442
San Francisco, California 94120

Mr. John Hickman
Senior Health Physicist
Environmental Radioactive Mgmt. Unit
Environmental Management Branch
State Department of Health Services
714 P Street, Room 616
Sacramento, California 95814

Regional Adminstrator, Region V
U.S. Nuclear Regulatory Commission
1450 Maria Lane, Suite 210
Walnut Creek, California 94596

Mr. Peter H. Kaufman
Deputy Attorney General
State of California
110 West A Street, Suite 700
San Diego, California 92101

Ms. Nancy Culver
192 Luneta Street
San Luis Obispo, California 93401

Michael M. Strumwasser, Esq.
Special Assistant Attorney General
State of California
Department of Justice
3580 Wilshire Boulevard, Room 800
Los Angeles, California 90010