V. Stello

March 22, 1979

MEMO TO FILES

SUBJECT: ESTIMATES OF RISK ASSOCIATED WITH BEAVER VALLEY SEISMIC DEFICIENCIES

On March 15, 1978, we provided D. Bunch, NRR, with a rough draft of an estimate of the risk associated with the Beaver Valley* seismic design deficiencies and briefed the Director of NRR on its contents. The final version of the draft which is attached has also been provided to NRR.

The estimate suggests that the overall risk and the core melt probability might be increased by a factor of three to four relative to the estimates presented in the Reactor Safety Study. Considering the error bounds associated with the RSS estimates, this increase is within the uncertainties of the analysis. Consistent with previous views using risk assessment (such as in NUREG-0460), factors of 3-4 probably should not be regarded as significant.

In addition, we believe these estimates are somewhat conservative, due largely to the applicability of the Hsieh-Okrent estimates of seismic frequency for Eastern U. S. as we applied them to the Beaver Valley site.

M. A. Taylor, PAS, RES

J. A. Murphy, PAS, RES

Attachment

cc: Del Bunch
Roger Mattson

*Beaver Valley is very similar in design to Surry which was analyzed in the Reactor Safety Study.

Estimated Risk Due to Seismic Design Deficiencies

Given the seismic design deficiencies presently believed to exist at the Beaver Valley plant*, the staff has estimated the likelihood for various events occurring, including the possibility of a significant core damage accident occurring. These estimates are acknowledged to have significant uncertainties both upward and downward; nonetheless, they provide insight regarding the possible reactor accident risks involved in this matter.

The likelihood estimates given below have relied on seismic margin insights developed by Newmark and on Eastern U.S. earthquake frequency estimates by Hsieh and Okrent. Additionally, the recent and extensive work performed in connection with the Diablo Canyon design was used to obtain insight as to the likelihood of failure of important ESF's at seismic levels significantly above the Beaver Valley Nuclear Plant design levels (e.g., 1.5 x SSE).

The Beaver Valley plant at present appears to have exceeded the recommended code allowable stress levels that should have been used as design bases (DBE and other loads $\lesssim 1.8\ S_H$, OBE plus other loads $\lesssim 1.2\ S_H$) for the smaller piping connected to the reactor coolant system. The more serious over-stress levels are encountered in small piping that provides coolant to the reactor coolant pump seals. Further, some of the small piping in the ECCS might experience stresses somewhat beyond recommended code levels under seismic excitation.

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*Beaver Valley, DBE $\approx$ 0.12 g.
OBE $\approx$ 0.06 g.

Considering the RCP seal injection piping which might be severely overstressed, likelihoods of exceeding allowable stresses and of piping failures are estimated to be as follows:

Exceeding	
OBE $\lesssim$ 1.2 S_H Requirements	$\sim 5 \times 10^{-2}$/year @ .016 g.
DBE $\lesssim$ 1.8 S_H Requirements	$\sim 1.4 \times 10^{-2}$/year @ .043 g.
Exceeding ultimate ($\sim$3.6 S_H)	$\sim 4.5 \times 10^{-3}$/year @ .086 g.

(These estimates suggest that relative to WASH-1400, the likelihood of a small LOCA occurring (e.g., 1/2 - 2" dia. range) could be roughly increased by about a factor of 4.)

For small safety injection piping, the likelihood of exceeding allowable stresses given an earthquake are presented below:

Exceeding	
OBE $\lesssim$ 1.2 S_H Requirements	$\sim 2 \times 10^{-2}$/year @ $\sim$.033 g.
DBE $\lesssim$ 1.8 S_H Requirements	$\sim 4.3 \times 10^{-3}$/year @ $\sim$0.09 g.
Exceeding ultimate ($\sim$3.6 S_H)	$\sim 1.2 \times 10^{-3}$/year @ $\sim$0.18 g.

Core Damage Estimates (Rough)

Using insights from Diablo Canyon seismic risk analyses and the estimated unavailabilities of various ESFs over a range of accelerations through approximately 1.5 x DBE (where the RCP seal piping and the more severely stressed SI piping would be expected to fail), the loss of either ECCS or electric power is roughly:

BV Core Melt Estimates (Seismic)

RCP Lines:

	$P_{RCP\ Small\ Loca}$	x	$P_{Independent\ ECCS\ failure}$	
@ 0.086 g.	$\sim 4 \times 10^{-3}$	x	10^{-2}	$\approx 4 \times 10^{-5}$/RY

BV Core Melt Estimates (Seismic)

Seismic-Induced Failure of RCP line and SI line:

BV-SIS (higher stressed single pipe) and LOCA @ 0.18 g.		(Some ECCS dependence assumed due to 1 train loss)	
1×10^{-3}	x	10^{-1}	$\lesssim 10^{-4}$/RY

High Risk Estimate (Seismic)

High Risk Accident Sequence:

Loss of Power (AC) (All ESFs) @ 0.18 g.	SIS and LOCA	Loss of AC Power	
	10^{-3}	$\sim 2 \times 10^{-2}$	$\approx 2 \times 10^{-5}$/RY

Relative to WASH-1400 Results

WASH-1400	BV Seismic + WASH-1400	Estimated Factor of Increase
PWR Core Melt $\sim 6 \times 10^{-5}$/RY	$\sim 2 \times 10^{-4}$/RY	3-4x
PWR high Risk $\sim 8 \times 10^{-6}$/RY	$\sim 3 \times 10^{-5}$/RY	3-4x

MEMORANDUM OF CALL

TO: Bill

YOU WERE CALLED BY— ☐ YOU WERE VISITED BY—

John [illegible]

OF (Organization)

[illegible] Mt. [illegible] Pa.

☐ PLEASE CALL → PHONE NO. CODE/EXT. ________ ☐ FTS

☐ WILL CALL AGAIN ☐ IS WAITING TO SEE YOU

☐ RETURNED YOUR CALL ☐ WISHES AN APPOINTMENT

MESSAGE

(717) 783-3190

RECEIVED BY	DATE	TIME
[illegible]	4/5	3:45p

63-109

STANDARD FORM 63 (Rev. 8-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.6

*USGPO:1978:281-184/13