FPL

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

December 4, 2000

L-2000-236
10 CFR 50.90

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

RE: St. Lucie Unit 1
Docket No. 50-335
Proposed License Amendment
Main Steam Line Break Crediting Non-Safety
Main Feedwater and Condensate Pump Trips

Pursuant to 10 CFR 50.90, Florida Power and Light Company (FPL) requests to amend Facility Operating License DPR-67 for St. Lucie Unit 1 by incorporating a change to the licensing bases for Unit 1. The proposed license amendment will revise the Unit 1 UFSAR main steam line break (MSLB) inside containment analysis to correct non-conservative assumptions used in the original analysis. The new analysis of the MSLB terminates feedwater addition to the faulted steam generator by crediting MFIV closure and tripping the main feedwater and condensate pumps. This change to the St. Lucie Unit 1 MSLB analysis is required to resolve an existing Generic Letter 91-18 degraded but operable condition regarding the postulated peak pressure during a MSLB inside containment. Probabilistic insights into this change to the licensing bases are also provided.

Attachment 1 is an evaluation of the proposed changes. Attachment 2 is the "Determination of No Significant Hazards Consideration." Attachment 3 contains a copy of the St. Lucie Unit 1 UFSAR pages marked-up to show the proposed changes.

The proposed amendment has been reviewed by the St. Lucie Facility Review Group and the FPL Company Nuclear Review Board. In accordance with 10 CFR 50.91 (b) (1), copies of the proposed amendment are being forwarded to the State Designee for the State of Florida. Please contact us if there are any questions about this submittal.

A001

FPL requests that this amendment be reviewed and approved before the upcoming Unit 1 SL1-17 refueling outage tentatively scheduled to start April 2001. FPL requests an implementation date of May 1, 2001 to coincide with the end of the SL1-17 outage.

Very truly yours,

Rajiv S. Kundalkar
Vice President
St. Lucie Plant

RSK/EJW/KWF

Attachments

cc: Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant
Mr. W. A. Passetti, Florida Department of Health and Rehabilitative Services

STATE OF FLORIDA)
) ss.
COUNTY OF ST. LUCIE)

Rajiv S. Kundalkar being first duly sworn, deposes and says:

That he is Vice President, St. Lucie Plant, for the Nuclear Division of Florida Power and Light Company, the Licensee herein;

That he has executed the foregoing document; that the statements made in this document are true and correct to the best of his knowledge, information and belief, and that he is authorized to execute the document on behalf of said Licensee.

Rajiv S. Kundalkar

STATE OF FLORIDA

COUNTY OF St. Lucie

Sworn to and subscribed before me

this 4th day of December, 2000

by Rajiv S. Kundalkar, who is personally known to me.

Signature of Notary Public-State of Florida

Leslie J. Whitwell
MY COMMISSION # CC646183 EXPIRES
May 12, 2001
BONDED THRU TROY FAIN INSURANCE, INC.

Name of Notary Public (Print, Type, or Stamp)

Attachment 1 to FPL Letter L-2000-236

EVALUATION OF PROPOSED CHANGE

TO THE ST. LUCIE UNIT 1 MSLB ANALYSIS

Introduction

Pursuant to 10 CFR 50.90, Florida Power and Light Company (FPL) requests to amend Facility Operating License DPR-67 for St. Lucie Unit 1 by incorporating a change to the licensing bases for Unit 1. The proposed license amendment will revise the Unit 1 UFSAR to reflect the new main steam line break (MSLB) analysis treatment of a hypothesized single failure of a main feedwater isolation valve (MFIV). The new analysis of the MSLB terminates feedwater addition to the faulted steam generator by crediting MFIV closure and tripping the main feedwater (MFW) and condensate pumps.

Background/Discussion

This change to the St. Lucie Unit 1 MSLB analysis is required to resolve an existing Generic Letter (GL) 91-18 degraded, but operable condition regarding the postulated peak pressure during a MSLB inside containment. In December 1998 the draft results of a Unit 1 main steam line break containment re-analysis indicated an unexpected higher peak containment pressure of 55.9 psig. The Unit 1 containment design pressure is 44 psig. The cause for the higher peak pressure in the re-analyzed MSLB event is that non-conservative assumptions were used in the original analysis of record. The original MSLB analysis of record was developed jointly between Combustion Engineering (mass energy input) and Ebasco (containment performance). This analysis considered a spectrum of break sizes, initial power levels, and single failures.

The CONTEMPT computer code was used by Ebasco for the current MSLB containment pressure and temperature response calculations. The code used to calculate the mass and energy release to the containment for steam line breaks is Combustion Engineering code SGNIII (reference 3).

These codes assumed that for the worst case single failure (i.e., failure of a MFIV) to close and the subsequent main feed pump discharge isolation valve closure in 60 seconds after receipt of the main steam isolation signal (MSIS)) approximately 107,000 pounds of feedwater are added to the faulted steam generator. The analysis assumed that the MFW pump operates at runout flow during valve closure and further that all of the high temperature fluid in the feedwater lines to the furthest isolation valve flashes into the containment.

Feedwater Flow and Isolation Non-Conservatisms

During review of the GL 89-10 motor operated valve (MOV) program, concerns with the MFIVs were identified with respect to feedwater assumptions used in the original MSLB analysis. Specifically, the feedwater flow isolation was assumed as a 60-second linear ramp. Actual valve characteristics for the MFIVs are more consistent with a step change in flow at 60 seconds. Additionally, other non-conservatisms were identified.

When these non-conservatisms were corrected and input to the MSLB licensing bases analysis, the containment peak pressure exceeded the containment design pressure. This condition was reported to the NRC via LER 50-335/1998-009 (reference 4).

Description of the Proposed Changes

For St. Lucie Unit 1, the main steam isolation signal (MSIS) is provided to terminate blowdown of steam from the steam generators and normal feedwater flow to the steam generators in the event of a steam line break accident. The MSIS measurement channels include four steam generator pressure transmitters for each steam generator. The signals from the four sensors for each steam generator are combined in a two-out-of-four logic to provide closure of both main steam isolation valves (MSIVs), both MFIVs, and both MFW pump discharge valves on low steam generator pressure. A MSIS signal on either channel will close the MSIV and MSIV bypass valve, the MFIV, and MFW pump discharge valve on that channel and send a signal through an isolation relay to close the MSIV and MSIV bypass valve, the MFIV, and the MFW pump discharge valve of the other channel. In the event of a steam line break accident at least one MSIV closes, limiting blowdown to a single steam generator. Additionally, for MFIV single failure considerations the MSLB analysis of record credits closing of the MFW pump discharge valves.

FPL elected to resolve the MSLB analysis issues by limiting the feedwater flow into the faulted steam generator with the use of rapid feedwater isolation. When the MSLB analysis of record uses conservative inputs and rapid feedwater isolation, the results are bounded by the design containment pressure. However, the current MOVs for the MFIVs and main feedwater pump discharge valves lack the design margins necessary to ensure rapid valve closure. FPL will be implementing a plant modification during the 2001 SL1-17 refueling outage to ensure that one main feedwater valve per train will close within the time constraints supported by the new MSLB analysis. In addition, FPL proposes to change the MSLB feedwater addition single failure analysis of the safety related MFIVs by crediting a backup trip of the non-safety grade MFW and condensate pumps from the safety grade MSIS trip signal. Although the MFW pump trip modification was implemented during the 1999 St. Lucie Unit 1 SL1-16 refueling outage (reference 1), this feature is not currently credited in the MSLB analysis. The condensate pump trip modification will be implemented during the 2001 SL1-17 refueling outage.

Justification of The Proposed Changes

Use of A Non-Safety Backup Trip

NUREG-0800, Rev 2, “Standard Review Plan,” (reference 2) allows crediting the use of a non-safety system backup system to mitigate the effects of the failure of an active safety related component. Section 6.2.1.4, "Mass And Energy Release Analysis For Postulated Secondary System Pipe Ruptures," states that:

> *"A single active failure in the steam or feedwater line isolation provisions or feedwater pumps, such that the containment peak pressure and temperature are maximized, should be assumed to occur in steam and feedwater line break analyses. For the assumed failure of a safety grade steam or feedwater line isolation valve, operation of nonsafety grade equipment may be relied upon as a backup to the safety grade equipment."*

Section 15.1.5, "Steam System Piping Failures Inside And Outside Of Containment (PWR)," states that:

> *"For postulated instantaneous pipe failures in seismically qualified portions of the main steam line (inside containment and upstream of the MSIVs), only safety grade equipment should be assumed operative. If, in addition, a single malfunction or failure of an active component is postulated, credit may be taken for the use of a backup nonsafety grade component to mitigate the consequences of the break."*

Therefore, the use of a non-safety backup trip to mitigate a postulated active failure of safety related components is allowed by the Standard Review Plan.

Design of the Non-Safety Backup Trip

FPL implemented a trip of the non-safety related MFW pumps from a signal from the safety related MSIS. The design added MSIS-A and MSIS-B trips to the 1A and 1B MFW pump breaker control circuits. This non-safety backup trips both MFW pumps on MSIS A or MSIS B signals. This diverse trip signal provides a high degree of assurance that rapid feedwater isolation will occur when a MSIS signal is generated. The design of the new engineered safety features actuation signal (ESFAS) trip circuits is such that failure of one channel does not prevent a pump trip by the redundant channel.

The design includes the installation of two isolation/trip relays in an enclosure to maintain electrical separation between the safety related MSIS trip circuitry and the non-safety related pump breaker control circuitry. The enclosure is seismically mounted. The isolated MSIS signals are generated using fused SA and SB 125 VDC power and spare contacts on ESFAS relays. This signal is used to energize the isolation relay coils, which will then close trip contacts connected to the pump trip circuits. Cable and conduit installation complies with safety related electrical separation requirements. This includes separation of the SA and SB cables from the ESFAS cabinets to the new enclosure, a barrier to maintain separation in the enclosure where spatial separation is not attainable, and fuses to protect the cables and the 125 VDC power supplies from over-current.

The isolation relays are Nuclear Certified Class 1E devices. The test response spectrum (TRS) of the relays meets or exceeds the seismic requirements. Reliable operation of these devices is enhanced by the "energize to trip" design of the new trip circuits, since the coil and contacts will only be energized during testing or when an MSIS signal is present. The "energize to trip" design has no impact on normal operation of the plant, and since each relay trips all running pumps, a failure of one relay would not prevent a MSIS trip of the 1A and 1B MFW pump circuit breakers. The insulation resistance of 500 megohms (minimum) between non-connected terminals and the relay yoke provides the "contact to coil" isolation. Loading of the safety related 125 VDC system is not impacted by the addition of the isolation relays. The isolation relays will be normally de-energized, and are activated only on receipt of the MSIS trip.

The failure modes and effects analysis (FMEA) show that a circuit failure (short) would result in tripping the running MFW pumps, an event that may lead to a loss of feed transient. However, due to the energized to actuate design, this is less probable than existing postulated failures in the MSIS circuitry that would also lead to a loss of feedwater event. A circuit failure (open) would result in a failure of that protection channel to trip the MFW pumps. This failure, however, would not prevent manual tripping of the pumps from the control room or automatic tripping of the pumps by the redundant protection channel.

FPL concludes that the design of safety related portion of the non-safety backup MFW pump MSIS trip meets all applicable design requirements for the safety related MSIS system. The redundancy of the MSIS trip circuit provides reasonable assurance that the trip of the non-safety related MFW pumps is a highly reliable backup to the postulated failure of the MFIVs to close. The design for the non-safety condensate pump MSIS trip is in progress and will be similar to the MFW pump trip modification described above. The condensate pump trip will be implemented during the St. Lucie Spring 2001 refueling outage (SL1-17).

To ensure that the trip of the non-safety related MFW and condensate pumps remains a highly reliable backup function, procedures will be revised or developed to periodically test the trip function of the MFW and condensate pumps on receipt of a MSIS. In addition, the MFW and condensate pump breakers will be included in the St. Lucie Unit 1 Maintenance Rule monitoring program to ensure the continued reliability of the breakers.

Single Failure Effects on Feedwater Addition in the MSLB Analyses

This licensing basis change does not affect the original codes used for the MSLB containment response. The code of record was rerun using conservative inputs instead of the original non-conservative values. The new containment pressure and temperature response analysis for the MSLB event focused on a matrix of cases. This matrix included five different initial power levels and several single failures. The goal of the analysis is to maximize the severity of the mass and energy release, which in turn maximizes the containment pressure and temperature response. The updated MSLB containment analysis included a detailed single failure analysis. Each of these failures was evaluated at five different power levels: 102%, 75%, 50%, 25%, and 0%.

1. One containment spray pump fails to operate. This will leave one containment spray available.

2. The failure of a MFIV to close.

3. The failure of a MFW or condensate pump to trip.

4. Loss of offsite power (LOOP) and one emergency diesel fails to start, resulting in the loss of one spray train. This will leave one spray pump available. Reactor coolant pumps (RCPs) coast down on loss of power. This represents the loss of offsite power case.

The failure of a MFIV to close was not shown to be a limiting single failure. In the case of the MFIV failure, the MFW and condensate pump trip was credited. In accordance with the Standard Review Plan, Section 6.2.1.4, non-safety grade control systems may be utilized as a backup to the primary isolation. Therefore, the MFW and condensate pump trip was considered as backup to the MFIV. The MFW and condensate pumps trip on MSIS generated on low steam generator pressure. There is some diversity in terminating feedwater flow. Tripping the condensate pumps results in the loss of suction pressure for the MFW pumps such that the MFW pumps will not function even if a MFW pump fails to trip on low suction pressure or MSIS. The MSIS occurs slightly later than the safety injection isolation signal (SIAS), which initiates the closure of the MFIV. As an added conservatism, no credit was taken for the coast down of the MFW and condensate pumps with regard to limiting feedwater addition. Credit was taken for the closure of the MFW pump discharge valves to discount the flashing of the water volume upstream of the MFW pump discharge valves. For simplicity it was assumed that tripping the MFW and condensate pumps adds the same feedwater inventory to the faulted steam generator as in the MFIV failure scenario. This overall response remains bounded by the MFIV failure.

Therefore, FPL concludes that the change to the licensing bases to allow the use of the non-safety MFW and condensate pump trips has no adverse effect on the MSLB containment analyses.

Main Feedwater Isolation Design

The plant modification is presently being developed by FPL. The feedwater isolation valves in the seismically qualified portion of the feedwater line outside containment will be modified to ensure that the valves' closing times support the new MSLB containment response analysis. The modification will replace the installed motor operators on the MFIVs (original tag numbers MV-09-7 and MV-09-8) with pneumatic actuators (new tag numbers HCV-09-7 and HCV-09-8). Valve closure will be accomplished by directing high pressure gas (nitrogen or air) to the valve actuators via the actuation of redundant electrically operated solenoid valves and pneumatically operated pilot valves. The modification will comply with all applicable safety related design criteria including (but not limited to) the following:

- seismic
- class 1E electrical
- diesel/battery loading
- ASME Code requirements
- HELB requirements
- Environmental qualification
- Appendix R requirements

The plant modification will be implemented during the April 2001 St. Lucie Unit 1 refueling outage SL1-17.

Risk Insights to the Proposed Change to the Licensing Bases

A study of the potential risk impact of failure to isolate Unit 1 main feedwater was performed. The new analysis of the MSLB terminates feedwater addition to the faulted steam generator by crediting MFIV closure, or tripping of the MFW and condensate pump breakers. For the purposes of this analysis, termination of feedwater flow is successful by the tripping of the condensate pump breakers because without adequate suction pressure, the MFW pumps are not capable of delivering flow. Additionally, closure of the main feedwater (MFW) pump discharge valves (MV-09-1 and MV-09-2) is requisite to remove the flashing of the water volume contained in piping upstream of these valves from consideration in the assessment. This evaluation provides the probabilistic safety assessment of the change in reliability of feedwater termination between crediting the closure of redundant feedwater isolation valves versus crediting the closure of the MFIVs in conjunction with the trip of the condensate pump breakers and closure of the main feedwater (MFW) pump discharge valves.

MFW Isolation Failure Assumptions/Calculations:

1. Existing Design:

   The existing design has two MFIVs (MV-09-7/MV-09-8) and two MFW pump discharge valves (MV-09-1/MV-09-2). The MFIVs and MFW pump discharge valves have motor operators. This assessment assumes a 3E-03/demand failure rate for motor operated valve "fails to operate" (reference 5). A generic failure rate is used since plant specific data analysis for the MFW isolation valves was not performed for the Unit 1 probabilistic safety assessment (PSA).

Since the MFIV on the faulted steam generator (SG) or both of the MFW pump discharge valves must close to provide MFW isolation, the motor operated MFIV/MFW pump discharge valve failure to isolate probability =

$F_{MOV\text{-}OLD\ CLOSE}$ = 3E-03 * (3E-03 + 3E-03) = 1.80E-05

The failure mode "motor operated valve fails to remain closed" was also considered. The failure rate used is 5E-07/hr (reference 5). A 24-hour exposure time is conservatively assumed. The transfer open probability per valve is thus 24 hrs * 5E-07 /hr = 1.2E-05.

Since both the MFIV on the faulted SG and one of the MFW pump discharge valves must transfer open to fail MFW isolation, the motor operated MFIV failure to isolate probability due to transferring open =

$F_{MOV\text{-}OLD\ TRANSER}$ = 1.2E-05 * (1.2E-05 + 1.2E-05) = 2.88E-10

The total MFW isolation failure probability for the existing design =

$F_{MOV\text{-}OLD} = F_{MOV\text{-}OLD\ CLOSE} + F_{MOV\text{-}OLD\ TRANSER}$ = 1.80E-05 + 2.88E-10 = 1.80E-05

2. Proposed Design, Pneumatic operated MFIVs (HCV-09-7/HCV-09-8):

FPL proposes to replace the existing MFIV motor operators with fast acting pneumatic actuators. The following calculates the failure probability for the MFIVs with the new actuators.

Success criteria for MFW isolation: The MFIV on the faulted SG must close following a MSIS.

Since new valve actuators are to be installed for the MFIVs, no plant specific failure data is available. This assessment assumes a failure rate of 2E-03/demand for air operated valve "fails to operate" (reference 5).

Failure of the pneumatic operated MFIV on the faulted SG to close probability =

$F_{AOV\ CLOSE}$ = 2.00E-03

The failure mode of "air operated valve spurious operation" was also considered. The failure rate used is 5E-07/hr (reference 5). A 24-hour exposure time is conservatively assumed. The spurious operation probability per valve is thus 24 hrs * 5E-07 /hr = 1.20E-05.

The probability that the pneumatic operated MFIV on the faulted SG transfers open =

$F_{AOV\ TRANSER}$ = 1.20E-05

Each pneumatic MFIV will have an accumulator supplied with nitrogen. A relief valve will be installed on each accumulator. The failure mode of "relief valve spurious open" was also considered. The failure rate used is 3.9E-06/hr (reference 5). A 24-hour exposure time is conservatively assumed. The "spurious operation" probability per valve is thus 24 hrs * 3.9E-06/hr = 9.36E-05.

$F_{RV\ OPENS}$ = 9.36E-05

The total pneumatic MFIV isolation failure probability for the proposed design =

$F_{AOV} = F_{AOV\ CLOSE} + F_{AOV\text{-}\ TRANSER} + F_{RV\ OPENS}$
= 2.00E-03 + 1.20E-05 + 9.36E-05 = 2.11E-03

3. Condensate pump trip and MV-09-1 and MV-09-2 closure assumptions/failure calculation:

FPL will implement a backup trip of the non-safety related condensate pumps by adding safety related MSIS-A and MSIS-B trip signals to the breaker control circuits. This allows both condensate pumps to trip on MSIS-A or MSIS-B signals. Although the new trip circuit design is safety related, the actual pump breakers and control circuits are not safety related. These breakers are similar in design and vendor to safety related breakers used throughout the plant.

The baseline St. Lucie PSA 4.16/6.9 kV breaker "fails to operate" failure rate is used: 4.07E-03/demand. This failure rate incorporates St. Lucie Unit 1 specific breaker data, and is slightly greater than the failure rate for breakers (reference 5).

As discussed above, the assumed demand failure rate for MV-09-1 and MV-09-2 is 3-03/demand and the transfers open probability per valve (conservatively assuming a 24-hr. exposure) is 1.2E-05.

Probability of failure to isolate feedwater via condensate pump breakers and MV-09-1 and MV-09-2 =

$F_{BKRS\ OPEN} + F_{MOVS\ CLOSE} + F_{MOV\ TRANSFERS\ OPEN}$ = (2 * 4.07E-03) + (2* 3E-03) + (2 * 1.2E-05) = 1.42E-02

The failure probability of the MSIS signal from ESFAS would not change between the current and proposed design and, therefore, will not be included in the calculations.

4. Failure probability (proposed design)

- Probability of isolation via condensate pump breakers and MV-09-1 and MV-09-2 = failure of 1-of-2 pump breakers to open or failure of 1-of-2 valves to close w/MSIS signal.

- Probability of isolation via MFIVs = failure of the MFIV on the faulted SG to close or the MFIV on the faulted SG transferring open.

MFW isolation failure probability =

$(F_{BKRS\ OPEN} + F_{MOVS\ CLOSE} + F_{MOV\ TRANSFERS\ OPEN}) * F_{AOV}$ = 1.42E-02 * 2.11E-03 = 3.00E-05

Sensitivity Study:

Assume the highest failure to close on demand failure rate from the St. Lucie Unit 1 PSA is used for MV-09-1 and MV-09-2 (4.11E-03). Note that this failure rate is influenced by plant specific data.

Probability of failure to isolate feedwater via condensate pump breakers and MV-09-1 and MV-09-2 =

$(F_{BKRS\ OPEN} + F_{MOVS\ CLOSE} + F_{MOV\ TRANSFERS\ OPEN})$ = (2 * 4.07E-03) + (2* 4.11E-03) + (2 * 1.2E-05) = 1.64E-02

MFW isolation failure probability =

$(F_{BKRS\ OPEN} + F_{MOVS\ CLOSE} + F_{MOV\ TRANSFERS\ OPEN})$ * FAOV = 1.64E-02 * 2.11E-03 = 3.46E-05

Treatment of Dependencies:

The current design has two sets of motor operated valves. The two MFW pump discharge valves have safety related "A" 480 VAC motive power for the valve operators and the two MFIVs have safety related "B" 480 VAC motive power for the valve operators. The existing motor operated valves "fail as is" on loss of power. MSIS signals from either "A" or "B" safeguards train will close both sets of valves. SIAS signals from the same train will also close the valves.

The proposed design has one set of pneumatic operated MFIVs, and a trip of the condensate pumps in conjunction with closure of the MFW pump discharge valves. The MFIVs will each have an accumulator supplied with nitrogen. The accumulators will be safety related and Seismic Class I, with double check valves to isolate them from the (non-safety related) nitrogen supply system. Thus, the motive power for the proposed MFIVs is essentially a passive pre-charged system. Low accumulator pressure and low nitrogen supply pressure alarms will monitor the readiness of the accumulators to close the MFIVs upon demand. Nitrogen from the passive accumulator to close each MFIV will be admitted to the operator by either of two redundant solenoid valves, one powered from safety related "A" DC and the other powered from safety related "B" DC. MSIS signals from either "A" or "B" safeguards train will actuate both sets of solenoid valves on each MFIV, thus closing both MFIVs. The pneumatic operated MFIVs will "fail as is" on loss of nitrogen pressure or "fail open" on loss of both redundant trains of DC power. Control power for tripping the condensate pump breakers is from safety related "A" DC for the "A" condensate pump breaker and from safety related "B" DC for the "B" condensate pump breaker. Control power for both the MFIVs and the condensate pump breakers are thus supplied from safety related DC sources. The dependencies for the MFW pump discharge valves are the same for the existing and proposed designs.

Based on the discussion above and the comparisons summarized in Table 1, it is judged that the failure probability related to dependencies for the proposed design is less than or equal to that of the existing design.

Table 1
Dependency Summary

	Existing MFW Isolation Design	Proposed MFW Isolation Design
Power	• MFW pump discharge valves powered from safety related "A" 480 VAC. "B" DC power required for MSIS-B isolation device, "Fail As-Is" on loss of power • MFIVs powered from safety related "B" 480 VAC. "A" DC power required for MSIS-A isolation device, "Fail As-Is" on loss of power	• "A" and "B" safety related DC to each MFIV actuator (each actuator will have redundant "A" and "B" DC powered solenoids) • MFIVs "Fail open" on loss of DC power to both safety trains • MFW pump discharge valves powered from safety related "A" 480 VAC. "A" DC power required for MSIS-B isolation device, "Fail As-Is" on loss of power • "A" DC power is required for: - MSIS-B signal (isolation device) to "A" train MFIV solenoids - Condensate pump "A" and "B" MSIS-A signal - Condensate pump "A" breaker trip • "B" DC power is required for: - MSIS-A signal (isolation device) to "B" train MFIV solenoids - Condensate pump "A" and "B" MSIS-A signal - Condensate pump "B" breaker trip
Control Air	NA (motor operated valves)	• Accumulator for each MFIV with nitrogen (passive system) • No instrument air system dependency • Redundant solenoids for each MFIV • MFIVs "Fail As-Is' on loss of nitrogen
ESFAS Signal	• SIAS-A/MSIS-A signal to MFW pump discharge valves (also has MSIS-B signal via isolation relay) • SIAS-B/MSIS-B signal to one set of MFIVs (also has MSIS-A signal via isolation relay)	• SIAS-A/MSIS-A and MSIS-B via isolation relay to MFIV "A" train redundant solenoids • SIAS-B/MSIS-B and MSIS-A via isolation relay to MFIV "B" train redundant solenoids • MSIS-A to both condensate pump breakers via isolation relay • MSIS-B to both condensate pump breakers via isolation relay

Comparison of Risk for Current versus Proposed Design

The MFW isolation failure probability for the current design was calculated as 1.80E-05. The MFW isolation failure probability of the proposed design is calculated as 3.00E-05.

The St. Lucie initiating events that are assumed to result in a demand for MFW isolation are main steamline breaks upstream of the MSIVs and main feedline breaks in containment. The total St. Lucie PSA frequency for these initiating events is 2.63E-03/yr. The change in frequency of MFW isolation failure =

Base case: (3.00E-05 - 1.80E-05) * 2.63E-03/yr = 3.16E-08/yr.
Sensitivity case: (3.46E-05 - 1.80E-05) * 2.63E-03/yr = 4.37E-08/yr.

If it is conservatively assumed that failure of MFW isolation would lead directly to core damage and a large early release, the change in risk calculated for the base and sensitivity cases (3.16E-08/yr and 4.37E-08/yr respectively) would be considered very small per RG 1.174 (reference 6), Figures 3 and 4. The proposed change is judged, therefore, to be not risk significant.

Conclusion

Based on the above, FPL concludes that the proposed change to the MSLB containment response analyses is consistent with the Standard Review Plan. The plant modifications necessary to support this change, replacement of the MFIV actuators and implementation of the MFW and condensate pump breaker trips, will be performed pursuant to the requirements of 10 CFR 50.59. The modifications did not introduce any unacceptable failure modes and did not represent an Unreviewed Safety Question. In addition, FPL determined that this change to the licensing basis is not risk significant when compared to the existing design. This proposed change would simply allow these changes to be credited in the MSLB containment response.

References

1. PC/M 99101, Revision 0, "St. Lucie Plant Unit 1 MSLB Rapid Feedwater Isolation."

2. NUREG-0800, Rev 2, "Standard Review Plan."

3. St. Lucie Unit 1 UFSAR, Amendment 17.

4. Licensee Event Report 50-335/1998-009-00, "Non-Conservative MSLB Analysis Inputs Result in Operation of Facility Outside Design Bases."

5. NUREG/CR-4550, "Analysis Of Core Damage Frequency: Internal Events Methodology", Vol. 1, Table 8.2-5."

6. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis."

Attachment 2 to FPL Letter L-2000-236

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATION

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATION

Description of amendment request: Pursuant to 10 CFR 50.90, Florida Power and Light Company (FPL) requests to amend Facility Operating License DPR-67 for St. Lucie Unit 1 by incorporating a change to the licensing bases for Unit 1. The proposed license amendment will revise the Unit 1 UFSAR to reflect the new main steam line break (MSLB) analysis. The new analysis terminates feedwater addition to the faulted steam generator by crediting the closure of the main feedwater isolation valves (MFIVs) and tripping of the main feedwater (MFW) and condensate pumps. There is no safety significance associated with the proposed changes to the St. Lucie Unit 1 licensing basis.

Pursuant to 10 CFR 50.92, a determination may be made that a proposed license amendment involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated; (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. Each standard is discussed as follows.

1. Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.

   This amendment changes the licensing bases for the MSLB analysis to credit a trip of the non-safety MFW and condensate pumps as a backup method to terminate feedwater addition should a MFIV fail to close. This activity has no increase in the probability of a MSLB, as no physical changes are being made to the steam generators, main steam piping, and the normal operating temperatures and pressures for the main steam system remain unchanged. This activity also has no adverse effect on the consequences of an accident because the MSLB containment response is bounded by the new analysis. Main feedwater termination occurs during a postulated MSLB such that the containment design pressure is not exceeded. Although a circuit failure (short) in the MSIS backup trip of the MFW and condensate pump breakers would result in tripping the running MFW and condensate pumps, this is less probable due to the energized to actuate design than existing postulated failures in the MSIS circuitry that would also lead to a loss of feedwater event. Therefore, operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Operation of the facility in accordance with the proposed amendment would not create the possibility of a new or different kind of accident from any accident previously evaluated.

   This amendment changes the licensing bases for the MSLB analysis to credit a trip of the non-safety MFW and condensate pumps as a backup method to terminate feedwater addition should a MFIV fail to close. The physical modifications made to support the installation of the new pneumatic valve operators for the MFIVs and installation of the backup main steam isolation signal (MSIS) trip of the non-safety MFW and condensate pumps conform to all applicable design standards. Failure modes introduced by these changes are bounded by the original design, and no other physical changes were made to the plant. Therefore, operation of the facility in accordance with the proposed amendment would not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Operation of the facility in accordance with the proposed amendment would not involve a significant reduction in a margin of safety.

   This amendment changes the licensing bases for the MSLB inside containment response analysis to credit a trip of the non-safety MFW and condensate pumps as a backup method to terminate feedwater addition should a MFIV fail to close. This differs from the currently licensed analysis that credits the closure of redundant safety related valves for main feedwater termination single failure considerations. However, Sections 6.2.1.4 and 15.1.5 of the Standard Review Plan allows the use of a non-safety backup in response to a failure of safety related components with regards to mitigating the effects of the mass energy release of ruptured secondary piping inside containment. This change to the licensing bases is consistent with the guidance provided in the Standard Review Plan. In addition, a probabilistic safety assessment was performed to evaluate the change in main feedwater isolation reliability between crediting redundant safety related isolation valves or safety related isolation valves and trip of the non-safety MFW and condensate pumps. This assessment concluded that the change in reliability is not risk significant. Therefore, operation of the facility in accordance with the proposed amendment would not involve a significant reduction in a margin of safety.

Conclusion

Based on the above discussion and the supporting evaluation of changes to the licensing bases for the MSLB analyses, FPL has determined that the proposed license amendment involves no significant hazards consideration.

Environmental Consideration

The proposed license amendment changes requirements with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The proposed amendment involves no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite, and no significant increase in individual or cumulative occupational radiation exposure. FPL has concluded that the proposed amendment involves no significant hazards consideration and meets the criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) and that, pursuant to 10 CFR 51.22(b), an environmental impact statement or environmental assessment need not be prepared in connection with issuance of the amendments.

Attachment 3 to FPL Letter L-2000-236

ST. LUCIE UNIT 1 MARKED UP UFSAR PAGES

1.C LOCA Results

A summary of the containment peak pressure and temperature and peak CCW temperature results are provided in Table 6.2-1. Note that this is an overall summary table which compares the original design basis calculations with the updated analysis. Also listed are the relevant pressure and temperature criteria which were followed in the analysis. As can be seen from the summary table, the peak pressure and temperature from the updated analysis were from the single ended hot leg break case. The peak CCW temperature was from the Double-Ended Discharge Leg break case. Plots of the updated peak containment pressure and CCW temperature are provided in Figures 6.2-1A through 6.2-1C. As can be seen, each case is characterized by an initial blowdown peak followed for the cold leg cases by a reflood peak. The small bump further into the transient represents the switchover to the recirculation mode when relatively hot containment spray water is introduced to the containment. The CCW temperature profile depicts CCW temperature response as a function of the various heat loads coming on-line.

The peak pressure and temperature results are all very similar. Like any containment analysis, trade-offs in blowdown times, condensation intervals, safety injection assumptions, metal heat contribution, delays associated with active heat removal devices, among many other critical items, make the determination of the limiting case very difficult. It is only through the containment analysis computer codes that these competing effects are quantified to produce a meaningful result.

Each case was shown to meet the peak containment pressure and CCW temperature criteria. The peak containment pressure and temperature cases fell below the original design basis analysis results largely due to improved methods and enhanced computer codes. All updated cases were also shown to meet the SRP Section 6.2.1.3 criteria to demonstrate containment pressure reduced to less than half the peak calculated value by 24 hours.

The replacement steam generators have 52 ft^3 more volume (each) on the primary side than do the original steam generators. This additional mass could increase the building pressure at the end of blowdown by 0.3 psi. If this increase in pressure were conservatively superimposed on the entire transient, the peak pressure would increase to 37.5 psig, and would still be below the acceptance criterion of 44 psig.

~~2) Steam Line Break in Containment~~

~~The code used to calculate the mass and energy release to the containment for steam line breaks is Combustion Engineering code SGNIII. A detailed description of this code is provided in Appendix 6A.~~

~~The closure time for the steam line isolation valves is assumed to be a six second ramp that initiates on MSIS and the feedwater valves close on a sixty second ramp initiated by MSIS or SIAS.~~

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The code assumes closure of all steam generator isolation valves on MSIS for the faulted steam generator. In addition, back flow into the containment from the unfaulted steam generator via the main steamline header crosstie is assumed until isolation valve closure occurs.

Backflow for the St. Lucie design is essentially zero since the check valve downstream of the isolation valve of the faulted steam generator would close immediately on flow reversal, thereby terminating this flow and because the faulted steam generator MSIS signal will initiate closure of the isolation valve on the faulted generator. However, the analysis does not take credit for the existence of the check valves or unfaulted generator isolation and assumes energy is added to the containment from the faulted steam generator. This is an obviously conservative approach.

Assuming the worst case, i.e., single failure of the feedwater block valve (I-MV-09-7 or 8), the pump isolation valve closes in 60 seconds after receipt of MSIS or SIAS and approximately 107,000 pounds of feedwater are added to the faulted steam generator. The analysis conservatively assumed that the main feed pump operates at runout flow during valve closure and further that all of-the high temperature fluid in the feedwater lines to the furthest isolation valve flashes into the containment.

A spectrum of main steam line break accidents were examined using the CONTEMPT code. Table 6.2-4CA lists the results of the analysis. The highest containment pressure and temperature is found for the case of the 105 percent pre-stretch Power (2698 MWT) 85 percent Break Area (5.355 ft^2) steam line break. Figures 6.2-12 to 6.2-14 show the time history of the containment pressure containment atmosphere and sump temperatures, and the partial pressure of steam for this break. Table 6.2-4D lists the mass and energy release for this break. The temperature for each case is maximum early in the transient while the pressure is low and no condensation of the steam has taken place.

The steam line break temperature transients indicated peak containment atmosphere temperatures in excess of the containment shell design. Note that the peak atmosphere temperatures calculated are of such short duration that, for the limiting steam line break transients, the containment shell reaches a peak temperature well below the containment shell design value.

The replacement steam generators (RSGs) have an integral orifice in the steam discharge nozzle that limits the break area to 3.69 ft^2. Consequently, the blowdown rate following a main steam line break with the RSGs would be significantly less than the rate calculated in the analyses for a 5.355 ft^2 break. Slowing the steam generator blowdown following a rupture would delay the reactor trip and steam generator isolation signals on low steam generator pressure. The delay in steam generator isolation would result in more mass entering containment from the unaffected generator and would result in more feedwater flow into the affected steam generator. It is estimated that approximately 287 lb more saturated steam would enter the containment building with the RSGs than would with the original steam generators (OSGs). It is also estimated that, because of the reduced blowdown rate, the containment building peak pressure with the RSGs would be reached more than 40 seconds later than was predicted with the OSGs. Forty additional seconds of heat removal by the containment building sprays and coolers is more than sufficient to condense 287 lb of saturated steam. Therefore, the peak containment building pressure following a main steam line break with the RSGs would be less than the value calculated with the OSGs.

Delete

REFERENCES FOR SECTION 6.2.1

(1) L. C. Richardson, L. J. Finnegan, R. J. Wagner, J. M. Waage, CONTEMPT A Computer Program for Predicting the Containment Pressure Temperature Response to a Loss-of-Coolant Accident, IDO- 17220 (June, 1967) and update: R. J. Wagner, CONTEMPT Modifications, Phillips Petroleum Company Memo WAG-24-68 AM, September 23, 1968.

NOTE: The contents of this update, plus subsequent Ebasco revisions and additions, are summarized in the "Revisions, Ebasco Service Modifications, CONTEMPT Program", March 1971.

(2) Tagami, Takashi, "Interim Report on Safety Assessments and Facilities Establishment Project in Japan for Period Ending June 1965 (No. 1)."

(3) J. A. Norberg, et al, "Simulated Design Basis Accident Tests of the Carolina's Virginia Tube Reactor Containment -- Preliminary Results," IN-1325.

(4) Ebasco Report, "User's Manual for Dry Air Annulus Response to a Loss of Coolant Accident, ATEMPT" October, 1971 - Plus subsequent Ebasco modifications.

(5) Louisiana Power & Light letter (LPL-2656 Q-3-A28.11) to AEC, re Waterford Steam Electric Station, Docket No. 50-3.82, Attachment "A".

(6) CENPD-63, 1/5 Scale, Intact Loop Post-LOCA Steam Relief Tests, November 1972.

(7) CENPD-65, Steam-Water Mixing Test Program Task D: Formal Report for Task A, 1/5 Scale Broken Loop, January 1973.

(8) Corrected Redirect and Rebuttal Testimony Submitted on Behalf of Combustion Engineering, Inc., Docket RM-50-1, April 1973.

(9) ABB/C-E calculation 007-AS93-C-004 Rev. 0, dated March 17, 1993, St. Lucie 1 LOCA Containment Pressure/Temperature (P/T) Analysis at 102% Power (2754 Mwt).

(10) NRC Standard Review Plan, NUREG-0800, Section 6.2.1, July, 1981.

(11) CEFLASH-4A, A FORTRAN77 Digital Computer Program for Reactor Blowdown Analysis, CENPD-133, Supplement 5-P, June 1985 and previous supplements (Proprietary).

(12) Computer Code Description and Verification report for FLOOD3, Combustion Engineering Inc., dated February 4, 1988.

(13) FLOOD-MOD2 - A Code to Determine the Core Reflood Rate for a PWR Plant with Two Core Vessel Inlet Legs, Interim Report, Aerojet Nuclear Company, November 2, 1972.

(14) Combustion Engineering Topical Report CENPD-140-A, dated June 1976, Description of the CONTRANS Digital Computer Code for Containment Pressure and Temperature Transient Analysis.

(15) L. A. Weins (NRC) to T. F. Plunkett (FPL), Issuance of Amendments RE: Implementation of 10 CFR Part 50 Appendix J, Option B, February 10, 1997.

INSERT B

INSERT A

2) Steam Line Break in Containment

2.A MSLB Physical Description of Event

The Main Steam Line Break (MSLB) containment event is characterized by the rapid blowdown of steam into containment due to a rupture in the main steam line. The location of this break is at the steam generator outlet nozzle, upstream of the Main Steam Isolation Valves (MSIVs). This location results in the largest possible steam flow for a given break size. The blowdown is limited to one steam generator due to the reverse flow check valve, which prevents flow from the unaffected side steam generator. In this early phase of the event, steam continues to flow to the turbine, until the reactor trip. Following the reactor trip, which occurs on containment high pressure, the turbine stop valves close. During this portion of the transient, all the main feedwater is conservatively fed to the affected steam generator.

During the initial phase of the event, the only source of containment heat removal is via condensation heat transfer to the heat sinks or containment walls.

Containment high pressure initiates the reactor trip and a Safety Injection Actuation Signal (SIAS). This signal initiates the closure of the Main Feedwater Isolation Valves (MFIVs). A Main Steam Isolation Signal (MSIS) occurs on low steam generator pressure to initiate the closure of the MSIVs. The signal to initiate closure of the MFIVs is also initiated on the MSIS however, the containment high pressure signal occurs first. A Containment Spray Actuation Signal (CSAS) occurs on containment high-high pressure to open the containment spray valves and start the containment spray pumps.

Normally, the Containment Fan Coolers (CFCs) also start in response to SIAS to supplement the active containment heat removal provided by the containment sprays. However, in order to preclude the need to address NRC's Generic Letter 96-06, Reference (16), the CFCs are not credited in this analysis.

The closure time for the steam line isolation valves is assumed to be a 5.5 second step function that initiates on MSIS after a 1.4 second delay. The feedwater valves step close in twenty seconds following a SIAS or MSIS.

Backflow for the St. Lucie design is essentially zero since the check valve downstream of the isolation valve of the faulted steam generator would close immediately on flow reversal, thereby terminating the reverse steam flow. The operation of the reverse flow check valve has been credited in the analysis.

Auxiliary Feedwater (AFW) is actuated on the low SG level during the main steam line break. Since the SG pressure differential between the ruptured and intact units quickly diverges due to the double-ended guillotine break, the high SG differential pressure setpoint for blockage of flow to the ruptured SG is quickly reached. However, for simplicity, all the AFW flow is diverted to the intact steam generator after 170 seconds delay following the time the low SG level setpoint is reached.

With auxiliary feedwater isolated from the ruptured SG, it boils dry, thus terminating the mass & energy release to containment. At this point, the containment spray system continues to decrease the containment pressure and temperature inside containment.

2.B MSLB Inputs and Assumptions

CE Nuclear Power's NRC approved computer code SGNIII was used to generate the mass and energy releases for the main steam line break inside containment. SGNIII is a coupled primary and secondary model, which calculates a time dependent mass & energy release. The mathematical model used in SGNIII divides the Reactor Coolant System into a reactor core region, and for each loop a hot plenum and hot leg pipe, steam generator tubes, and cold plenum and cold leg pipe regions. The secondary side consists of the main feedwater line (to the MFIV), steam and water volume in the steam generators (to the MSIV) and the main steam line header. The core model is represented by one-group point kinetics with six delayed neutron groups. Non-linear Doppler and moderator temperature dependent feedback are considered. Shutdown CEA's and decay heat generation are included. As discussed in the input section, the SGNIII design inputs were conservatively biased to maximize the mass & energy release. The SGNIII code was also used to calculate containment pressure and temperature response simultaneously with the mass & energy release. A detailed description of the SGNIII code is provided in Appendix 6A.

The containment pressure and temperature response analysis for the MSLB event focused on a matrix of cases. This matrix included five different initial power levels and several single failures. The goal of the analysis is to maximize the severity of the mass & energy release, which in turn maximizes the containment pressure and temperature response.

The initial plant conditions for the MSLB analysis were selected to maximize the mass and energy release. The initial power levels assumed for this analysis were 102%, 75%, 50%, 25%, and 0% of 2700 MWt. An additional 17.3 MWt was also included for reactor coolant pump heat. Since five power levels were evaluated in this analysis, a number of power dependent inputs were adjusted to conservatively reflect plant conditions for each power level. Presented in Table 6.2-4.A is a summary of the key inputs and assumptions for the cases considered in this analysis. In accordance with Section 6.2.1.4 of the Standard Review Plan, Reference (10), moisture carry over was not considered in this analysis.

The input data for the mass and energy release and containment pressure/temperature analysis, Reference (17), have been developed based upon the design of the plant and Reference (18). A thorough compilation of geometric, thermodynamic, design, and initial operating conditions prior to the hypothetical occurrence of an MSLB has been prepared. These physical and performance conditions were determined based upon conservative estimates of the most adverse design parameters with respect to maximizing containment pressure and temperature. The initial plant conditions assumed in the analysis of the containment response to an MSLB are provided in Table 6.2-4B. In addition to the containment initial conditions, Table 6.2-4B also lists several of the key assumptions concerning the actuation and performance of the containment spray system.

A loss of offsite power (LOOP) at the initiation of the event with the coincident failure of one diesel generator was evaluated as part of this analysis. It was determined that the LOOP scenario produces a less severe containment response than with offsite power available. This is due to the continued operation of the reactor coolant pumps with offsite power available, which maximizes the primary to secondary heat transfer. This offsets the loss of one train of containment sprays for the LOOP scenario. Although the limiting case did include the worst single failure (failure of a containment spray pump), no concurrent event (such as loss of offsite power) was assumed.

The updated MSLB containment analysis included a detailed single failure analysis. Each of these failures was evaluated at five different power levels: 102%, 75%, 50%, 25%, & 0%.

1. One containment spray pump fails to operate. This will leave 1 containment spray available.

2. The failure of a Main Feedwater Isolation Valve to close.

3. The failure of a Main Feedwater pump to trip.

4. LOOP and one emergency diesel fails to start, resulting in the loss of one spray train. This will leave one spray pump available. RCPs coast down on loss of power. This represents the loss of offsite power case.

The failure of a MFIV to close was not shown to be a limiting single failure. In the case of the MFIV failure, the MFW and condensate pump trip was credited. In accordance with the Standard Review Plan, Section 6.2.1.4, non-safety grade control systems may be utilized as a backup to the primary isolation. Therefore, the MFW and condensate pump trip was considered as backup to the MFIV. The MFW and condensate pumps trip on MSIS generated on low steam generator pressure. There is some diversity in terminating feedwater flow. Tripping the condensate pumps results in the loss of suction pressure for the MFW pumps such that the MFW pumps will not function even if a MFW pump fails to trip on low suction pressure or MSIS. The MSIS occurs slightly later than the safety injection isolation signal (SIAS), which initiates the closure of the MFIV. As an added conservatism, no credit was taken for the coast down of the MFW and condensate pumps with regard to limiting feedwater addition. Credit was taken for the closure of the MFW pump discharge valves to discount the flashing of the water volume upstream of the MFW pump discharge valves. For simplicity it was assumed that tripping the MFW and condensate pumps adds the same feedwater inventory to the faulted steam generator as in the MFIV failure scenario. This overall response remains bounded by the MFIV failure.

The MSLB events considered in the analysis were 5.412 ft^2 guillotine break at the SG steam outlet nozzle for all power levels except 0% power level. For the 0% power level, the break considered was a 2.160 ft^2 slot break at the SG steam outlet nozzle.

The Main Steam Safety Valves (MSSVs) were relied upon to remove energy from the intact steam generator. The opening setpoint of the first bank was 1030 psia while the full open pressure of the last bank, including accumulation, was 1071.2 psia.

No operator actions were credited in the MSLB analysis.

A normal initial SG water level was assumed. This is consistent with the approved CE Nuclear Power's containment MSLB methodology for mass & energy release and containment response calculations.

Closure of the Turbine Stop Valves was assumed following reactor trip. These valves are stepped closed in 0.26 seconds following a 0.10 second delay time after reactor trip. Since delaying the closure of the Turbine Stop Valves would reduce the severity of energy content of the steam generators, this time response is conservatively short. Closure of the Turbine Stop Valves is not a safety function in this instance since their rapid closure makes containment response slightly worse.

2.C MSLB Analysis Results

CE Nuclear Power's NRC approved SGNIII containment code was used to determine the containment pressure/temperature response to a MSLB inside containment for the matrix of cases described above.

The most limiting case was determined to be the 102% power case with the failure of a containment spray pump. This event assumed the availability of offsite power and continued operation of RCPs since this condition results in a more severe containment response.

Table 6.2-4C provides a summary of the peak containment pressures and temperatures for the eleven cases cited above. The peak calculated pressure and temperature for the limiting MSLB initiated from 102% power with the failure of a containment spray pump were 42.76 psig and 389.20 °F, respectively.

The pressure and temperature profiles for the containment response to the limiting MSLB are provided in Figures 6.2-12 and 6.2-13, respectively.

Table 6.2-4D provides a Sequence of Events for the limiting case.

END INSERT A

INSERT B

(16) US Nuclear Regulatory Commission Generic Letter, GL 96-06, dated September 30, 1996, Assurance of Equipment Operability and Containment Integrity During the Design-Basis Accident Condition.

(17) CE Nuclear Power LLC Calculation No. A-SL1-ST-0015, Revision 000, dated August 7, 2000, Updated Main Steam Line Break Containment Pressure/Temperature Response Analysis for St. Lucie 1.

(18) FPL Letter No. ENG-SPSL-00-0147, dated May 19, 2000, C. R. Bible to M. J. Gancarz, St. Lucie Plant Unit 1 Main Steam Line Break Containment Mass and Energy Release & P/T Response Analysis Design Input Revision, File: PSL 100-18.

END INSERT B

~~Table 6.2-4A~~ SINGLE ENDED HOT-LEG SLOT BREAK intentionally ~~deleted~~.

New Table 6.2-4A

TABLE 6.2-4A
MASS & ENERGY RELEASE RELATED INITIAL CONDITIONS AND KEY ASSUMPTIONS FOR MAIN STEAM LINE BREAK INSIDE CONTAINMENT

	ITEM	VALUE/ASSUMPTION
1.	**Methodology**	
	Break Type	5.412 ft^2 guillotine at SG outlet nozzle 2.160 ft^2 slot at SG outlet nozzle (0% power)
	Steam Separation Rate Multiplier	2.5
	Water in Feed Pipe	Considered
	Steam in Header Pipe	Considered (No impact due to Reverse Flow Check Valve)
2.	**Initial NSSS Parameters**	
	MODE	1
	Power Level	102 % (limiting case) 75%, 50%, 25%, 0% also considered
	Initial Primary Pressure	2250 psia
	Initial RCS Inlet Temperature	554.0 °F(1)
	Initial Secondary Pressure	862.3 psia(1)
	Primary & Secondary Volumetric Expansion Due to Pressure/Temperature	Considered
	Steam Generator Level	35.0' above tube sheet (Normal Water Level)
	Number of U-tubes plugged	0 (conservatively assumed)
3.	**Reactor Shutdown**	
	Reactor Trip Logic	On high containment pressure analytical setpoint of 4.1 psig

Delay Time	1.4 sec
Rod Drop Time	3.1 seconds including holding coil delay

4. **Reactor Coolant Pumps** — On throughout the event (except the loss of offsite power case)

Total RCS flowrate	438,500 gpm

5. **Main Steam Isolation Valves (MSIV)**

MSIV Logic	MSIS on low SG pressure analytical setpoint of 585 psig
Delay Time	6.9 seconds total delay after MSIS signal is generated

6. **Main Feedwater**

Initial Flow Rate	102 % of full flow(1) (Consistent with initial power level)
MFW Enthalpy	435 BTU/lbm
Contribution of MFW Flashing between Shut MFIV and Ruptured SG	Considered

7. **Main Feedwater Isolation Valves (MFIVs)**

MFIV Logic	SIAS on high containment pressure analytical setpoint of 6.3 psig
Delay Time	20 seconds total delay after SIAS is generated
Single Failure	Considered

8. **Main Feedwater Pumps**

MFW Pump Logic	MSIS on low SG pressure analytical setpoint of 585 psig
Delay Time	20 seconds total delay after SIAS is generated(2)

Single Failure	Considered(3)

9. Auxiliary Feedwater

AFW Logic	on low SG level setpoint of ≥ 19%
Flow Rate	1282 gpm
Delay Time	170 seconds total delay after AFW is actuated (4)

(1) Power dependent values

(2) For simplicity, the MFW flow is isolated after 20 seconds delay following the time at which high containment pressure trip setpoint is reached.

(3) The MFW pump trip occurs slightly later than the time of MSIS actuation, which initiates the closure of the MFIV. However, for simplicity, it was assumed that the main feedwater flow is terminated to the steam generator at exactly the same time as in the MFIV failure scenario. Therefore, the response of the MFW pump failure scenario would be the same as the response of the MFIV failure scenario. Therefore, only the failure of the MFIV was analyzed.

(4) For simplicity, the AFW flow is actuated after 170 seconds delay after the low SG level setpoint is reached.

~~Table 6.2-4B FIVE SQUARE FOOT HOT LEG SLOT BREAK~~ intentionally ~~deleted~~.

New Table 6.2-4B

TABLE 6.2-4B

CONTAINMENT RELATED INITIAL CONDITIONS AND KEY ASSUMPTIONS FOR MAIN STEAM LINE BREAK INSIDE CONTAINMENT

Free Volume	2.506×10^6 ft^3
Safety Injection Actuation Setpoint (SIAS)	6.3 psig in containment
Containment Spray Actuation Setpoint (CSAS)	11.3 psig in containment
Spray Delivery Time (after CSAS is generated)	52 sec., with off-site power available 63.5 sec., with loss of off-site power
Spray (RWT) Temperature	100 °F
Containment Spray Logic	2 spray trains (2700 gpm per train)
Containment Fan Coolers (CFCs)	Not Credited
Initial Containment Temperature	120 °F
Initial Containment Pressure	17.1 psia
Initial Relative Humidity	45%
Heat Transfer Coefficient Used for Passive Heat Sinks	Uchida Correlation
Credit for Condensate Revaporization	Not Credited
Credit for Heat Transfer to Water in Containment Sump	Not credited

Table 6.2-4C FIVE SQUARE FOOT HOT LEG BREAK BLOWDOWN ENERGY BALANCE
intentionally deleted.

New Table 6.2-4C.

TABLE 6.2-4C

RESULTS OF MAIN STEAM LINE BREAKS INSIDE CONTAINMENT

Peak Containment Pressure and Temperature Results		
Case	**Description***	**Results**
1	102% power MSLB with failure of one Containment Spray Pump (CSP)	PMAX = 42.76 psig @ 80.02 sec TMAX = 389.20 °F @ 58.90 sec
2	102% power MSLB with failure of Main Feedwater Isolation Valve (MFIV) to Close	PMAX = 41.13 psig @ 87.94 sec TMAX = 389.20 °F @ 58.90 sec
3	75% power MSLB with failure of one Containment Spray Pump (CSP)	PMAX = 39.67 psig @ 81.33 sec TMAX = 381.71 °F @ 59.05 sec
4	75% power MSLB with failure of Main Feedwater Isolation Valve (MFIV) to Close	PMAX = 38.98 psig @ 91.41 sec TMAX = 381.71 °F @ 59.05 sec
5	50% power MSLB with failure of one Containment Spray Pump (CSP)	PMAX = 38.19 psig @ 99.41 sec TMAX = 375.45 °F @ 59.11 sec
6	50% power MSLB with failure of Main Feedwater Isolation Valve (MFIV) to Close	PMAX = 37.72 psig @ 98.71 sec TMAX = 375.45 °F @ 59.11 sec
7	25% power MSLB with failure of one Containment Spray Pump (CSP)	PMAX = 37.60 psig @ 110.08 sec TMAX = 370.55 °F @ 59.07 sec
8	25% power MSLB with failure of Main Feedwater Isolation Valve (MFIV) to Close	PMAX = 37.03 psig @ 108.99 sec TMAX = 370.55 °F @ 59.07 sec
9	0% power MSLB with failure of one Containment Spray Pump (CSP)	PMAX = 37.68 psig @ 149.62 sec TMAX = 360.77 °F @ 63.01 sec
10	0% power MSLB with failure of a Main Feedwater Isolation Valve (MFIV) to Close	PMAX = 36.76 psig @ 147.52 sec TMAX = 360.77 °F @ 63.01 sec
11	102% power MSLB with Loss of Offsite Power	PMAX = 35.66 psig @ 211.26 sec TMAX = 368.06 °F @ 70.56 sec

* Note that all of the breaks except the 0% power case are 5.412 ft^2 guillotine breaks at the SG steam outlet nozzle. The 0% power case break is 2.160 ft^2 slot break at the SG steam outlet nozzle.

TABLE 6.2-4CA

STEAM LINE BREAK ACCIDENT ANALYSIS
CONTAINMENT PRESSURE AND TEMPERATURE

Accident Conditions	Peak Containment Pressure (psig)	Peak Containment Atmosphere Temperature (F)
I. 105% Power 85% break area (5.355 ft^2)	41.6	290
II. 100% Power 85% break area (5.355 ft^2)	41.3	290
III. 75% Power 70% break area (4.41 ft^2)	39.0	277
IV. 50% Power 60% break area (3.78 ft^2)	36.9	273
V. 25% Power 40% break area (2.52 ft^2)	36.7	269
VI. 0% Power 20% break area (1.26 ft^2)	35.3	260

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TABLE 6.2-4CA

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TABLE 6.2-4D

MAIN STEAM LINE BLOWDOWN DATA

105 Percent Power - 85 Percent Break Area (5.355 Sq. Ft.)

	Intact Unit		Ruptured Unit	
Time Seconds	Mass Flow Lbs/Sec	Enthalpy Flow Million Btu/Sec	Mass Flow Lbs/Sec	Enthalpy Flow Million Btu/Sec
0.0	1733.49	2.08	9303.0	11.1
0.5	1671.35	2.01	8334.0	10.0
1.0	1621.92	1.94	7578.0	9.11
1.5	1570.21	1.88	6968.0	8.38
2.0	1527.58	1.83	6471.0	7.79
2.5	1489.48	1.79	6051.0	7.29
3.0	1455.01	1.75	5691.0	6.85
3.5	1424.62	1.71	5383.0	6.48
4.0	1396.95	1.68	5120.0	6.17
4.1	2046.0	2.46	5072.0	6.11
5.1	1772.0	2.13	4667.0	5.62
6.1	1474.0	1.77	4376.0	5.27
7.1	1146.0	1.38	4153.0	5.0
8.1	788.0	0.946	3975.0	4.78
9.1	388.0	0.466	3830.0	4.61
10.1	0.0	0.0	3707.0	4.46
15.0			3289.0	3.95
20.0			2978.0	3.58
30.0			2531.0	3.03
50.0			1999.0	2.39
70.0			1540.0	1.83
90.0			963.0	1.14
120.0			363.0	0.427
150.0			132.0	0.155
200.0			64.0	0.0751
Integrals	12895.14 Lbs.	15.51×10^6 Btu	249000.0 Lbs	297.0×10^6 Btu

Replace with New Table 4.2-4D

TABLE 6.2-4D

SEQUENCE OF EVENTS FOR LIMITING MAIN STEAM LINE BREAK INSIDE CONTAINMENT

TIME, sec	EVENT	COMMENT
0.0	Break occurs	Break area = 5.412 ft^2
1.03	Reactor trip analytical setpoint reached, Containment High Pressure	Containment pressure = 4.1 psig
2.00	AFW isolation to the affected SG (high SG ΔP) analytical setpoint reached	SG ΔP = 150 psid.
2.43	CEAs begin entering core	Reactor trip delay time = 1.4 sec.
2.56	SIAS analytical setpoint reached, Containment High Pressure	Containment pressure = 6.3 psig
2.79	Turbine Stop Valves closed	Based on 0.26 second valve stroke time plus a 0.1 second signal delay time after reactor trip signal actuated.
3.80	MSIS analytical setpoint reached, SG Low Pressure	SG pressure = 585 psig
6.98	CSAS analytical setpoint reached, Containment High-High Pressure	Containment pressure = 11.3 psig
10.70	MSIV Closure	A 6.9-second total delay time after MSIS analytical setpoint is reached
22.56	Main Feedwater Isolation Valves closed	A 20-second total delay time after SIAS analytical setpoint is reached
58.90	Containment peak temperature occurs	Containment temperature = 389.20 °F
59.88	Containment Sprays full on	A 52.0-second total delay after CSAS signal actuated
80.02	Containment peak pressure occurs	Containment pressure = 42.76 psig
172.0	AFW to Intact SG initiated	A 170.0-second total delay time after AFAS high SG ΔP analytical setpoint is reached*
300.0	End of simulation of the transient	

* see the footnote (4) in Table 6.2-4A

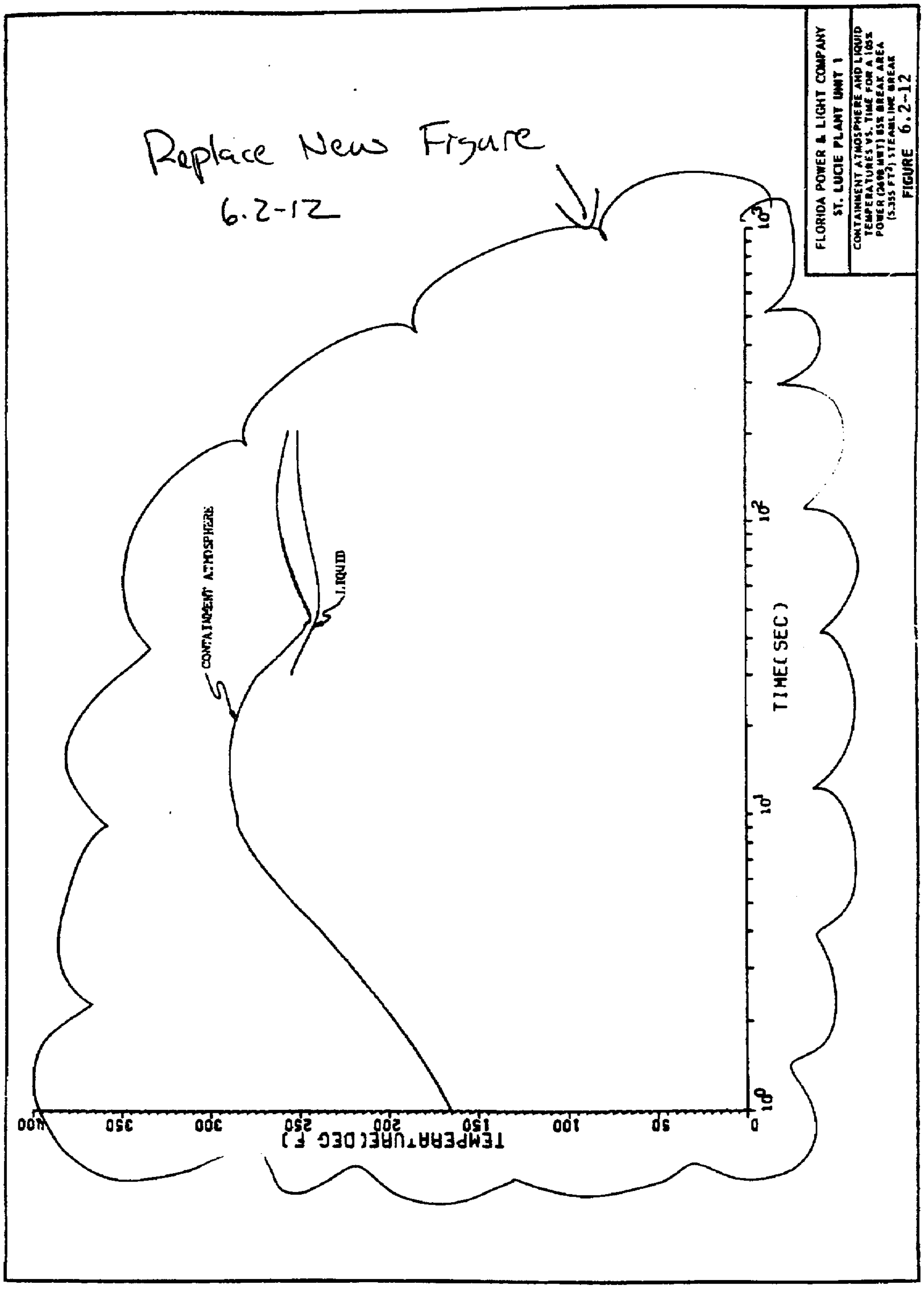
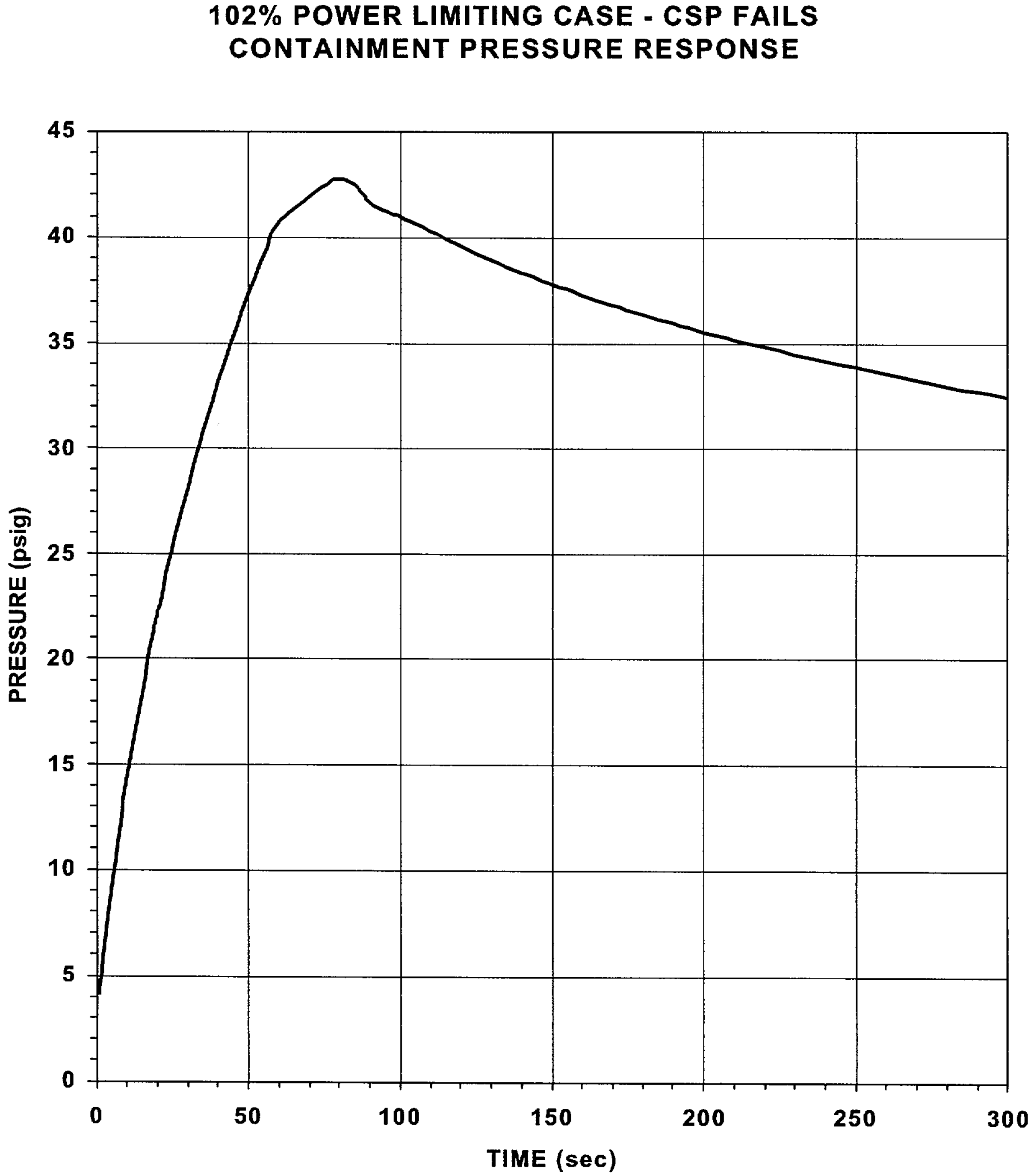

Replace New Figure 6.2-12
CONTAINMENT ATMOSPHERE
LIQUID
TIME (SEC)
TEMPERATURE (DEG F)
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1
CONTAINMENT ATMOSPHERE AND LIQUID TEMPERATURES VS. TIME FOR A 105% POWER STEAMLINE BREAK
FIGURE 6.2-12

Figure 6.2-12


102% POWER LIMITING CASE - CSP FAILS
CONTAINMENT PRESSURE RESPONSE
PRESSURE (psig)
0
5
10
15
20
25
30
35
40
45
TIME (sec)
0
50
100
150
200
250
300

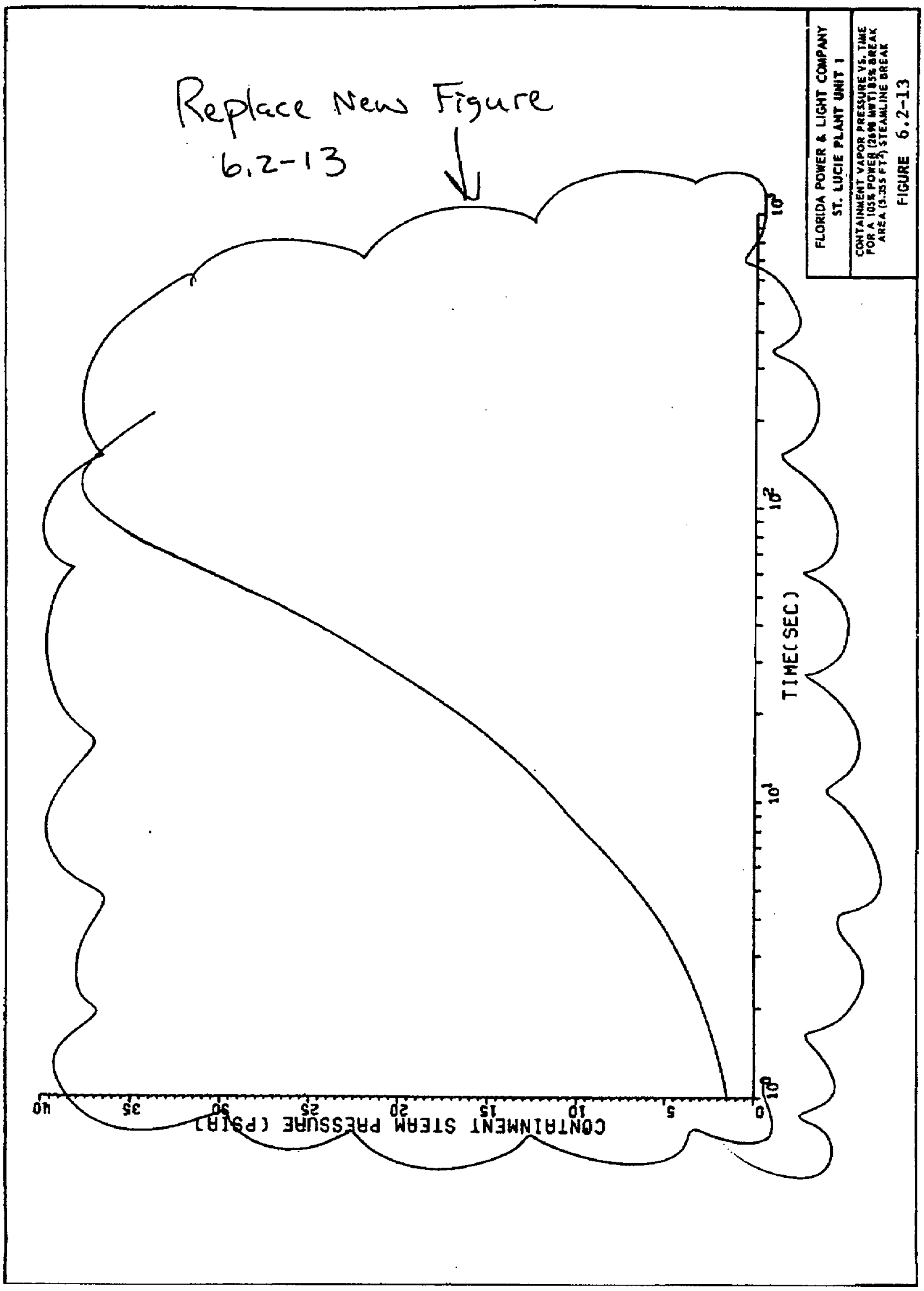
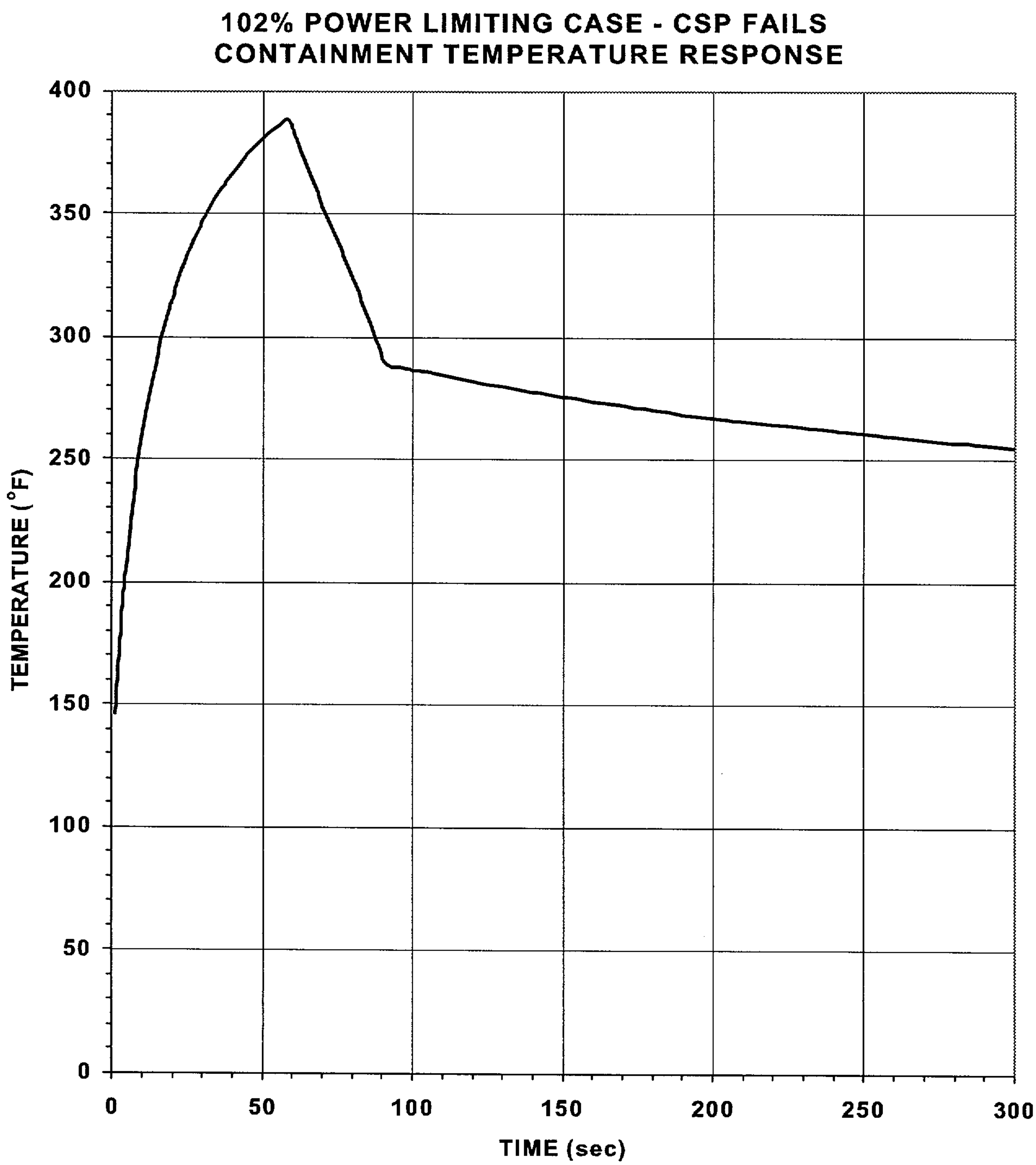

Replace New Figure
6.2-13
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1
CONTAINMENT VAPOR PRESSURE VS. TIME
FIGURE 6.2-13
TIME (SEC)
CONTAINMENT STEAM PRESSURE (PSIA)

Figure 6.2-13


102% POWER LIMITING CASE - CSP FAILS
CONTAINMENT TEMPERATURE RESPONSE
TEMPERATURE (°F)
400
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
TIME (sec)

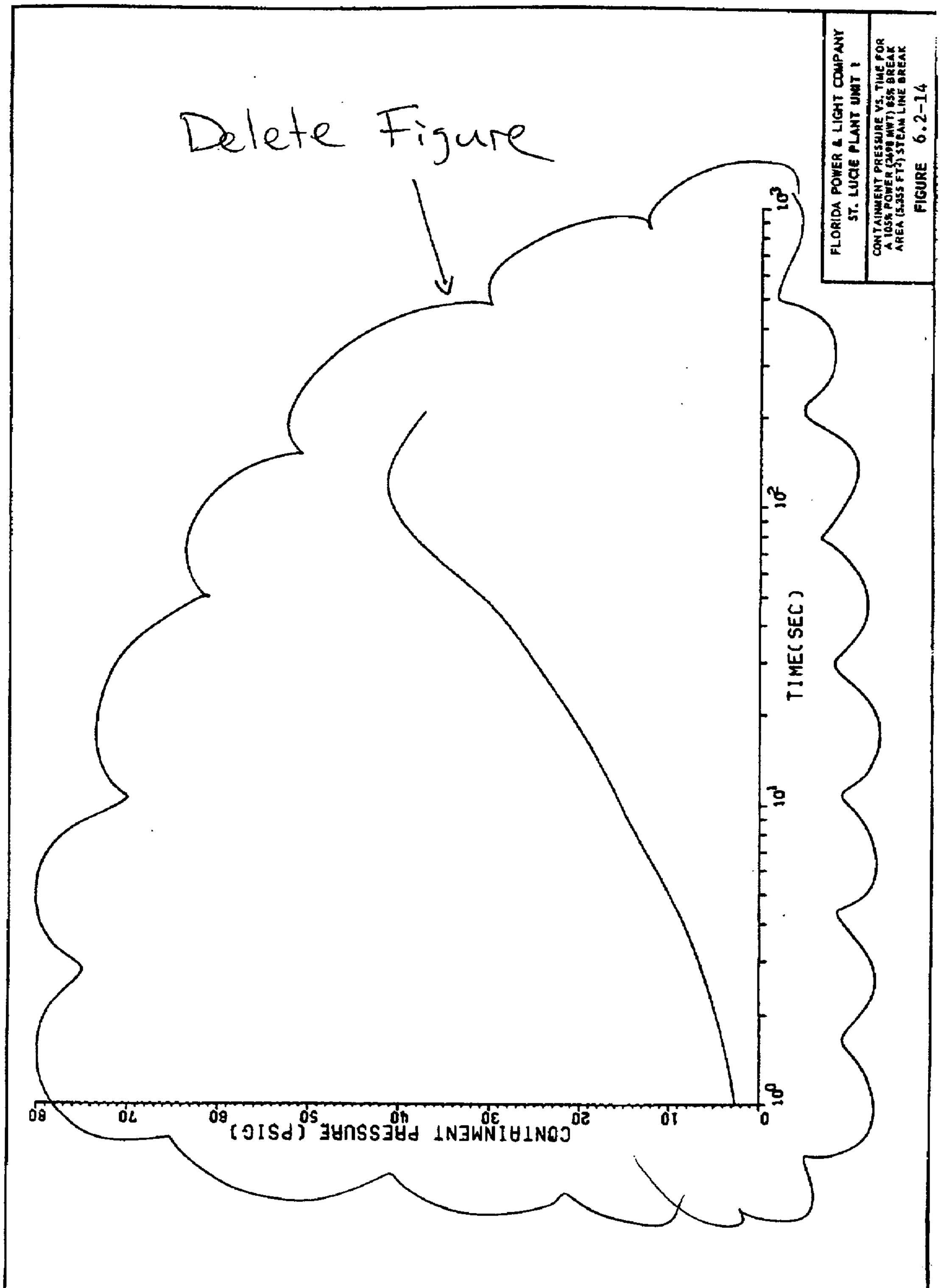

Delete Figure
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1
FIGURE 6.2-14
TIME(SEC)
CONTAINMENT PRESSURE (PSIG)

Figure 6.2-14

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ABSTRACT

This appendix details the SGNIII digital computer program. This code calculates the transient response of the primary coolant system, pressurizer, and steam generators to steam line breaks to develop mass/energy releases for containment design. The model consists of fluid flow and heat transfer representations in the reactor core, hot leg plena and piping, pressurizer, steam generators, cold leg piping and plena, and steam generator secondary side. Reverse heat transfer from the intact steam generators to the reactor coolant loop is considered. A two-lump core fuel model is used together with a point kinetics representation and non-linear moderator, Doppler, boron, and CEA reactivity effects. Time dependent reactivity and coolant flow functions may also be inputed to the code. The secondary side of each steam generator is represented by a finite two-node quasi-static balance of energy flux and secondary fluid thermodynamics. The steam lines to the turbine are modeled.

The following control systems are represented: feedwater flow, turbine bypass, turbine admission valve, pressurizer pressure and level, and CEA's. Primary and secondary safety valves, main steam line isolation valves, multiple charging pumps and letdown orifices, and pressurizer spray and heaters are included in the model. A full range of superheated steam, saturated steam and water, and sub-cooled water thermodynamic states is available in the pressurizer representation.

The differential equations used in the models are presented. In the simulation, the equations are in finite difference form and are numerically integrated in time. The SGNIII input/output format is given along with typical results.

This description of the SGNIII digital code is generic. The code has been used to generate steam line break mass/energy release data for containment design for many plants in addition to Systems 80 type plants. Accordingly description of certain models may not apply explicitly to Systems 80 type plants. However, the code input data is constructed conservatively for each plant for the purpose of steam line break analysis.

If the plant design changes in areas important to the description of the steam line break accident, then additional models are added to the basic code described herein, if these design changes can not be conservatively described through manipulation of the code input data.

SGNIII is a coupled primary, secondary and containment model which simultaneously determines the time dependent containment pressure and temperature response with the mass & energy release. The containment in the SGNIII is represented by the integration of the NRC approved CONTRANS coding as described in Reference (14).