NOV 24 1982

DISTRIBUTION:
Docket File
LB#2 File
EHylton
EWeinkam/RGilbert
ELJordan, DEQA:IE
JMTaylor, DRP:IE
Bordenick, Repka, OELD
ACRS (16)
NRC PDR
Local PDR
NSIC
PRC
Region I

Docket No.: 50-322

Mr. M. S. Pollock
Vice President - Nuclear
Long Island Lighting Company
175 East Old Country Road
Hicksville, New York 11801

Dear Mr. Pollock:

Subject: Shoreham PRA

By letter dated September 29, 1982, (Darrell G. Eisenhut to M. S. Pollock) the NRC staff requested additional information concerning a report prepared for Suffolk County as a part of Suffolk County's emergency planning efforts by Future Resources Associates, Inc. (FRA). The Atomic Safety and Licensing Board for Shoreham Nuclear Power Station, Unit 1 was notified of this report and the request for additional information by Board Notification (82-99). You were requested to respond within 45 days but your staff had indicated by telephone that you will require an additional ten days to respond.

Additional review of the FRA draft report by the NRC staff has generated the enclosed "Evaluation of the Flood Risk Estimates for the Shoreham Nuclear Power Station." Additional information required for our review is identified on page 5 of this evaluation. Please note that item 1 has already been requested in our letter dated September 29, 1982. We request that you provide us with your response to the enclosed evaluation and to our September 29, 1982 letter within 30 days of receipt of this letter.

If you have any questions concerning this subject, please contact NRC Project Manager, Edward Weinkam at (301) 492-8430.

Sincerely,

/S/

A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing

Enclosure: As stated

cc: See next page

OFFICE	DL:LB#2/PM	DL:LB#2/BC					
SURNAME	EWeinkam:pt	ASchwencer					
DATE	11/24/82	11/24/82					

Shoreham

Mr. M. S. Pollock
Vice President - Nuclear
Long Island Lighting Company
175 East Old Country Road
Hicksville, New York 11801

cc: Howard L. Blau, Esquire
Blau and Cohn, PC.
217 Newbridge Road
Hicksville, New York 11801

Mr. Jay Dunkleberger
New York State Energy Office
Agency Building 2
Empire State Plaza
Albany, New York 12223

Energy Research Group, Inc.
400-1 Totten Pond Road
Waltham, Massachusetts 02154

Mr. Jeff Smith
Shoreham Nuclear Power Station
Post Office Box 618
Wading River, New York 11792

W. Taylor Reveley, III, Esquire
Hunton & Williams
Post Office Box 1535
Richmond, Virginia 23212

Ralph Shapiro, Esquire
Cammer & Shapiro
9 East 40th Street
New York, New York 10016

Mr. Brian McCaffrey
Long Island Lighting Company
175 E. Old Country Road
Hicksville, New York 11801

Honorable Peter Cohalan
Suffolk County Executive
County Executive/Legislative Bldg.
Veteran's Memorial Highway
Hauppauge, New York 11788

David Gilmartin, Esquire
Suffolk County Attorney
County Executive/Legislative Bldg.
Veteran's Memorial Highway
Hauppauge, New York 11788

MHB Technical Associates
1723 Hamilton Avenue, Suite K
San Jose, California 95125

Stephen Latham, Esquire
Twomey, Latham & Shea
Post Office Box 398
33 West Second Street
Riverhead, New York 11901

Matthew J. Kelly, Esquire
Staff Counsel
New York State Public Service Commission
Three Rockefeller Plaza
Albany, New York 12223

Ezra I. Bialik, Esquire
Assistant Attorney General
Environmental Protection Bureau
New York State Department of Law
2 World Trade Center
New York, New York 10047

Resident Inspector
Shoreham NPS, U.S. NRC
Post Office Box B
Rocky Point, New York 11778

Herbert H. Brown, Esquire
Kirkpatrick, Lockhart, Hill,
Christopher & Phillips
1900 M Street, N.W.
Washington, D.C. 20036

Lawrence Coe Lanpher, Esquire
Kirkpatrick, Lockhart, Hill,
Christopher & Phillips
1900 M Street, N.W.
Washington, D.C. 20036

Karla J. Letsche, Esquire
Kirkpatrick, Lockhart, Hill,
Christopher & Phillips
1900 M Street, N.W.
Washington, D.C. 20036

Lawrence Brenner, Esq.
Administrative Judge
Atomic Safety & Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. James L. Carpenter
Administrative Judge
Atomic Safety & Licensing Board
U. S. Nuclear Regulatory Coimmission
Washington, D. C. 20555

Dr. Peter A. Morris
Administrative Judge
Atomic Safety & Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

ENCLOSURE

Evaluation of the Flood Risk Estimate For the Shoreham Nuclear Power Station

Future Resources Associates, Inc. (FRA) has recently completed a draft report of its review of the draft Shoreham Probabilistic Risk Assessment (PRA). FRA raises the concern that the dominant accident involves flooding at Elevation (El. 8) of the Reactor Building (RB) and can lead to a "core-vulnerable" (the PRA term for core-damage) state with a significantly higher frequency than is calculated in the PRA. FRA acknowledged that its estimates are rough because it has not performed a complete risk analysis to quantify the flood risk and its contribution to the total core-vulnerable frequency. We have reviewed the applicable portions both of the FRA draft report "Review and Critique of Previous Probabilistic Accident Assessments for the Shoreham Nuclear Power Station," dated September 17, 1982 and of the draft Shoreham PRA.

The FRA Approach:

FRA's basic methodology for flood initiation at El. 8 of the RB is the combination of the four basic events (A, B, C and D) shown in Table 1. FRA has calculated the frequency of Events A and B (on-line maintenance of HPCI pump requiring opening of the pump housing) based on the PRA's value for HPCI system unavailability, and it has suggested values for the conditional probability of Event C (operator opens the isolation valve inadvertently during maintenance) and Event D (operator failure to isolate the flood). According to FRA, a flood at El. 8 can be mitigated only by operator action (reclosing the isolation valve F004). If the operator fails to isolate the flood, the water level will rise and the RCIC and LPCI pump components will be submerged and are assumed to be inoperable. Also FRA assumed that the flooding causes the MSIV to close and is followed by a reactor trip leaving only the normally operating coolant make-up system (the condensate system). Thus, FRA defines a core-vulnerable condition to result if Event E (the operator erroneously isolates the power conversion system including the condensate system) occurs following a flood at El. 8 of the RB. FRA considers this a high stress condition for the operators with the flood progressing at El. 8 and the reactor tripped. They estimate a value of 1×10^{-3} per reactor year for the expected frequency of the flood at El. 8 of the RB (Sequence A, B, C, D), and a value of approximately 2.5×10^{-4} per reactor year for the expected frequency of a core vulnerable condition resulting from the flood at El. 8 of the RB (Sequence A, B, C, D, E).

Shoreham Draft PRA Approach:

The draft PRA assumes that the source for the flood is either the leakage of HPCI/RCIC suction piping or the on-line maintenance accident sequence described by FRA. The PRA contains fault trees to quantify both flood initiation events. The PRA shows a value of 8.5×10^{-7} for flood initiation due to the pipe leakage and 1×10^{-5} due to on-line maintenance of HPCI pump. According to the PRA, the flood can be mitigated either by the operator isolating the flood or by the operator reclosing valve (F010). The PRA value for the conditional probability that a flood and a transient that induces MSIV closure will simultaneously occur is 0.1.

We took the values for the individual Events B, C, D and E shown in the PRA and calculated the expected frequencies of the scenarios defined by FRA. In summary, we inferred that the PRA estimates 5.4×10^{-7} per reactor year for flood frequency and about 6.5×10^{-8}/ry for the core-vulnerable frequency.

Staff Conclusion:

The draft PRA and the preliminary FRA scenarios that define the cause of the flood at EL. 8 of the RB seem reasonable (jointly events A, B, C and D). It is important to note that we have not reviewed all possible accident sequences and risks resulting from a flood at El. 8 of the RB to estimate a total flood risk. However, we can review the final Shoreham PRA (when it is submitted) for flood risk.

The contributions to the large difference (a factor of 4000) in the flood risk estimates are due to:

(a) the FRA selection of a maintenance frequency of the HPCI pump that is a factor of 100 higher, and

(b) the FRA selection of human error probabilities that are a factor of 40 higher.

FRA assumed a conservatively high value of 0.2 for the joint Events A and B. Although we have not reviewed the Shoreham plant maintenance schedule and procedures, we believe that the high value for joint Events A and B is very conservative and is not appropriate for a realistic estimate of risk due to the maintenance activities required for HPCI or RCIC pumps.

The probability of the basic events such as "opening of pump housing" (Event B) and "inadvertent opening of isolation valve by human" (Event C) are also dependent on Shoreham plant maintenance procedures, and the human behavior during the maintenance. A large modeling uncertainty exists in assigning values to such errors, and FRA has in our opinion taken a very conservative bias. FRA has discussed various values for Event C, referring to the "Human Reliability Handbook" (NUREG/CR-1278) by A. S. Swain, et al, and selected the high value (90% upper bound) of 0.02 per maintenance outage for Event C. However, we believe that FRA should have used best estimates (mean values) for Events A, B, and C; not the upper bounds or conservative values.

Given the flood initiation, FRA has assumed that all HPCI, RCIC, core spray pumps and LPCI pumps and their instrument racks will be submerged after about 30 minutes and the reactor will trip. No further design description is given by FRA in their report (or by PRA in theirs) to verify these assumptions regarding flood induced interactions.

We are not aware of any reactor trip signal that would occur directly from a flood at El. 8. The FRA assumption that the trip would occur with probability 1.0 in 30 minutes may be conservative. No basis is given for the PRA estimate for a probability of 0.1 for this. Because of the time assumed by FRA to be available (at least 30 minutes) for the operator to mitigate the flood progression and to recover condensate system, we feel that the high stress condition assumed by FRA during the flood and the reactor trip is conservative. A summary of the frequency and probability values used by the PRA and FRA along with the underlying differences is shown in Table 1.

The PRA appears to have a better basis for the value it assigned to the individual events, but we do not have enough information to verify the basis. We recommend that the applicant verify the PRA analysis of the Shoreham plant regarding: (1) the potential for flooding at El. 8 of the RB, (2) the potential for the flood-induced reactor scram assumed in the PRA and by FRA, (the possible interactions should include hostile environments other than submergency, e.g., splashing, humidity, debris), and (3) the probabilities for each event in the scenarios based upon maintenance schedules and procedures for ECCS and RCIC system to select the most realistic values. The applicant should report their results to the staff for review.

The staff will evaluate the adequacy of the revised assessment for the frequency of the flooding sequences at elevation 8, and the conditional probability of flood-induced reactor scram. If the staff determines that the PRA values have been underestimated, then a basis may exist for subsequent regulatory actions with broader implications.

TABLE 1

ITEMIZATION OF MAJOR DIFFERENCES BETWEEN THE ANALYSES OF FRA AND THE PRA

BASIC EVENTS	EVENT DESCRIPTION	FREQUENCY/PROBABILITY FRA	FREQUENCY/PROBABILITY PRA	REMARKS (FACTOR FOR THE DIFFERENCE FRA/PRA)
A	On-line Maintenance act of HPCI or RCIC Pump	1.08/ry	Not shown	
B	HPCI or RCIC Pump is disassembled during on-line maintenance	0.2 1/	0.002 2/	100 higher
C	Inadvertent opening of isolation valve F004 by Human	0.02 3/	0.005 4/	4 higher
D	Human failure to isolate the flood	0.25 5/	0.054 6/	5 higher
E	Failure of Condensate System	0.25 5/	0.120 7/	2 higher
(ABCD)	Frequency of flood at El. 8	$\sim 1 \times 10^{-3}$/ry	$\sim 5.4 \times 10^{-7}$ 8/	2000 higher
(ABCDE)	Frequency of core-vulnerable condition	$\sim 2.5 \times 10^{-4}$/ry.	$\sim 6.5 \times 10^{-8}$ 9/	4000 higher

NOTE: 1/ A frequency value of 0.2 can be inferred from the values used by FRA for the frequency of El. 8 RB flood. FRA based its selection on their interpretation of the HPCI maintenance schedule. Although we have not reviewed the Shoreham plant maintenance schedule, the FRA value seems very high and may be very conservative.

2/ PRA did not estimate the frequency value of A. However, based upon a review of similar plant maintenance schedules and procedures, SAI selected the value for p(B). We have not reviewed plant maintenance schedules and procedures to verify the value.

Table 1 - Continued

3/ FRA selected a conservative value (90% confidence level). FRA should have used some measure of the expected value not a limiting value when combining the probability of events.

4/ PRA value seems reasonable since PRAs reference is widely used and recognized by industry (NUREG/CR-1278).

5/ FRA assumed a high stress condition and selected a value accordingly.

6/ The SAI has not considered the operator error to leave the flood unisolated a "high stress condition" because the operator has at least 30 minutes to isolate the flood before submergence of equipment at El. 8. We consider this value appropriate.

7/ The SAI value seems reasonable considering that the condensate system is available to the operator and that he has about 30 minutes to provide primary coolant make-up to keep the core covered. This does not seem like a "high stress" situation. The PRA value seems reasonable considering the condenser hotwell availability for a limited time. We expect that the implementation of symptom orientated procedures could improve the operators likelihood to recover coolant injection capabilities from PCS.

8/ Values are based upon assuming $P(A) \sim 1/ry$.

9/ Value is based on the assumption of flood-induced reactor trip.