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SUBJECT: Resubmits Attachment 2,including Pages 18 & 19 of 881020 safety analysis of application for amemd to License NPF-16.

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

Gentlemen:

Re: St. Lucie Unit 2
Docket No. 50-389
Proposed License Amendment
Control Element Assembly Drop Time

Per letter L-88-459 dated October 20, 1988, Florida Power & Light Company (FPL) submitted a request to amend Facility Operating License NPF-16. The amendment request was submitted to revise the control element assembly drop time based on FPL's review of NRC Information Notice No. 88-47, "Slower-Than-Expected Rod Drop Time Testing," dated July 14, 1988. Pages 18 and 19 of the Safety Analysis, Attachment 2, were inadvertently omitted from the subject proposed amendment. The purpose of this letter is to resubmit Attachment 2 including pages 18 and 19.

Please contact us if there are any questions about this submittal.

Very truly yours,

W. F. Conway
Senior Vice President - Nuclear

WFC/MSD/gp

Attachment

cc: Malcolm L. Ernst, Acting Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant
Mr. Jacob Nash, Florida Department of Health and Rehabilitative Services

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ATTACHMENT 2

Safety Analysis

Introduction

A change in the maximum allowable control element assembly (CEA) drop time for the St. Lucie Unit 2 from the current value of 2.7 seconds to a value of 3.1 seconds is proposed. This change is proposed to Limiting Condition for Operation 3.1.3.4, which specifies the maximum allowable CEA drop time. Recently, at Arkansas Nuclear One Unit 2, Arkansas Power and Light observed (NRC Information Notice No. 88-47) a small, but significant, increase in the CEA drop time when the CEA's were de-energized together instead of separately. The CEA drop times were observed to increase by approximately 0.25 seconds. Because a similar increase in the measured CEA drop times at St. Lucie Unit 2 may result in exceeding the current Technical Specification limit, Florida Power and Light will demonstrate the acceptability of longer CEA drop times.

To bound the expected increase in measured CEA drop times, an evaluation was performed to determine the impact on all Design Basis Events (DBE's) for a 0.4 second increase in the CEA drop time. This was determined by analyzing the impact on the most limiting events with respect to the fuel and plant safety limits. The results of this re-analysis were then shown to bound the consequence of the remaining DBE's. A summary of the re-analysis, and the results, is provided below.

Discussion

The CEA drop time was assumed to increase by 0.4 seconds from the previously assumed 0.34 seconds to 0.74 seconds as a result of an increase in the assumed Control Element Drive Mechanism (CEDM) holding coil delay time. Large inductance coils around the CEDM magnetically hold the CEA's in position. When a scram signal is received, these holding coils are de-energized. However, because of the large currents passing through these coils, there is a time delay associated with the decay of the magnetic field. After the CEDM holding coil decay delay time, the CEDM's physically disengage and the CEA's drop into the core.

The DBE's have been re-evaluated against the currently approved analyses of record as presented in the St. Lucie Unit 2 Updated Final Safety Analysis Report (UFSAR). These events can be grouped in the following categories:

1. Increase in heat removal by the secondary system
2. Decrease in heat removal by the secondary system
3. Decrease in reactor coolant flow rate
4. Reactivity & power distribution anomalies
5. Decrease in reactor coolant system inventory
6. Loss of coolant events

An increase in CEA rod drop time by 0.4 seconds has an impact primarily on those events which (a) involve a rapid approach to a

safety limit during the same time-frame as the scram and/or (b) the event involves a rapid approach to a Specified Acceptable Fuel Design Limit (SAFDL) (minimum DNBR) during the first part of the scram insertion.

With respect to the various acceptance criteria for DBE's, certain events are more limiting than others. These events were identified and re-analyzed. The remaining events were evaluated using, as a basis, the impact of the increased holding coil delay time on the limiting events. The results and conclusions of the re-analysis are presented below.

1.0 Increase in Heat Removal by the Secondary System

1.1 Inside Containment Steam Line Break Pre-Trip Power Excursion

The Pre-Trip Steam Line Break (SLB) event (with a Loss of A.C. Power) is the limiting event with respect to reaching the minimum absolute DNBR value and the greatest amount of predicted fuel failure fraction. To support an increase in the CEA drop time, a re-analysis was performed. Two analysis assumptions were changed when compared to the analysis of record presented in the St. Lucie Unit 2 UFSAR: 1) increased CEDM holding coil delay time from 0.34 seconds to 0.74 seconds 2) time at which Loss of AC Power (LOAC) occurs. The Analysis

of Record assumed an overly conservative time for LOAC, occurring concurrently with the RPS trip on high containment pressure. Sensitivity studies have shown that relaxing the time for the RPS trip high containment pressure by 3 seconds is a more realistic (but still conservative) assumption.

Attachment 4 provides a thorough discussion of the re-analysis, the assumptions and results, following the UFSAR format. The results of the re-analysis show a predicted minimum DNBR of 0.782. The analysis of record predicted a minimum DNBR of 0.783. In both cases, the predicted fuel failure fraction is less than 10%. It can be concluded, based on the results of the re-analysis, that a coolable geometry is maintained since the predicted fuel failure fraction is less than 10%.

An additional calculation was performed to evaluate the impact on the minimum DNBR due only to the increased CEDM holding coil delay time. The results of this analysis show a 3% degradation in minimum DNBR due to this analysis assumption change. This evaluation will serve as reference to determine the impact on the minimum DNBR due to the increased CEDM holding coil delay time for less limiting events. Site boundary doses for this event are bounded by the doses obtained in the outside

containment SLB which, as discussed below, is not impacted by the proposed amendment.

1.2 Outside Containment Steam Line Break - Post-Trip Power Excursion from Full Power

The 0.4 second increase in the CEDM holding coil delay has a negligible impact on the minimum DNBR attained during this event since the time at which the CEA breakers are predicted to open is 4.3 seconds and the time of minimum DNBR is 119.6 seconds; at which time the DNBR value is well above the 1.3 SAFDL.

1.3 Post-Trip Steam Line Break from Zero Power

Increasing the CEDM holding coil delay by 0.4 seconds has a negligible impact on the minimum DNBR attained during this event since the time of trip is 3.5 seconds and the time of minimum DNBR is 209.9 seconds; at which time the DNBR value is well above the 1.3 SAFDL.

1.4 Decrease in Feedwater Temperature

The increase in holding coil delay is non-conservative as it delays a trip and results in a lower DNBR. The re-analysis of the Pre-Trip Steam Line Break event

indicates that the decrease in minimum DNBR is approximately 3% with respect to a 0.74 second versus a 0.34 second holding coil delay. Applying this DNBR degradation to the Decrease in Feedwater Temperature event is conservative since the SLB event is a much more severe increase in heat removal event. The last analysis of this event documents a minimum DNBR of 1.34. Accordingly, the expected decrease in minimum DNBR would result in a value well above the SAFDL of 1.28.

1.5 Increase in Feedwater Flow

The increase in holding coil delay is non-conservative as it delays the trip and results in a lower DNBR. The re-analysis of the Pre-Trip Steam Line Break event indicates that the decrease in minimum DNBR is approximately 3% with respect to a 0.74 second versus a 0.34 second holding coil delay. Applying this DNBR degradation to the Increase in Feedwater Flow event is conservative since the SLB event is a much more severe increase in heat removal event. The last analysis of this event documents a minimum DNBR of 1.63. Accordingly, the expected decrease in minimum DNBR would result in a value well above the SAFDL of 1.28.

1.6 Increase in Main Steam Flow

The increase in holding coil delay is non-conservative as it delays the trip and results in a lower DNBR. The re-analysis of the Pre-Trip Steam Line Break event indicates that the decrease in minimum DNBR is approximately 3% with respect to a 0.74 second versus a 0.34 second holding coil delay. Applying this DNBR degradation to the Increase in Main Steam Flow event is conservative since the SLB event is a much more severe increase in heat removal event. The last analysis of this event documents a minimum DNBR of 1.63. Accordingly, the expected decrease in minimum DNBR would result in a value well above the SAFDL of 1.28.

1.7 Inadvertent Opening of a S. G. Safety Valve or Atmospheric Dump Valve

The impact of an extra 0.4 second delay on a trip occurring at 830.3 seconds into the transient is negligible with respect to the two hour site boundary dose calculated.

2.0 Decrease in Heat Removal by the Secondary System

2.1 Loss of Condenser Vacuum

The Loss of Condenser Vacuum (LOCV) event is the most limiting event in this category since it produces the highest calculated (peak) RCS and secondary pressure. The LOCV event was re-analyzed to demonstrate that with an increased CEDM holding coil time, the RCS and secondary pressures do not exceed the acceptance criteria of 2750 psia and 1100 psia, respectively. With an increased holding coil delay time of 0.74 seconds, it takes a longer time before the control rods begin to drop increasing the duration of the power excursion and consequently resulting in higher RCS and secondary pressures. Attachment 4 provides a thorough discussion of the analysis, the assumptions and results following the UFSAR format. The results of the re-analysis demonstrate that the LOCV event with an increased CEDM holding coil time will not result in peak RCS pressure or peak secondary pressure in excess of their respective upset limits. The increased CEDM holding coil delay time results in an incremental increase in the calculated peak RCS and secondary pressure of 18 psia and 2 psia, respectively. Therefore, it can be concluded that the

safety analysis criteria for the LOCV or any other DBE which challenges the pressure upset limits are not violated with the proposed amendment.

2.2 Loss of Normal A.C. Power

The 0.4 second increase in CEDM holding coil delay has no impact on the results of this analysis since the trip occurs at 1.91 seconds (almost instantaneously) and the criterion is the 2 hour site dose release. Hence, the extra 0.4 seconds of CEDM holding coil delay is judged to have a negligible impact on the dose calculation results.

2.3 Feedwater System Pipe Breaks

The effect of the increased CEDM holding coil delay is to increase the peak RCS pressure attained during a Feedwater Line Break (FLB) event. For the LOCV event, the peak pressure increased 18 psia for a 0.4 second increase in the holding coil delay. Since the LOCV event shows a more severe pressurization response with respect to peak RCS pressure than that of a FLB event, it is expected that the peak pressure increase observed for the LOCV event as a result of the increased CDEM holding coil delay will bound the expected impact on the results of

the FLB event. Therefore, assuming an RCS pressure increase of 18 psia for the peak RCS pressure calculated for the FLB event is clearly conservative. The analysis of record results show a peak RCS pressure of 2715 psia, therefore enough margin is available to accommodate this pressure increase. The resultant peak RCS pressure expected with the proposed amendment is shown to be below the acceptance criterion of 2750 psia.

3.0 Decrease in Reactor Coolant Flowrate

3.1 Loss of Flow

Protection against a 4-pump Loss of Flow (LOF) is provided by building sufficient thermal margin into the DNB related Limiting Conditions for Operation (LCO), i.e., by including sufficient Required Overpower Margin (ROPM) and by the action of the Low Flow trip. The ROPM conservatively accounts for the margin degradation from the initiation of a LOF and the time of minimum DNBR.

The LOF event is the limiting event with respect to establishing the LCO for protection against DNB. The LOF event was re-analyzed to determine the minimum initial margin that must be maintained by the LCO's to ensure that the DNBR will not violate the SAFDL of 1.28

when an increased CEDM holding coil delay time of 0.74 seconds is assumed. Attachment 4 provides a thorough discussion of the analysis, assumptions and results, following the UFSAR format.

A 3.5% decrease in overpower margin (or equivalently by a 3.5% increase in ROPM) was calculated for the 0.4 second increase in CEA drop time. This 3.5% margin degradation was checked with respect to the existing margin available. Since there existed at least 5% overpower margin between the actual calculated DNB LCO and the Technical Specification LCO, the 3.5% reduction can be accommodated without changing the existing DNB LCO in the Technical Specification.

3.2 Sheared Shaft

The Single Sheared Shaft (SSS) event is the limiting event with respect to the rate of DNBR degradation. The analysis of record for the SSS event predicted a minimum DNBR of 1.256. At that time, the value was reported to be 1.23 in order to obtain a conservative prediction of the fraction of fuel failure following a SSS event. An evaluation was performed to determine the impact on the predicted minimum DNBR and the related fraction of failed fuel due to an increased CEDM holding coil delay time.

The calculated minimum DNBR for this event occurs at 1.3 seconds. This time is 0.6 seconds after the trip breakers open and 0.26 seconds after the rods begin to fall into the core. By this time, the RCS flow degradation has been completed and RCS flow remains constant for the rest of the transient. Therefore, the impact on minimum DNBR due to an increased CEDM holding coil delay time is due mainly to the power and temperature effects and not to RCS flow degradation which typically has the more limiting effect on minimum DNBR degradation. Results of the evaluation show that increasing the CEDM holding coil delay time decreased the predicted minimum DNBR by .3%, to a new value of 1.252. The calculated minimum DNBR is still bounded by the previously reported value of 1.23 for Cycle 2 therefore, it can be concluded that the results of the single sheared shaft event after implementation of the proposed amendment are bounded by the results presented in the analysis of record.

4.0 Reactivity and Power Distribution Anomalies

4.1 CEA Ejection from Hot Full Power

The CEA Ejection Event from Hot Full Power (HFP) is the most limiting with respect to the limits on the deposited

energy in the fuel. The design criteria used to determine fuel pin failure occurrence are: 1) clad damage - total average enthalpy = 200 cal/gm, and 2) incipient centerline melting - total centerline enthalpy = 250 cal/gm. The CEA Ejection event was re-analyzed to evaluate the impact of an increased CEDM holding coil delay time of 0.74 seconds on the predicted deposited energy in the fuel. In addition to the holding coil delay time analysis assumption, two other analysis assumptions were changed when compared to the existing analysis of record: 1) The post-ejected radial peaking factor was reduced from 3.5 to 3.2 to reflect a value more characteristic of the actual calculated values for recent cycles, and 2) the assumed scram worth was conservatively reduced from -4.5% $\Delta\rho$ to -3.0% $\Delta\rho$ to accommodate expected reductions in available scram worths for future cycles.

With these two additional changes, the peak average and centerline enthalpy calculated for the hottest pellet were both below all the fuel deposited energy limits, therefore, no fuel failure is predicted to occur as a result of the proposed amendment. Attachment 4 provides a thorough discussion of the analysis, the assumptions, and results, following the UFSAR format.

4.2 CEA Ejection - Initiated from Zero Power

The full power CEA ejection event re-analysis shows that the increase in CEDM holding coil delay time resulted in an 11 cal/gm average enthalpy rise and a 19 cal/gm centerline enthalpy rise. The previous analysis of the CEA ejection event from zero power showed a total average enthalpy of 124 cal/gm and a total centerline enthalpy of 180 cal/gm. Hence, the expected increase in the two values due to the increased CEDM holding coil delay would result in a total average enthalpy of 135 cal/gm and a total centerline enthalpy of 199 cal/gm; both of which are well below the acceptance criteria for the event.

4.3 Uncontrolled CEA Withdrawal - Initiated from Zero Power

Increasing the CEDM holding coil delay time will decrease the previously calculated minimum DNBR of 2.55. As was demonstrated in the Pre-Trip SLB event evaluations, the change in DNBR calculated to account for the increased CEDM holding coil delay is small, about 3%. Clearly, a change of this magnitude can be accommodated for the CEA Withdrawal event from zero power without violation of the SAFDL.

The LHR SAFDL will not be violated, since the LHR calculated was equivalent to a final centerline enthalpy of 180 cal/gm. The re-analysis of the CEA ejection event from hot full power shows that the increased CEDM holding coil increases the deposited energy in the centerline at the most by 19 cal/gm; for a total of 199 cal/gm. Clearly, this change can be accommodated in the CEA Withdrawal (CEAW) event from zero power without violating either the average deposited energy criterion of 200 cal/gm or the incipient centerline melt threshold of 250 cal/gm.

4.4 Uncontrolled CEA Withdrawal - Initiated from Full Power

It is judged that the RCS pressure increase will be less than in the LOCV event which was 18 psia. Assuming an 18 psia increase in the CEAW HFP case, the peak RCS pressure attained would be 2550 psia plus 18 psia which clearly is well below 2750 psia.

For the limiting CEAW, the analysis of record calculated peak LHR was 16.38 kw/ft. The increased CEDM holding coil delay time would allow the power excursion to continue for an additional 0.4 seconds. The previous peak linear heat rate calculation for Full Power was based on a 20% fractional power rise; having a rate of

about 5% per second. For this limiting case, a 0.4 second increase in holding coil delay would equate to a 2% increase in the maximum power change. Thus, the new peak linear heat rate is about 16.7 kw/ft which is still well below the SAFDL of 22 kw/ft.

This event is also evaluated to determine the TM/LP setpoints. Since the TM/LP trip is designed to protect the core against very slow power excursions where large amounts of CEA motion are required to produce the power excursion, an increase of 0.4 seconds in CEDM holding coil delay time will not significantly impact the results of this analysis with respect to minimum DNBR considerations. Therefore, it can be concluded that the current TM/LP setpoints remain valid.

4.5 CEA Drop

The CEA drop event does not require a scram to demonstrate adequate protection. Instead, sufficient margin is built into the Technical Specification LCO to accommodate the margin decrease due to a CEA drop event without requiring a trip. Thus the CEDM holding coil delay time assumed has no impact on the results of this event.

4.6 Inadvertent Boron Dilution

The boron dilution methodology does not depend on a trip to demonstrate adequate protection. Accordingly, the increase in the CEDM holding coil delay time does not impact the results for this event.

5.0 Decrease in Reactor Coolant System Inventory

5.1 Pressurizer Pressure Decrease Events

The pressurizer pressure decrease event is analyzed primarily to generate a pressure bias incorporated in the γ term of the TM/LP trip equation. The previous analysis produced a γ bias of 41 psia. Increasing the CEDM holding coil delay time by 0.4 seconds would delay rod insertion by 0.4 seconds. This would be expected to move out the time of minimum DNBR by an equivalent amount. Based on the rate of pressure change close to the time of minimum DNBR, an additional pressure decrease of 15 psia is conservatively predicted.

Therefore, the total γ bias calculated for this event when the CEA holding coil delay is 0.74 seconds is 56 psia. This value is still below the 70 psia which was

calculated for the CEA Withdrawal event and used to set the TM/LP LSSS limits appearing in the Technical Specifications.

5.2 Steam Generator Tube Rupture

The increase in the CEDM holding coil delay has negligible impact on the calculated doses. The reactor trip signal occurs at 877.3 seconds. The increased CEDM holding coil delay would only increase the time for the CEA's to begin to enter the core, from 878.75 seconds to 879.15 seconds. Since the doses calculated are for 2 hours (7,200 seconds) and 8 hours (28,800 seconds) for the EAB (Exclusion Area Boundary) and the LPZ (Low Population Zone), respectively, the impact of a 0.4 second increase is within the calculational accuracy.

6.0 Loss of Coolant Accidents (LOCA)

6.1 Large Break LOCA

The Large Break LOCA accident is not impacted by the increase in CEDM holding coil delay time. The reactor trip occurs relatively early in the transient while the critical parameter, peak clad temperature occurs much later in the transient. Therefore, an increase of 0.4

seconds in time for rod insertion has no impact on the results of the current analysis of record.

6.2 Small Break LOCA

The Small Break LOCA accident is not impacted by the proposed amendment. The reactor trip occurs relatively early in the transient while the critical parameter, peak clad temperature occurs much later in the transient. An increase of 0.4 seconds in time for rod insertion has no impact on the results of the current analysis of record.

7.0 Miscellaneous

7.1 Asymmetric Steam Generator Transient (ASGT)

The ASGT ROPM is 115%. The increased ROPM due to the CEDM holding coil delay is small and the resultant ROPM is bounded by the LOF and CEA Drop events.