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

SEP 4 1985

MEMORANDUM FOR: Hugh L. Thompson, Director
Division of Licensing

FROM: Themis P. Speis, Director
Division of Safety Technology

SUJBECT: FINAL REVIEW OF SHOREHAM PRA STUDY

References:
1. Memorandum from T. Speis, DST, to H. Thompson, DL, and J. P. Knight, DE, "Unisolated LOCA Outside Drywell in Shoreham," March 22, 1985
2. Memorandum from A. Thadani, DST/RRAB, to B. Sheron, DSI/RSB, "Makeup to Mitigate Large LOCAs Outside of Containment at Shoreham," June 14, 1985
3. Memorandum from T. Speis, DST, to D. Eisenhut, DL, "Preliminary Review of Shoreham PRA Study," December 31, 1984
4. Memorandum from F. Rowsome, DST, to L. Rubenstein, DSI, "Review of BWR Water Level Measurement System," October 27, 1983
5. Memorandum from A. Thadani, DST, to A. Schwencer, DL, "Shoreham Flooding," March 30, 1984
6. Memorandum from A. Thadani, DST, to A. Schwencer, DL, "Shoreham PRA Review," June 19, 1984

We have completed our review of the Shoreham probabilistic risk assessment (PRA) study. The Shoreham PRA study considers only internal events (including internal flooding but excluding fire) and does not consider external events such as earthquakes. Ex-plant consequence analysis is not included in the current Shoreham PRA study.

The front-end of the PRA study (frequency of core-melt events) was reviewed by the Reliability and Risk Assessment Branch with technical assistance from Brookhaven National Laboratory (BNL). The back-end of the PRA study (containment failure and radionuclide release analysis) is being reviewed by the Reactor Systems Branch (RSB) in the Division of Systems Integration (DSI), also with BNL technical assistance.

The Shoreham PRA estimated a "core-vulnerable" frequency instead of a core melt frequency, or a severe core damage frequency. Some unspecified fraction of "core-vulnerable" events could be arrested before core melt occurred. However, no estimate of this fraction is given, and it appears difficult to estimate. We shall equate "core-vulnerable" frequency to severe core damage frequency. The total severe core damage frequency at Shoreham estimated in the Shoreham

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PRA study is about $5x10^{-5}$/reactor-year. Our estimate, based on the BNL analysis, is about $1.4x10^{-4}$/reactor-year.

The dominant accident sequences (those of high severe core damage frequency or of high consequences) are:

(1) Anticipated Transients Without Scram (ATWS) Sequences ATWS sequences at Shoreham are estimated by BNL to contribute significantly to the total severe core damge frequency (about 33%). The reasons are discussed in Enclosure 1. However, we believe that the implementation of the ATWS rule requirements and the revision of the ATWS procedures would reduce the severe core damage frequency due to ATWS events.

(2) Unisolated Loss of Coolant Accidents (LOCAs) in the Reactor Building BNL estimates that the severe core damage frequency due to high-energy line breaks (HELBs) or interfacing LOCAs in the reactor building is about $2x10^{-7}$/reactor-year. The consequences of these events are estimated to be high because there is a bypass of the containment. There are still ongoing reviews to address two issues we identified in our review of the unisolated LOCA in the reactor building. These issues are:

(i) We are uncertain whether the motor-operated valves in the high-energy lines can isolate under blowdown conditions. We have asked the Equipment Qualification Branch (EQB) in the Division of Engineering (DE) to address this issue (Ref. 1). Based on the informal communication with the lead reviewer in the EQB, we believe that the review will be completed by September 15, 1985.

(ii) We are uncertain whether makeup from the condensate system can mitigate a large interfacing LOCA. We have asked the Reactor Systems Branch to address this issue (Ref. 2). Based on informal communication with the lead reviewer in the RSB, we believe that the RSB will complete the study by August 1985.

These two issues are further discussed in Enclosure 1. Our plans to address these two issues, either on a plant-specific basis or generically, will be developed after the review is complete.

(3) Loss of Offsite Power (LOOP) Sequences
BNL estimates that the severe core damage frequency due to LOOP sequences at Shoreham is about $3x10^{-5}$/reactor-year. The LILCO estimate is about $1.1x10^{-5}$/reactor-year. However, with the installation of additional qualified diesel generators, there would be a smaller contribution to the overall severe core damage frequency due to LOOP events. Station blackout events are being addressed in the ongoing work related to Unresolved Generic Issue (USI) A-44, "Station Blackout."

(4) Flooding Sequences
The mean value of the severe core damage frequency of accidents initiated by flooding in the reactor building at Shoreham is estimated by BNL to be about $2x10^{-5}$/reactor-year. The LILCO estimate is about $4x10^{-6}$/reactor-year. Based on our review, we identified some potential deficiencies in

the Shoreham alarm response procedure for mitigating a flood. The resolution of this issue is discussed in our previous memoranda[3],[5] and in Enclosure 1.

(5) Reactor Water Level Instrumentation Failure Sequences
BNL estimates that reactor water level instrumentation failure contributes about 1.2×10^{-5}/reactor-year to the total severe core damage frequency. The LILCO estimate is about 4×10^{-6}/reactor-year. We note that Shoreham is adding new level transmitters to the existing system and modifying the power supplies for initiation of ECC systems. With these changes, there would be a smaller contribution to the overall severe core damage frequency due to reactor water level instrumentation failure. The adequacy of the Shoreham reactor water level instrumentation is being addressed in Generic Issue 50, "Reactor Vessel Level Instrumentation in BWRs," as discussed in our previous memorandum.[4]

Based on our review findings, we do not identify any safety issue that needs immediate action. Our overall impression is that the Shoreham PRA study is a good and comprehensive piece of work within its stated scope.

With respect to the Shoreham containment response and radionuclide release analyses, BNL has completed their preliminary review and submitted it to the Reactor Systems Branch. The BNL final review is expected to be completed by December 31, 1985. The scope of the final back-end review is discussed in Enclosure 1.

Enclosure 1 contains a summary of the findings of our completed review. Enclosure 2 contains the final report from BNL on the review of the Shoreham PRA study. Enclosure 3 contains the final report from BNL on an evaluation of unisolated LOCA outside the Shoreham containment. With this evaluation, the Phase II (our final review assessment (Ref. 6) work on the Shoreham PRA study is complete.

Themis P. Speis, Director
Division of Safety Technology

Enclosures:
1. Final Review of Shoreham PRA Study
2. "A Review of the Shoreham Nuclear Power Station Probabilistic Risk Assessment," BNL, June 1985
3. "An Evaluation of Unisolated LOCA Outside the Drywell in the Shoreham Nuclear Power Station," BNL, June 1985

cc: See next page

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