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SUBJECT: Forwards info requested by NRC staff during 990916 telcon to complete staff review of request for risk-informed extension of action completion/AOT specified for inoperable train of LPSI sys at plant.

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Florida Power & Light Company, 6351 S. Ocean Drive, Jensen Beach, FL 34957

September 25, 1999

L-99-215
10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Re: St. Lucie Unit 1 and Unit 2
Docket Nos. 50-335 and 50-389
Proposed License Amendments
LPSI System Risk Informed AOT Extension
Response to Request for Additional Information

Ref: FPL Letter L-99-079: J.A. Stall (FPL) to NRC (DCD), St. Lucie Unit 1 and Unit 2, Docket Nos. 50-335 and 50-389, Proposed License Amendments, *LPSI System Risk Informed AOT Extension*; June 1, 1999.

The enclosure with this letter provides information requested by the NRC staff during a telephone conversation with FPL on September 16, 1999. The information is deemed necessary to complete the staff's review of our request for a risk-informed extension of the action completion/allowed outage time (AOT) specified for an inoperable train of the Low Pressure Safety Injection (LPSI) system at St. Lucie Units 1 and 2.

Please contact us if there are any questions about the enclosed response or the reference proposed license amendments.

Very truly yours,

J. A. Stall
Vice President
St. Lucie Plant

JAS/RLD

050084

Enclosure

A001 1/1

cc: Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

ST. LUCIE UNITS 1 AND 2

LPSI SYSTEM RISK INFORMED AOT EXTENSION

ENGINEERING EVALUATION PSL-ENG-SERS-99-048, R0 (ABRIDGED/EDITED)

ST. LUCIE PLANT – UNITS 1 AND 2
RESPONSE TO NRC RAI Re: LPSI AOT PLA

FPL letter L-99-079 (Reference 1) submitted FPL's Proposed License Amendments (PLAs) for St. Lucie Units 1 and 2 to increase the Allowable Outage Time (AOT) for a single Low Pressure Safety Injection (LPSI) train from 72 hours to 7 days (168 hours). This evaluation documents responses to a NRC request for additional information regarding the PSA input to this Technical Specification change request.

NRC Staff Request: To ensure that specific PRA's are adequate to support the requested TS changes, the staff will require each licensee to furnish, in its submittal, information on PRA quality including:

1. Verification that the PRA reflects the as-built/as-operated plant

Response: Section 3.2.2 of Reference 1 addressed this as follows:

The St. Lucie contribution to the 1995 preparation of CE NPSD-995 (Reference 2) was generated using the IPE models developed in response to Generic Letter (GL) 88-20, *Individual Plant Examination for Severe Accident Vulnerabilities,* and associated supplements. Subsequently in 1997, the NRC completed its review of the GL 88-20 submittals and in a letter to FPL dated July 21, 1997, Subject: Staff Evaluation Report of St. Lucie, Units 1 and 2, Individual Plant Examination (IPE) Submittal – TAC Nos. M74473 AND M74474, the NRC staff stated, "The NRC staff concluded that the FPL IPE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities for St. Lucie, Units 1 and 2, and, therefore, meets the intent of GL 88-20."

Since then, FPL has updated both the models and the reliability/unavailability databases for St. Lucie Units 1 and 2. The updated models and databases were then used to re-calculate the risk numbers for the units. A summary of the major changes (also discussed in Reference 1) is provided in the response to question 2, and additional discussion regarding PSA updates is provided in the response to question 4 below.

Additional information not in the PLA: Before performing the risk assessment for the LPSI PLA, FPL reviewed all design changes implemented since the last PRA update and reviewed current revisions of the critical procedures which establish requirements and timing for operator recovery actions. No model changes were required as a result of this review.

2. Updates of the PRA since the last review cycle, including corrections of weaknesses identified by past reviews.

Response: The PLA submittal (Reference 1) provided a summary of the model updates. This includes several items previously considered to be weaknesses. The information from Reference 1 (pages 7 and 8 of Attachment 1) is repeated below for convenience.

The most significant change included with each model update is the creation of a "one-top" model which is constructed from the original model's individual top events for various initiators, e.g., small LOCA, large LOCA, SGTR, reactor trips, etc. The one-top model allows rapid quantification, and each case for this re-evaluation of LPSI was individually quantified. The truncation used for quantification was 2E-10 or lower. This replaces the use of one master cutset file (per unit) in the original (1995) CEOG evaluation.

The model update process included a review of all plant design changes that were implemented since creation of the original models. Due to the maturity of the St. Lucie units, only one plant design change was implemented (Unit 2) that resulted in a notable impact on the analysis results, and is discussed in the following summary of significant changes. For the reliability/unavailability database update, FPL was able to use the last three years of data gathered pursuant to the Maintenance Rule (10 CFR 50.65) which provided concise, high-quality unavailability and reliability data for the risk-significant systems. Outside peer review was not performed for the update because creating a one-top model essentially involved combining the existing tops for the various scenarios, and other model changes that were implemented were not extensive. A summary of significant model changes relevant to the LPSI AOT extension follows:

Test & Maintenance (T&M) events for selected equipment were added to better support Maintenance Rule implementation and related risk evaluations. Minor improvements were made in the modeling of instrument air systems and in the handling of common cause events.

New initiating event (IE) frequencies were calculated for all LOCAs. This was done in accordance with CEOG Probabilistic Safety Assessment Working Group (PSAWG) Technical Position Paper, "*Evaluation of the Initiating Event Frequency for the Loss of Coolant Accident*", CEOG Task 941, January 1997. Although the IE frequency for two LOCA sizes (large and small) decreased, the net impact was an increase in the total LOCA IE frequency of nearly 48%, i.e., from 2.09E-3 to 3.09E-3 per year.

The process of adding recoveries is now automated using a recovery "rule file". The rule file utilizes a manual recovery action process in that recovery actions are added to each cutset rather than being generated from the model, but the process is automated such that all the similar cutset scenarios are recovered automatically. This automatic feature ensures uniform and complete inclusion of recovery actions throughout all of the generated cutsets, and yields more realistic and consistent results.

FPL re-evaluated all offsite power recovery cases for both St. Lucie units. One case was added to the Unit 1 analysis for recovery of offsite power in 9 hours (approximately 1 hour before the Unit 1 CST would deplete without condensate replenishment). The non-recovery probability for one case was increased for both units due to an incorrect assumption that was used in the original analysis. In addition, the related recovery for getting power from the alternate unit was increased due to timing considerations. Although 60 minutes total is available (as assumed in the original evaluation), only 45 minutes remains for power recovery after diagnosis of the event per the plant Emergency Procedures. This factor was combined with hardware-related failures to calculate the total non-recovery probability of 0.1 for the crosstie recovery event.

For Unit 2, a plant design change was made that requires the SDC suction cross-connect valve to be locked open. The valve was normally closed during power operations, and this action was taken in response to concerns raised by GL 95-07, "*Pressure Locking and Thermal Binding of Safety-Related Power Operated Gate Valves*". The modification also included a requirement to remove electrical power from each of the SDC suction isolation valve actuators by locking open their associated motor control circuit breakers. The intersystem-LOCA (ISLOCA) calculations were revised to include the plant design change. This resulted in an increase in the ISLOCA frequency. However, the plant design change prevents inadvertent opening of the SDC suction valves during power operations and improves the ability to initiate shutdown cooling operations for events involving loss of one train of electrical power. These factors were judged to offset the calculated risk increase such that the net change to ISLOCA is at least risk neutral.

The net effect of the modeling changes caused a slight increase in the calculated core damage frequency (CDF). However, when the data update was completed, including all other initiating events, the final result was a decrease in the calculated CDF for both units.

Additional Information not in the PLA:

An issue addressed in the NRC SER for the IPE regarded the IE frequency used for loss of a DC bus. The IE frequency used in the IPE was based on the generic bus failure probability over a year. As part of the PSA update, a fault tree was used to assess a new IE frequency for loss of a DC bus. The revised loss of DC bus IE frequency was incorporated in the previous PSA update and is, therefore, reflected in the LPSI AOT extension evaluation. The new Loss of DC Bus IE frequency is 1.07E-03/yr compared to the IPE value of 3.94E-04/yr. It is judged that this re-assessment corrects the perceived deficiency identified by the NRC and thus no further action is required.

A sensitivity study has been performed covering selected operator actions. The actions chosen were either related to LPSI system operation or were questioned by the NRC in the SER for the St. Lucie IPE. The operator actions modified are listed in the following table.

Operator Actions Reviewed for LPSI Sensitivity Study			
Operator Action	Description	Old Value	New Value for Sensitivity Study
RTOP1[2]RLTC	Failure to initiate shutdown cooling for SGTR	7.5E-04	1.0E-02
RTOP1TLTC (N/A ON UNIT 2)	Failure to initiate shutdown cooling for transients	1.22E-02	1.22E-02
RTOP1[2]S1LTC	Failure to initiate shutdown cooling for S1 LOCA	7.5E-04	1.0E-02
RTOP1[2]ROTC	Failure to initiate once- through cooling for SGTR	7.5E-03	5.0E-02
RTOP1[2]TOTC	Failure to initiate once- through cooling - transients	7.5E-03	5.0E-02
RTOP1[2]S1OTC	Failure to initiate once- through cooling - S1 LOCA	7.5E-03	5.0E-02
R#CAFWMAN	Failure to manually operate steam driven AFW pump	7.88E-02	2.0E-01
R#AFXVLVS	Failure to manually operate AFW cross-connect valves	3.68E-02	1.0E-01
R#AFWCMP	Failure to manually actuate AFW components (Control Room action)	3.0E-03	3.0E-02
RTOP1[2]S1RCP	Failure to stop RCPs on loss of sealing water	3.0E-4	1.0E-02
U2XTSDC	U2 SDC Failure on LOG, no CST water for U1 LTC	5.58E-02	2.43E-01

For this operator action sensitivity study, three operator actions directly related to shutdown cooling (SDC) were evaluated. These are the first three in the table of Operator Actions Reviewed for LPSI Sensitivity Study above (RTOP1[2]RLTC, RTOP1TLTC, and RTOP1[2]S1LTC, where [2] indicates Unit 2). New values for these actions were chosen to give a significant increase (approximately two orders of magnitude) to the failure probabilities for initiating SDC for SGTR and S1 (small small LOCA). It should be noted that RTOP1TLTC (not used for Unit 2) was originally quantified as a time dependent action whereas the other two were initially considered as time independent, causing the original values to be smaller. Using a time-dependent approach brings those two in line with the failure probability for SDC initiation following transients (RTOP1TLTC).

The next three operator actions (RTOP1[2]ROTC, RTOP1[2]TOTC, and RTOP1[2]S1OTC) are not directly related to SDC. However, once-through cooling (OTC) is one means of cooling down to SDC conditions. The above actions were quantified as "slips" (i.e., time-independent actions) for the St. Lucie IPE. The NRC concluded in the St. Lucie IPE SER that treating post-initiator human actions with a time-independent approach is "troublesome" since the approach does not model diagnosis and decision-making and has the potential to over-estimate the likelihood of success. Another observation made by the NRC was that the quantification of the above actions was not sequence-specific, i.e., the same probability was used for all sequences thus not considering potential differences in time for diagnosis and the available time to complete the action. Although these actions are not specifically related to a LPSI pump/system being OOS in most cases, they could have an impact on the overall PSA results and are thus included in this study.

For once-through-cooling (OTC) initiation, FPL agrees with the NRC conclusion that the timing is scenario-specific. The most limiting case would be a total loss of main feedwater resulting in a unit trip on low SG level. OTC must be initiated before SG dryout (approximately 19-20 minutes). The only initiating events (IEs) that would result in this scenario are related to loss of MFW. For all other IEs, the reactor trip would occur with at least normal operating SG level, and thus the available time to initiate OTC would be lengthened. For some scenarios, the initiation of OTC may be several hours after shutdown, when the decay heat is substantially lower than immediately after the trip. Since analysis of multiple OTC recovery actions based on various OTC timing assumptions will not be completed in time to support this PLA, a representative and conservative timing assumption will be used for this sensitivity study. Applying the time-dependent technique used for the PSL IPE and assuming 20 min to SG dryout, a conservative 15-minute diagnosis time (thus 5 minutes available for performing the action), and a 2-minute response time, the estimated non-recovery probability would be approximately 2E-02. This timing would actually only apply to the t=0 loss of all feedwater events (i.e., reactor trip on low SG level). For longer-term loss of feedwater scenarios, the available time would be longer. For this operator action sensitivity study, a conservative value of 5E-02 for all OTC recovery events was used. The benefit of performing sequence-specific quantification of OTC recovery events will be evaluated as part of a future PSA update.

The next three selected operator actions (R#CAFMAN, R#AFXVLVS, and R#AFWCMP) are for the Auxiliary Feedwater (AFW) system. The non-recovery probability for these events was increased to address NRC concerns expressed in the IPE SER regarding timing. R#CAFWMAN involves manual local operation of the turbine driven ("C") AFW pump. The action is primarily associated with loss of DC control power to the pump. The dominant method of losing power would be battery depletion following loss of AC power to the battery chargers or charger failure. Battery depletion would be at least 4 hours after loss of the chargers. Decay heat level would be less than that immediately after a unit trip. The available time to recovery feedwater would thus be greater than the 60 minutes assumed for a t=0 loss of all feedwater. This basic event was originally quantified as an ex-control room action with a 10-minute diagnosis time, a 13-minute response time, and 50 minutes available time (assuming 60 minutes to recover feedwater). If it is assumed for this study that an additional 10 minutes is required for diagnosis (20 minutes total), 40 minutes would then be available to complete the action. This results in a revised probability of 0.12. A conservative value of 0.2 was used for this study. R#AFXVLVS involves opening (locally) AFW cross connect valves after failure of a motor-driven AFW pump on one train and the failure of the AFW flow path to the SG on the other train. This action was quantified assuming a 10-minute response time and 55-minute available time. For this study, the response time was increased to 15 minutes and the available time was reduced to 50 minutes (i.e., 5 additional minutes assumed for diagnosis and 5 fewer minutes assumed for response). This results in a non-recovery probability of approximately 0.1 (baseline is 3.68E-02). R#AFWCMP involves the operator manually activating AFW components from the control room in the event of an automatic actuation failure. Since this action is well covered by procedures and training, it is judged that a one decade increase, from 3E-03 to 3E-02, is conservative and is adequate for this study.

Action RTOP1S1RCP (RTOP2S1RCP) involves the operator securing the RCPs after loss of Component Cooling Water (CCW) cooling to the pumps. It is assumed that the pumps must be secured within 10 minutes to prevent a seal LOCA, although industry events have shown that the pumps could operate longer than 10 minutes without catastrophic seal damage. Since this is an in-control room action clearly addressed by procedures, the operator action was assumed to be time-independent ("slip") for the PSL IPE. For this study, it was assumed that this is a time-dependent in-control room response action requiring 3 minutes to diagnose (thus a 7-minute available time) and a 1-minute response time. The resulting non-recovery probability would be approximately 7E-03. For this study, a conservative value of 1E-02 was used.

The last event is U2XTSDC. This represents the probability of Unit 2 failing to reach shutdown cooling on a Loss of Grid thereby being unable to supply water from the Unit 2 CST to the Unit 1 AFW pump suction for long-term cooling (beyond about 9 hours). This was recalculated assuming Unit 2 had one LPSI (SDC) pump out for maintenance. The new value for this basic event would become 2.43E-01 using this assumption. Although this is not an operator action, it is directly related to LPSI (SDC) operation and is appropriate for inclusion in this sensitivity study.

The sensitivity study results are shown in the following tables. All table numbers used correspond to the equivalent tables in the PLA submittal with the addition of an "S" (for sensitivity), except Tables 1 and 2 are combined for this study.

TABLE 1S and 2S - CONDITIONAL CDF CONTRIBUTIONS OPERATOR ACTION SENSITIVITY STUDY				
			UNIT 1	UNIT 2
CURRENT AOT (DAYS)			3	3
PROPOSED AOT (DAYS)			7	7
BASELINE			3.47E-05	2.90E-05
(1)	CCDF/YR (1 TRAIN AVAILABLE)	CM (CASE 1A)	6.13E-05	4.59E-05
		PM (CASE 1B)	3.92E-05	3.21E-05
(2)	CCDF/YR (1 TRAIN NEVER OUT FOR T/M)	CASE 2	3.47E-05	2.89E-05
(3)	INCREASE IN CDF/YR [= (1) - (2)]	CM	2.67E-05	1.70E-05
		PM	4.52E-06	3.24E-06
(4)	SINGLE AOT RISK (CURRENT AOT) [= (3)/HR * CURRENT AOT HRS]	CM	2.19E-07	1.40E-07
		PM	3.71E-08	2.66E-08
(5)	SINGLE AOT RISK (PROPOSED AOT) [= (3)/HR * PROPOSED AOT HRS]	CM	5.11E-07	3.26E-07
		PM	8.68E-08	6.21E-08
(6)	ASSUMED DOWNTIME FREQUENCY (/YR/LPSI TRAIN)	CM	1	1
		PM	3	3
(7)	YEARLY AOT RISK (CURRENT AOT) [= (4) * (6) * 2 TRAINS]	CM	4.38E-07	2.79E-07
		PM	2.23E-07	1.60E-07
(8)	YEARLY AOT RISK (PROPOSED AOT) [= (5) * (6) * 2 TRAINS]	CM	1.02E-06	6.52E-07
		PM	5.20E-07	3.73E-07
(9)	PROPOSED TOTAL DOWNTIME (HRS/YR/TRAIN)	CM	24	24
		PM	208	208
(10)	ASSUMED MEAN DURATION (HRS/DOWNTIME EVENT) [= (9) / (6)]	CM	24	24
		PM	69	69
(11)	SINGLE AOT RISK FOR ASSUMED MEAN DURATION [= (3)/HR * (10)]	CM	7.30E-08	4.66E-08
		PM	3.56E-08	2.55E-08
(12)	YEARLY AOT RISK FOR ASSUMED MEAN DURATION [= (11) * (6) * 2 TRAINS]	CM	1.46E-08	9.31E-8
		PM	2.13E-07	1.53E-07

RG 1.174 (Reference 3) discusses acceptance criteria for changes in CDF and LERF. RG 1.174 indicates that a change in CDF of <1E-06 with a total CDF of <1E-04 and a change in LERF of <1E-7 with a total LERF of <1E-05 is considered very small. As can be seen in Table 3S, the change in the average CDF assuming the proposed LPSI unavailability is <1E-06 for the sensitivity study results. Table 4S shows that the change in the average LERF assuming the proposed LPSI unavailability is <1E-07 for the sensitivity study. The proposed change in CDF and LERF due to the proposed AOT extension is, therefore, considered very small.

Table 3S (Operator Action Sensitivity Study) PROPOSED AVERAGE CDF		
Parameter	St. Lucie Unit 1	St. Lucie Unit 2
LPSI System Success Criteria	1 of 2	1 of 2
Present AOT, days	3	3
Proposed AOT, days	7	7
Proposed Downtime, hrs/train/yr.	232	232
Average CDF, base, per yr.	3.47E-05	2.90E-05
Proposed Average CDF, per yr., using LPSI T/M set at Proposed Downtime value	3.49E-05	2.91E-05

Table 4S (Operator Action Sensitivity Study) PROPOSED AVERAGE LERF				
	Early Containment Failure Probability = 0.01 (baseline)		* Early Containment Failure Probability = 0.1	
Parameter	St. Lucie Unit 1	St. Lucie Unit 2	St. Lucie Unit 1	St. Lucie Unit 2
Avg. base LERF per yr.	3.77E-06	6.18E-06	6.85E-06	8.76E-06
Proposed LERF, per yr., using LPSI T/M set at proposed downtime value	3.77E-06	6.18E-06	6.86E-06	8.78E-06

* Sensitivity evaluation (factor of 10 increase)

RG 1.177 (Reference 4) states that the licensee must demonstrate that the proposed AOT change has only a small quantitative impact on plant risk. Per Reference 4, an ICCDP of less than 5.0E-07 is considered small for a single AOT change. As is shown in Tables 5S, the ICCDP values for the proposed AOT extension are below the RG 1.177 specified values except for the Unit 1 CM case which is only slightly above 5E-07 (i.e., 5.11E-07). The ICCDP results for this study are considered small. Also per NRC RG 1.177, an ICLERP of less than 5.0E-08 is considered small for a single AOT change. For ICLERP, the Unit 1 CM case is slightly above these guidelines. However, this case also includes an increased early containment failure probability of 0.1, which is ten times the baseline assumption. Additionally, this potential risk increase must be balanced against the risks inherent in maneuvering the plant for a shutdown and potentially having to enter a mode where the LPSI pump is the only means of cooling, i.e., with one pump already out-of-service. This is especially true since the only case at issue is unplanned corrective maintenance, which implies a pump or train has failed and requires repair. It is arguable that it is safer to do so on line rather than to shutdown and be forced to rely on the only remaining pump or train. Finally, this study is intentionally quite conservative.

Table 5S (Operator Action Sensitivity Study) ICCDP RESULTS		
Parameter	St. Lucie Unit 1	St. Lucie Unit 2
ICCDP for Corrective Maintenance (CM) case	5.11E-07	3.24E-07
ICCDP for Preventive Maintenance (PM) case	8.64E-08	5.95E-08

Table 6S (Operator Action Sensitivity Study) ICLERP RESULTS				
	Early Containment Failure Probability = 0.01 (baseline)		*Early Containment Failure Probability = 0.1	
Case	St. Lucie Unit 1	St. Lucie Unit 2	St. Lucie Unit 1	St. Lucie Unit 2
CM	1.88E-08	5.94E-09	6.42E-08	3.53E-08
PM	2.11E-09	7.67E-10	9.78E-09	6.32E-09

* Sensitivity evaluation (factor of 10 increase)

It is judged that appropriate uncertainty issues are addressed by the combination of the sensitivity studies provided in the PLA and the additional sensitivity studies documented above.

3. Details of the peer review process, a summary of peer review findings, and a discussion of the independence of internal reviews/reviewers.

Response: Reference 5, section 5.2, and the response to Reference 6 question 2 provide a summary of the original IPE model peer review process. This information is repeated below:

Three levels of review were used for the St. Lucie PRA. The first consisted of normal engineering quality assurance carried out by the organization performing the analysis. A qualified individual with knowledge of PRA methods and plant systems performed an independent review of the results for each task. This represents a detailed check of the input to the PRA model and provides a high degree of quality assurance.

The second level of review was performed by plant personnel not directly involved with the development of the PRA model. This consisted of individuals from Operations, Technical, Training, and ISEG groups who reviewed the system description notebooks and accident sequence description. This provided diverse expertise with plant design and operations knowledge to review the system descriptions for accuracy.

The third level of review was performed by PRA experts from ERIN Engineering, FRH, Inc., NUS, and Baltimore Gas & Electric. This review provided broad insights on techniques and results based on experience from other plant PRAs. The review team concentrated on the overall PRA methodology, accident sequence analysis, system fault trees and draft quantification results. The intent was to provide early feedback to the St. Lucie staff concerning the adequacy and accuracy of the reviewed products.

It should be noted that the methodologies used for the St. Lucie Level I and Level II analyses were similar to those used for the Turkey Point PRA. The Turkey Point IPE submittal was thoroughly reviewed by the NRC staff and NRC contractors. The NRC review concluded that the process used to develop the Turkey Point PRA was acceptable in meeting the intent of GL-88-20.

The general areas of review were described above. The overall purpose of the review was to ensure the quality of the PRA project and to ensure that the project objectives were being met. The review team found that the project was successfully meeting those objectives with a sound methodology.

A summary of the peer review comment areas is as follows:

- The overall methodology reflects the current state of the art for PRAs and will meet the requirements of GL-88-20 (confirmed by the NRC St. Lucie IPE SER).
- The system description notebooks were very well organized and very complete.
- The event trees and success criteria used to support the systems analysis interface are consistent with those of other similar analyses.
- CST replenishment should be included for sequences where long-term cooling via AFW may be required (this was included for Unit1, not applicable for Unit 2).
- Units 1 and 2 data should be combined to formulate the plant-specific history (this was incorporated).

Another level of peer review is accomplished through the CEOG joint comparison process. The intent of this process is to provide a cross comparison of CE units PSA results to validate the plant specific results and conclusions. An example of the joint comparison process related to the proposed LPSI AOT change is provided in the response to Reference 6 question 3. Additional CEOG cross comparisons have been performed since issuance of Reference 6. A sensitivity study was performed to address differences identified in these cross comparisons that are judged to have the potential to impact the conclusions of the St. Lucie LPSI AOT evaluation. See response to question 2 above for additional information regarding the St. Lucie sensitivity study performed.

FPL has updated both the models and the reliability/unavailability databases for St. Lucie Units 1 and 2. The updated models and databases were then used to re-calculate the risk numbers in support of the requested St. Lucie LPSI AOT extension. The significant model and data changes are summarized in Section 3.2.2 of the St. Lucie proposed license amendment (Reference 1) and in the response to question 2 above. As discussed in Reference 1, outside peer review was not performed for the update because changes that were implemented are not extensive. One or more FPL PSA engineers implemented the changes, and a FPL PSA engineer not involved with implementation of the changes performed an independent review.

4. Description of PRA Quality Assurance methods.

Response: As noted in the response to question 2 above and in Reference 1, the models used for this PLA were generated using the IPE models developed in response to Generic Letter (GL) 88-20, Individual Plant Examination for Severe Accident Vulnerabilities, and associated supplements. The original development work was classified and performed as "Quality Related" under the FPL 10CFR Appendix B quality assurance program. The revision and applications of the PRA models and associated databases continue to be handled as Quality Related. Since the approval of the IPE, the FPL Reliability and Risk Assessment Group (RRAG) has maintained the PSA models consistent with the current plant configuration such that they are considered "living" models. The PSA models are updated for different reasons, including plant changes and modifications, procedure changes, accrual of new plant data, discovery of modeling errors, advances in PSA technology, and issuance of new industry PSA standards.

The update process ensures that the applicable changes are implemented and documented timely so that risk analyses performed in support of plant operation reflect the plant configuration, operating philosophy, and transient and component failure history. The PSA maintenance and update process is described in the FPL

RRAG standard "PSA Update and Maintenance Procedure". This standard defines two different types of periodic updates: 1) a data analysis update, and 2) a model update. The data analysis update is performed at least every five years. Model updates consist of either single or multiple PSA changes and are performed at a frequency dependent on the estimated impact of the accumulated changes. Guidelines to determine the need for a model update are provided in the standard. This includes written procedures, independent review of all model changes, data updates and risk assessments performed using PSA methods and models. Risk assessments are performed by one individual, independently reviewed by another and approved by the Department Head or designee. The PSA group falls under the FPL Engineering Quality Instructions with written procedures derived from those QIs. Procedures, risk assessment documentation, and associated records are controlled and retained as QA records.

All computer programs that process PSA model inputs are verified and validated as needed. The RRAG policy on verification and validation of QA controlled/procured software, as well as the verification and validation for software and computers when used for Quality Related applications are described in RRAG standard "PSA Software Control Procedure". This standard provides a list of all the software used by the RRAG and indicates whether the software is QA controlled/procured. Software verification is the process used to ensure the software meets the software requirement specifications. The PSA software that is procured with a QA option and is developed under a 10 CFR 50 Appendix B QA program does not require further software verification by the RRAG. However, the PSA software, which is not procured with a QA option can be verified by comparison of results to previously approved software. Validation of software is performed for different conditions such as: 1) a new installation of software, 2) any new database or configuration file changes issued by the RRAG, 3) unreasonable results, 4) change in computer configuration (software, hardware), and 5) use of software for Quality Related applications for the first time. Validation requirements for each Quality Related PSA computer program are documented in a Software Verification/Validation Plan (SVVP) procedure. These requirements include the method of validation, the frequency of validation, the documentation required and the acceptance criteria. A SVVP procedure is submitted for each program. Actual validation benchmark problems can exercise more than one program, but a separate Software Verification/ Validation Report (SVVR) must be submitted for each program. Each SVVP procedure and SVVR is independently reviewed and then approved by the RRAG supervisor. Software validation tests both the software and the hardware. Validation tests are also performed following any significant change in the hardware, operating system, or program or if the validation period established in the SVVP procedure expires. Sample formats for the SVVP and SVVR are provided in the Engineering Quality Instruction (conforming to the pertinent 10 CFR 50 Appendix B requirements) for computer software control.

5. Results of reviews of pertinent accident sequences and cut sets for modeling adequacy and completeness (with respect to this application)

Response: The results of the evaluations performed in support of the St. Lucie LPSI AOT extension request were reviewed by two PSA engineers (a preparer and an independent reviewer). Both concluded that the results were appropriate considering the inputs and assumptions used. It is judged, based on a review of the results, that the models are adequate for this application. The following summarizes the dominant cutsets:

Unit 1:

- Attachment 1 lists the top 10 Unit 1 baseline cutsets. This is the value shown in the PLA Tables 1 and 2 as the "Conditional CDF, per yr., 1 LPSI train not out for T/M". The dominant accident sequence is related to a "Small-Small" (1/2" to 3") LOCA initiating event with failures related to high pressure safety injection. Other cutsets in the top 10 are related to ATWS.

- Attachment 2 lists the top 10 Unit 1 cutsets for the corrective maintenance (CM) case. This is the value shown in the PLA Table 1 for "Conditional; CDF, per yr., 1 LPSI train unavailable". For this case, one LPSI train is assumed out-of-service for corrective maintenance and the common cause LPSI failures are set to the beta factor. The dominant sequence is related to a "Large" (>5") LOCA with common cause failure of LPSI pumps. Additional cutsets that are now in the top 10 (i.e., not in the baseline top 10) are related to a "Large" LOCA, one LPSI train out-of-service, and failures in the other LPSI train.

- Attachment 3 lists the top 10 Unit 1 cutsets for the preventive maintenance (PM) case. This is the value shown in the PLA Table 2 for "Conditional; CDF, per yr., 1 LPSI train unavailable". For this case, one LPSI train is assumed out-of-service for preventive maintenance and the common cause LPSI failures are set to 0.0. The dominant sequence is the same as the baseline case. Additional cutsets that are now in the top 10 (i.e., not in the baseline top 10) are related to a "Large" LOCA, one LPSI train out-of-service, and failures in the other LPSI train.

- Attachment 4 lists the top 10 Unit 1 cutsets for the new average CDF assuming the proposed LPSI downtime. This is the value shown in the PLA Table 3 for "Proposed Average CDF, per yr., using LPSI T/M set at proposed downtime value". For this case, the LPSI unavailability was changed based on the proposed downtime assuming an increased AOT. The dominant sequences are the same as the baseline case.

Unit 2:

- Attachment 5 lists the top 10 Unit 2 baseline cutsets. This is the value shown in the PLA Tables 1 and 2 as the "Conditional CDF, per yr., 1 LPSI train not out for T/M". The dominant accident sequence is related to a "Small-Small" LOCA with failures related to high pressure safety injection.

- Attachment 6 lists the top 10 Unit 2 cutsets for the CM case. The dominant sequences are the same as discussed above for the Unit 1 CM case.

- Attachment 7 lists the top 10 Unit 2 cutsets for the PM case. The dominant sequences are the same as discussed above for the Unit 1 PM case.

- Attachment 8 lists the top 10 Unit 2 cutsets for the new average CDF assuming the proposed LPSI downtime. The dominant sequences are the same as the baseline case.

6. Provide a summary of the plant procedures that address plant actions in response to external events (e.g., hurricanes, tornadoes, fires)

Response: The Administrative Procedure entitled "Hurricane Season Preparation" outlines the actions to be reviewed prior to the start of hurricane season, and the Administrative Procedure entitled "Severe Weather Preparations" provides instructions to be followed to prepare for severe weather (including tornadoes) or in response to a hurricane watch or warning. Actions to be taken include, but are not limited to:

- Installing intake structure missile shielding if removed,
- Topping off the diesel oil storage tanks,
- Removing the stoplogs from storage and prepare them for installation,
- Surveying the plant site, removing trash and debris, and secure loose equipment,
- Closing Reactor Auxiliary Building outside doors and roof hatches, and

- Placing station batteries on equalizing charge.

The Administrative Procedure entitled "Hurricane Staffing" provides instructions for staffing in preparation of a hurricane.

The Emergency Plan Implementing Procedure entitled "Duties and Responsibilities of the Emergency Coordinator" provides the criteria for unit shutdown if a hurricane warning is in effect, and either one or both Unit(s) is/are in Mode 1, 2 or 3. The shutdown criteria is as follows:

- For storms projected to reach a Category 1 or 2, the unit(s) shall be placed in HOT STANDBY (Mode 3) or below at least two (2) hours before the projected onset of sustained hurricane force winds at the site and both units shall remain off-line for the duration of the hurricane force winds (or restoration of reliable offsite power).

- For storms projected to reach Category 3, 4 and 5 prior to landfall, the units shall be shut down to a temperature less than 350 degrees T ave. at least two (2) hours before the projected onset of sustained hurricane force winds at the site and both units shall remain off-line for the duration of the hurricane force winds (or restoration of reliable offsite power).

The Emergency Plan Implementing Procedure entitled "Classification of Emergencies" provides instructions on the classification of emergencies at the St. Lucie plant. The procedure includes criteria for emergency classification of events related to hurricanes, tornadoes, abnormal water level, and fires.

The Off-Normal Operating Procedure entitled "Response To Fire" provides operator actions for responding to a fire at each St. Lucie Unit. These procedures provide specific guidance to the operator for performing a safe shutdown fire impact assessment and direction as to which mode to place the unit in if the fire challenges continued unit operation or stable plant conditions. Additional procedures provide fire-fighting strategies to assist the fire brigade in combating the fire.

REFERENCES

1. FPL letter L-99-079, J.A Stall (FPL) to NRC (DCD), St. Lucie Unit 1 and Unit 2, Docket Nos. 50-335 and 50-389, Proposed License Amendments, *"LPSI System Risk Informed AOT Extension"*, June 1, 1999.

2. CE NPSD-995, *"Joint Applications Report For Low Pressure Safety Injection System AOT Extension"*, May 1995.

3. Regulatory Guide 1.174, *"An Approach for Using Probabilistic Risk Assessment in Decisions on Plant Specific Changes to the Licensing Basis"*, July 1998.

4. Regulatory Guide 1.177, *"An Approach for Plant-Specific Risk-Informed Decisionmaking: Technical Specifications"*, August 1998.

5. FPL letter L-93-301, D.A. Sager (FPL) to NRC (DCD), St. Lucie Units 1 and 2, Docket Nos. 50-335 and 50-389, *"Summary Report of Individual Plant Examination for Severe Accident Vulnerabilities - Generic Letter 88-20"*, December 9, 1993.

6. CEOG letter CEOG-96-254, D.F. Pilmer (CEOG) to Christopher I. Grimes (NRC), *"CEOG Response To Request For Additional Information (RAI) Related To The CEOG Joint Applications Reports"*, June 14, 1996.

ATTACHMENT 1

Unit 1 Conditional CDF w/1 LPSI Train Not Out for T/M (Baseline)

Total Frequency = 1.44E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM1AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FTC DUE TO COMMON CAUSES	5.44E-04	
2	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.26E-06
	GMM1MRMOV	MINIMUM RECIRC LINE MOTOR VALVES TRANSFER CLOSED	4.19E-04	
3	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM1FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
4	%ZZT1U1	REACTOR TRIPS	1.90E+00	8.38E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZMTCUNF1	MODERATOR TEMPERATURE COEFFICIENT UNFAVORABLE (UNIT 1)	2.10E-01	
5	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM1MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
6	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	4.17E-07
	GMM1MPACCF	COMMON CAUSE FAILURE OF HPSI PUMPS TO START	1.38E-04	
7	%ZZCCWU1	LOSS OF CCW	9.41E-04	2.82E-07
	RTOP1S1RCP	OPERATOR FAILS TO SECURE RCPS FOLLOWING LOSS OF SEAL COOLING	3.00E-04	
8	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	2.28E-07
	GMM1HCVCCF	COMMON CAUSE FAILURE OF HPSI INJECTION VALVES TO OPEN	7.58E-05	
9	%ZZT3AU1	LOSS OF MAIN FEEDWATER BUT RECOVERABLE	4.34E-01	1.91E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZMTCUNF1	MODERATOR TEMPERATURE COEFFICIENT UNFAVORABLE (UNIT 1)	2.10E-01	
10	%ZZT1U1	REACTOR TRIPS	1.90E+00	1.38E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZ1ABKSHUT	'A' BLK VLV CLOSE W/POWER	4.36E-02	
	ZZMTCNUNF1	MTC NOT UNFAVORABLE (UNIT 1)	7.90E-01	

ATTACHMENT 2

Unit 1 Conditional CDF w/1 LPSI Train Unavailable for CM Case

Total Frequency = 3.21E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZAU1	LARGE LOCA	5.85E-05	6.44E-06
	JMM1MPACFI	COMMON CAUSE FAILURE OF LPSI PUMPS TO START DURING INJECTION	1.10E-01	
2	%ZZAU1	LARGE LOCA	5.85E-05	6.44E-06
	JMM1MPFCFI	COMMON CAUSE FAILURE OF LPSI PUMPS TO RUN DURING INJECTION	1.10E-01	
3	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM1AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FTC DUE TO COMMON CAUSES	5.44E-04	
4	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.26E-06
	GMM1MRMOV	MINIMUM RECIRC LINE MOTOR VALVES TRANSFER CLOSED	4.19E-04	
5	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM1FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
6	%ZZT1U1	REACTOR TRIPS	1.90E+00	8.38E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZMTCUNF1	MODERATOR TEMPERATURE COEFFICIENT UNFAVORABLE (UNIT 1)	2.10E-01	
7	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM1MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
8	%ZZAU1	LARGE LOCA	5.85E-05	5.76E-07
	JMVK13207S	MOTOR-OPERATED VALVE V3207 TRANSFERS CLOSED DURING STANDBY	9.85E-03	
	JTM1PUMPA	LPSI PUMP A IN TEST OR MAINTENANCE	1.00E+00	
9	%ZZAU1	LARGE LOCA	5.85E-05	5.52E-07
	JMM1PBFTRI	FAILURE OF LPSI PUMP B TO RUN DURING INJECTION	9.44E-03	
	JTM1PUMPA	LPSI PUMP A IN TEST OR MAINTENANCE	1.00E+00	
10	%ZZAU1	LARGE LOCA	5.85E-05	5.16E-07
	JMVR13-1BS	MOTOR-OPERATED VALVE MV-03-1B TRANSFERS OPEN DURING STANDBY	8.81E-03	
	JTM1PUMPA	LPSI PUMP A IN TEST OR MAINTENANCE	1.00E+00	

ATTACHMENT 3

Unit 1 Conditional CDF w/1 LPSI Train Unavailable for PM Case

Total Frequency = 1.75E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM1AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FTC DUE TO COMMON CAUSES	5.44E-04	
2	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.26E-06
	GMM1MRMOV	MINIMUM RECIRC LINE MOTOR VALVES TRANSFER CLOSED	4.19E-04	
3	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM1FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
4	%ZZT1U1	REACTOR TRIPS	1.90E+00	8.38E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZMTCUNF1	MODERATOR TEMPERATURE COEFFICIENT UNFAVORABLE (UNIT 1)	2.10E-01	
5	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM1MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
6	%ZZAU1	LARGE LOCA	5.85E-05	5.76E-07
	JMVK13207S	MOTOR-OPERATED VALVE V3207 TRANSFERS CLOSED DURING STANDBY	9.85E-03	
	JTM1PUMPA	LPSI PUMP A IN TEST OR MAINTENANCE	1.00E+00	
7	%ZZAU1	LARGE LOCA	5.85E-05	5.52E-07
	JMM1PBFTRI	FAILURE OF LPSI PUMP B TO RUN DURING INJECTION	9.44E-03	
	JTM1PUMPA	LPSI PUMP A IN TEST OR MAINTENANCE	1.00E+00	
8	%ZZAU1	LARGE LOCA	5.85E-05	5.16E-07
	JMVR13-1BS	MOTOR-OPERATED VALVE MV-03-1B TRANSFERS OPEN DURING STANDBY	8.81E-03	
	JTM1PUMPA	LPSI PUMP A IN TEST OR MAINTENANCE	1.00E+00	
9	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	4.17E-07
	GMM1MPACCF	COMMON CAUSE FAILURE OF HPSI PUMPS TO START	1.38E-04	
10	%ZZAU1	LARGE LOCA	5.85E-05	3.34E-07
	JMM1PBFTSI	FAILURE OF LPSI PUMP B TO START DURING INJECTION	5.72E-03	
	JTM1PUMPA	LPSI PUMP A IN TEST OR MAINTENANCE	1.00E+00	

ATTACHMENT 4

Unit 1 Proposed Average CDF Using LPSI T/M Set at Proposed Downtime Value

Total Frequency = 1.45E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM1AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FTC DUE TO COMMON CAUSES	5.44E-04	
2	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	1.26E-06
	GMM1MRMOV	MINIMUM RECIRC LINE MOTOR VALVES TRANSFER CLOSED	4.19E-04	
3	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM1FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
4	%ZZT1U1	REACTOR TRIPS	1.90E+00	8.38E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZMTCUNF1	MODERATOR TEMPERATURE COEFFICIENT UNFAVORABLE (UNIT 1)	2.10E-01	
5	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM1MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
6	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	4.17E-07
	GMM1MPACCF	COMMON CAUSE FAILURE OF HPSI PUMPS TO START	1.38E-04	
7	%ZZCCWU1	LOSS OF CCW	9.41E-04	2.82E-07
	RTOP1S1RCP	OPERATOR FAILS TO SECURE RCPS FOLLOWING LOSS OF SEAL COOLING	3.00E-04	
8	%ZZS1U1	SMALL-SMALL LOCA	3.01E-03	2.28E-07
	GMM1HCVCCF	COMMON CAUSE FAILURE OF HPSI INJECTION VALVES TO OPEN	7.58E-05	
9	%ZZT3AU1	LOSS OF MAIN FEEDWATER BUT RECOVERABLE	4.34E-01	1.91E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZMTCUNF1	MODERATOR TEMPERATURE COEFFICIENT UNFAVORABLE (UNIT 1)	2.10E-01	
10	%ZZT1U1	REACTOR TRIPS	1.90E+00	1.38E-07
	NMM1CEDM	MECHANICAL FAULT PREVENTING ROD INSERTION	2.10E-06	
	ZZ1ABKSHUT	'A' BLK VLV CLOSE W/POWER	4.36E-02	
	ZZMTCNUNF1	MTC NOT UNFAVORABLE (UNIT 1)	7.90E-01	

ATTACHMENT 5

Unit 2 Conditional CDF w/1 LPSI Train Not Out for T/M (Baseline)

Total Frequency = 1.25E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM2AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FAIL TO CLOSE DUE TO COMMON CAUSES	5.44E-04	
2	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	9.90E-07
	GMM2SMVCCF	COMMON CAUSE FAILURE OF SUMP OUTLET MOTOR VALVES TO OPEN	3.29E-04	
3	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM2FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
4	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM2MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
5	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	4.17E-07
	GMM2MPACCF	COMMON CAUSE FAILURE OF HPSI PUMPS TO START	1.38E-04	1.38E-04
6	%ZZCCWU2	LOSS OF CCW	9.41E-04	2.82E-07
	RTOP2S1RCP	OPERATOR FAILS TO SECURE RCPS FOLLOWING LOSS OF SEAL COOLING	3.00E-04	
7	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	2.28E-07
	GMM2HCVCCF	COMMON CAUSE FAILURE OF HPSI INJECTION VALVES TO OPEN	7.58E-05	
8	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.56E-07
	GMVR23523	MOTOR-OPERATED VALVE V3523 TRANSFERS OPEN DURING STANDBY	1.80E+01	8.81E-03
	GMVR23551	MOTOR-OPERATED VALVE V3551 TRANSFERS OPEN	6.00E+00	5.88E-03
9	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.56E-07
	GMVR23540	MOTOR-OPERATED VALVE 3540 TRANSFERS OPEN DURING STANDBY	1.80E+01	8.81E-03
	GMVR23550	MOTOR-OPERATED VALVE V3550 TRANSFERS OPEN	6.00E+00	5.88E-03
10	%ZZDC2B	LOSS OF DC BUS 2B FOR UNIT 2	1.07E-03	1.03E-07
	NMM2TCBCCF	COMMON CAUSE FAILURE OF THE TRIP CIRCUIT BREAKERS	9.60E-05	

ATTACHMENT 6

Unit 2 Conditional CDF w/1 LPSI Train Unavailable for CM Case

Total Frequency = 2.91E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZAU2	LARGE LOCA	5.85E-05	6.44E-06
	JMM2MPACFI	COMMON CAUSE FAILURE OF LPSI PUMPS TO START DURING INJECTION	1.10E-01	
2	%ZZAU2	LARGE LOCA	5.85E-05	6.44E-06
	JMM2MPFCFI	COMMON CAUSE FAILURE OF LPSI PUMPS TO RUN DURING INJECTION	1.10E-01	
3	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM2AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FAIL TO CLOSE DUE TO COMMON CAUSES	5.44E-04	
4	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	9.90E-07
	GMM2SMVCCF	COMMON CAUSE FAILURE OF SUMP OUTLET MOTOR VALVES TO OPEN	3.29E-04	
5	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM2FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
6	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM2MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
7	%ZZAU2	LARGE LOCA	5.85E-05	5.76E-07
	JMVK23306S	MOTOR-OPERATED VALVE FCV-3306 TRANSFERS CLOSED DURING STANDBY	1.80E+01	9.85E-03
	JTM2PUMPB	2B LPSI/SDC PUMP OUT FOR TEST OR MAINTENANCE	1.00E+00	
8	%ZZAU2	LARGE LOCA	5.85E-05	5.16E-07
	JMVR23536S	MOTOR-OPERATED VALVE V3536 TRANSFERS OPEN DURING STANDBY	1.80E+01	8.81E-03
	JTM2PUMPB	2B LPSI/SDC PUMP OUT FOR TEST OR MAINTENANCE	1.00E+00	
9	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	4.17E-07
	GMM2MPACCF	COMMON CAUSE FAILURE OF HPSI PUMPS TO START	1.38E-04	
10	%ZZAU2	LARGE LOCA	5.85E-05	3.34E-07
	JMM2PAFTSI	FAILURE OF LPSI PUMP A TO START DURING INJECTION	5.72E-03	
	JTM2PUMPB	2B LPSI/SDC PUMP OUT FOR TEST OR MAINTENANCE	1.00E+00	

ATTACHMENT 7

Unit 2 Conditional CDF w/1 LPSI Train Unavailable for PM Case

Total Frequency = 1.55E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM2AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FAIL TO CLOSE DUE TO COMMON CAUSES	5.44E-04	
2	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	9.90E-07
	GMM2SMVCCF	COMMON CAUSE FAILURE OF SUMP OUTLET MOTOR VALVES TO OPEN	3.29E-04	
3	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM2FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
4	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM2MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
5	%ZZAU2	LARGE LOCA	5.85E-05	5.76E-07
	JMVK23306S	MOTOR-OPERATED VALVE FCV-3306 TRANSFERS CLOSED DURING STANDBY	9.85E-03	
	JTM2PUMPB	2B LPSI/SDC PUMP OUT FOR TEST OR MAINTENANCE	1.00E+00	
6	%ZZAU2	LARGE LOCA	5.85E-05	5.16E-07
	JMVR23536S	MOTOR-OPERATED VALVE V3536 TRANSFERS OPEN DURING STANDBY	8.81E-03	
	JTM2PUMPB	2B LPSI/SDC PUMP OUT FOR TEST OR MAINTENANCE	1.00E+00	
7	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	4.17E-07
	GMM2MPACCF	COMMON CAUSE FAILURE OF HPSI PUMPS TO START	1.38E-04	
8	%ZZAU2	LARGE LOCA	5.85E-05	3.34E-07
	JMM2PAFTSI	FAILURE OF LPSI PUMP A TO START DURING INJECTION	5.72E-03	
	JTM2PUMPB	2B LPSI/SDC PUMP OUT FOR TEST OR MAINTENANCE	1.00E+00	
9	%ZZAU2	LARGE LOCA	5.85E-05	3.16E-07
	JMM2PAFTRI	FAILURE OF LPSI PUMP A TO RUN DURING INJECTION	5.40E-03	
	JTM2PUMPB	2B LPSI/SDC PUMP OUT FOR TEST OR MAINTENANCE	1.00E+00	
10	%ZZCCWU2	LOSS OF CCW	9.41E-04	2.82E-07
	RTOP2S1RCP	OPERATOR FAILS TO SECURE RCPS FOLLOWING LOSS OF SEAL COOLING	3.00E-04	

ATTACHMENT 8

Unit 2 Proposed Average CDF Using LPSI T/M Set at Proposed Downtime Value

Total Frequency = 1.26E-05/yr.

#	Inputs	Description	Event Prob	Cutset Probability
1	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.64E-06
	CMM2AVCCCF	N-HEADER AIR OPERATED ISOLATION VALVES FAIL TO CLOSE DUE TO COMMON CAUSES	5.44E-04	
2	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	9.90E-07
	GMM2SMVCCF	COMMON CAUSE FAILURE OF SUMP OUTLET MOTOR VALVES TO OPEN	3.29E-04	
3	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	8.87E-07
	GMM2FTRCFI	COMMON CAUSE FAILURE OF HPSI PUMPS TO RUN DURING INJECTION	2.95E-04	
4	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	5.78E-07
	QMM2MVCCCF	ICW MOTOR OPERATED VALVES FAIL TO CLOSE DUE TO COMMON CAUSE FAILURES	1.92E-04	
5	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	4.17E-07
	GMM2MPACCF	COMMON CAUSE FAILURE OF HPSI PUMPS TO START	1.38E-04	
6	%ZZCCWU2	LOSS OF CCW	9.41E-04	2.82E-07
	RTOP2S1RCP	OPERATOR FAILS TO SECURE RCPS FOLLOWING LOSS OF SEAL COOLING	3.00E-04	
7	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	2.28E-07
	GMM2HCVCCF	COMMON CAUSE FAILURE OF HPSI INJECTION VALVES TO OPEN	7.58E-05	
8	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.56E-07
	GMVR23523	MOTOR-OPERATED VALVE V3523 TRANSFERS OPEN DURING STANDBY	8.81E-03	
	GMVR23551	MOTOR-OPERATED VALVE V3551 TRANSFERS OPEN	5.88E-03	
9	%ZZS1U2	SMALL-SMALL LOCA	3.01E-03	1.56E-07
	GMVR23540	MOTOR-OPERATED VALVE 3540 TRANSFERS OPEN DURING STANDBY	8.81E-03	
	GMVR23550	MOTOR-OPERATED VALVE V3550 TRANSFERS OPEN	5.88E-03	
10	%ZZDC2B	LOSS OF DC BUS 2B FOR UNIT 2	1.07E-03	1.03E-07
	NMM2TCBCCF	COMMON CAUSE FAILURE OF THE TRIP CIRCUIT BREAKERS	9.60E-05	